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Evaluating academic and student affairs partnerships: the impact of living-learning communities on the development of critical thinking skills in college freshmen

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EVALUATING ACADEMIC AND STUDENT AFFAIRS PARTNERSHIPS: THE
IMPACT OF LIVING-LEARNING COMMUNITIES ON THE DEVELOPMENT OF
CRITICAL THINKING SKILLS IN COLLEGE FRESHMEN

by

Andrew John Borst

An Abstract

Of a thesis submitted in partial fulfillment of the requirements
for the Doctor of Philosophy degree in
Educational Policy and Leadership Studies (Higher Education and Student Affairs)
in the Graduate College of The University of Iowa

May 2011

Thesis Supervisor: Professor Ernest T. Pascarella

ABSTRACT

This dissertation was the first study to estimate the direct and indirect effects of living-learning community (LLC) participation on a standardized measure of critical thinking using a multi-institution longitudinal research design. It is possible that despite being lauded nationally as an effective institutional intervention, LLCs may simply cluster students predisposed to be more engaged with their environment, more academically prepared, and more open to growth compared with traditional residence hall peers. Recent studies have demonstrated a positive relationship between LLC participation and self-reported growth in critical thinking. The findings of this study demonstrate markedly different conclusions from previous LLC studies exploring the outcome of critical thinking. The results of this study suggest that net of academic ability and background and institutional characteristics, students who participated in LLCs did not demonstrate greater gains on a standardized measure of critical thinking than their peers in traditional residence hall environments.

To investigate the relationship between LLC participation and growth in critical thinking, I performed secondary data analysis from the 2006, 2007, and 2008 cohorts of the Wabash National Study of Liberal Arts Education – a longitudinal study of teaching practices, programs, and institutional structures that support liberal arts education. From the initial 53 colleges and universities in the WNSLAE study, I selected a sub-sample of 19 institutions with formal LLC programs to make a more conservative estimate of the reliability of participation in an LLC. The final sub-sample included 435 (25%) students in the experimental group (students participating in LLCs) and 1,282 (75%) students in the control group (students living in traditional residence halls).

This study makes four important contributions to the literature on LLC. First, the longitudinal nature of the WNSLAE data allowed for an estimate of growth during the first-year of college and controls for students' self-selection into the experimental or control groups. Second, the critical thinking module of the Collegiate Assessment of

Academic Proficiency allowed for an objective measure compared to previous studies that use students' self-reports. Third, this was the first multi-institution LLC study to include liberal arts colleges in the sample. LLCs at liberal arts colleges did not demonstrate a differential impact compared with LLCs at regional and research universities on students' growth in critical thinking. Finally, post hoc analysis did not demonstrate conditional differences of LLC impact between students background, institutional characteristics, or the degree of faculty and peer interaction.

Abstract Approved:

Thesis Supervisor

Title and Department

Date

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CERTIFICATE OF APPROVAL

PH.D. THESIS

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

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Dedicated to my parents and grandparents who always made education a priority

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TABLE OF CONTENTS

LIST OF TABLES	vi
LIST OF FIGURES	vii
CHAPTER	
I. INTRODUCTION	1
Purpose of the Study	2
Statement of the Problem	3
Definition of Terms	6
Significance of the Study	7
II. LITERATURE REVIEW	9
History and Development of LLC Programs	11
Single-Institution, Cross-Sectional Studies	13
Single-Institution, Longitudinal Studies	16
Summary of Single-Institution Studies	20
Qualitative Studies	20
Multi-institutional Cross-Sectional Studies	25
Multi-institutional Longitudinal Studies	29
Student Choice to Participate in LLC	30
Dependent Variable – Critical Thinking	33
Independent Variables – Student and Institutional Characteristics	33
Mediating Variables – Interaction and Student Effort	34
Summary of the Current Literature	35
III. CONCEPTUAL FRAMEWORK AND METHODOLOGY	37
Conceptual Framework	38
Research Hypotheses	41
Methodology	42
Institutional Sample	42
Student Sample	45
Data Collection	46
Variables	48
Reliability	50
Validity	53
Lack of Information About the LLC Program Type	53
Standardized Measure of Critical Thinking	54
Longitudinal Research Design	55
Multi-Institutional Sample	56
Data Analysis	58
IV. RESULTS	60
Sample Profile	60
General Effects Model	64
Assumptions of OLS Regression	66
Equation 1: Student Backgrounds/Precollege Traits	70
Equation 2: Institutional Characteristics	70

Equation 3: LLC Environment	71
Equation 4: Interaction	71
Equation 5: Academic Effort and Challenge.....	71
Effect of the Pretest on the General Effects Model.....	72
Conditional Effects.....	73
Conditional Effects – LLC x Student’s Pre-College Traits.....	73
Conditional Effects – LLC x Institutional Type.....	74
Conditional Effects – LLC x Good Practice.....	75
LLC Influence on Principles of Good Practice	77
Results Summary.....	78
 V. DISCUSSION AND IMPLICATIONS	 80
Discussion of Findings.....	81
Implications.....	85
Limitations	88
Lack of Program Information.....	88
Generalizability	89
Clustered or Nested Data.....	89
Summary of Contributions	90
Directions for Future Research	91
 REFERENCES	 95

LIST OF TABLES

Table

3.1. Institutional Sample	44
3.2 Student Sample	45
3.3 Summary of Independent Variables.....	49
3.4 Summary of Mediating Variables.....	50
3.5. Internal Consistencies of Composite Scales	52
3.6. LLC by Institution.....	57
4.1. Weighted Means and Standard Deviations.....	61
4.2. Independent Sample t-test.....	64
4.3. Variance Inflation Factors and Correlations.....	67
4.4. General Effects Model	69
4.5. Contributions of Pretest Critical Thinking.....	72
4.6. LLC x Precollege Conditional Effects.....	73
4.7. LLC x Institutional Interaction Effects	74
4.8. Regression Coefficients by Institutional Type.....	75
4.9. LLC x Good Practice Interaction Effects.....	76
4.10. Regression Coefficients with Good Practice Scales as Outcomes Variables	78

LIST OF FIGURES

Figure

3.1. General Causal Model for Assessing the Effects of Differential Environments on Student Learning and Cognitive Development	39
3.2. General Effects Model	40

CHAPTER I

INTRODUCTION

Calls for accountability in higher education have created a renewed emphasis on undergraduate education and focused institutional efforts on student learning outside the classroom. Zeller (2006) noted that “campus residential environments may well become the setting where the most deep learning interactions will occur, as students and faculty are able to fully exploit the potential of living-learning opportunities” (p. 59). Several authors have identified the potential of intentionally structured residence hall environments, called living-learning communities (LLCs), to blur the boundaries between in-class and out-of-class experiences (Astin, 1993; Blimling & Whitt, 1999; Boyer Commission, 1998; Kuh, Schuh, & Whitt, 1991; Kuh, Kinze, Schuh, Whitt, & Associates, 2005). Dewey (1944) argued that “we never educate directly, but indirectly by means of the environment. Whether we permit chance environments to do the work, or whether we design environments for the purpose makes a great difference” (p. 19). The idea behind LLCs is that “having students live together in a community of scholarship, enriched by a high level of faculty participation and academic and cultural programs...brings about a closer integration of students’ living environment with their learning environment” (Blimling, 1993, p. 265).

Over the past three decades, many colleges and universities implemented LLCs in an attempt to create seamless learning environments between students' classroom and residence hall experiences (Inkelas & Soldner, 2011). As campuses hurried to put LLCs into practice, there was little focus on what defined LLCs, how they should be operated, or whether they were effective in achieving stated goals and objectives (Inkelas & Soldner, 2011). Institutional commitment to the programmatic delivery of the LLC experience can be seen in the designation of faculty time and financial allocation on many campuses. Inkelas and Soldner (2011) recommended that “researchers should not only be analyzing whether LLC participation is directly related to heightened critical

thinking skills, but also if participation in an LLC is related to greater faculty interaction and peer discussion, which in turn are related to critical thinking" (pp. 82-83).

Inkelas, Soldner, Longerbeam, and Leonard (2008) recommended that future research "assess direct and indirect relationships among student background characteristics, distinct facets of LLC programming and important student learning outcomes" (p. 508). This study used ordinary least squares regression to extend previous research findings with regard to standardized measures versus self-reported gains in critical thinking, and a longitudinal rather than a cross-sectional design controlling for background characteristics. Post-hoc analysis also explored if the impact of LLC participation was conditional on student background characteristics, institutional characteristics, or the degree to which students experienced interaction with faculty, interaction with peers, and academic effort.

Purpose of the Study

The theoretical relationship between LLC participation and critical thinking may be similar to Aristotle's transitive property of implication. Transitive relationships are defined by the following: if A implies B and B implies C, then A also implies C. This theoretical model suggests that if LLC participation implies faculty and peer interaction and these interactions imply growth in critical thinking, then LLC participation should be associated with growth in critical thinking. Practitioners would quickly identify that not all LLCs intend to affect growth in critical thinking; however, critical thinking may be an unintended indirect outcome of LLC participation. Researchers have reported that the primary intent of LLC participation is to facilitate faculty and peer interaction (Blimling, 1993; Schoem, 2004). Previous empirical evidence suggests that LLCs successfully create environments with more frequent and more purposeful interaction with faculty and peers (Garrett & Zabriskie, 2004; Inkelas, Vogt, Longerbeam, Owen, & Johnson 2006; Lacy, 1978; Pascarella & Terenzini, 1981; Pike, 1999). There is also evidence that faculty and peer out-of-class interactions influence student learning and intellectual

development such as critical thinking (Terenzini, Springer, Pascarella, & Nora, 1995; Whitt, Edison, Pascarella, Nora, & Terenzini, 1999). More recent research has explored the direct relationship between LLC participation and self-reported growth in critical thinking (Inkelas, Johnson, Lee, Daver, Longerbeam, Vogt, & Leonard, 2006; Inkelas, Vogt, et al., 2006; Inkelas & Weisman, 2003; Kohl, 2009; Schein, 2005). A reasonable and testable research question would ask if a direct or indirect relationship exists between LLC participation and critical thinking mediated by faculty and peer interaction. The purpose of this study was to test the theoretical transitive relationship and to estimate the direct and indirect effects of LLC participation on growth in critical thinking.

Statement of the Problem

The more recent literature on the impact of LLCs on student learning has been unsystematic and has had problems with validity. Many LLC studies have focused on single-institution samples with student self-reports of outcomes and no controls for student self-selection or student background characteristics. Recent studies have reported a positive relationship between LLC participation and self-reported growth in critical thinking (Inkelas, Johnson, et al., 2006; Inkelas, Vogt, et al., 2006; Kohl, 2009; Schein, 2005).

The present study addresses four gaps in the research on outcomes associated with LLC participation. The first gap in LLC research is the lack of longitudinal studies that follow the same students from pretest to posttest. A longitudinal research design that includes a pretest measure of the outcome variable may be more important in obtaining an unbiased estimate of the impact on critical thinking than other statistical procedures (e.g., propensity score matching, covariate adjustment) that approximate adjustment for students' self-selection within the experimental or control group (Padgett, Salisbury, An, & Pascarella, 2011). Selection bias or students' choice to participate in educational programs has threatened the internal validity of higher education research (Titus, 2007). It is still unclear if desired outcomes such as academic performance, retention, or growth

in critical thinking can be accurately attributed to the LLC environment or if they are simply a product of clustering students with advantaged ability and backgrounds or other factors. Single-institution, longitudinal LLC studies use panel designs that select random samples at each observation point without tracking the same individuals from pretest to posttest (Felver, 1983; Koerner, 2008; Lacy, 1978; Pascarella & Terenzini, 1980; Pascarella & Terenzini, 1981; Stassen, 2003). Previous national studies examining the impact of LLC on critical thinking, such as the National Study of Living Learning Programs (NSLLP), used cross sectional research designs (Inkelas, Johnson, et al., 2006; Inkelas, Vogt, et al., 2006; Kohl, 2009). Pascarella (2006) argued that, in the absence of randomized experiments, longitudinal designs provide the most internal validity to account for socialization and recruitment effects in college impact research. A longitudinal cohort research design allows for consideration of the natural maturation of critical thinking during the first year of college and for the selection bias that is common in LLC research.

Second, previous research has explored the impact of LLC participation using students' self-reported gains in critical thinking (Inkelas, Johnson, et al., 2006; Inkelas, Vogt, et al., 2006; Kohl, 2009; Schein, 2005). This study used the Collegiate Assessment of Academic Proficiency test (CAAP) as an objective test of critical thinking. Pascarella (2001) and Pike (1996) discussed the positive correlation between students' self-reports compared with standard measures but noted the disparate internal validity of student self-reports of college outcomes. Bowman (2010) provided empirical evidence that first-year students' self-reports of critical thinking showed divergent findings when compared to a longitudinal standardized measure of critical thinking. Students' perceived growth of critical thinking skills might misrepresent the actual outcomes associated with LLC participation.

Third, previous multi-institution research does not include liberal arts colleges in the institutional sample. Including different types of institutions such as research and

regional universities and liberal arts colleges in the sample allows for a comparison of the impact of LLCs at institutions with different size and purpose. Other national LLC studies, such as the National Study of Living-Learning Programs (NSLLP), included only large research universities and mid-sized regional institutions. Liberal arts colleges, compared to larger institutions, consistently demonstrate institutional learning environments that facilitate greater exposure to the principles of good practice in higher education, including effective teaching, interactions with faculty, and high expectations (Pascarella, Wolniak, Cruce, & Blaich, 2004; Pascarella, Wolniak, Seifert, Cruce, & Blaich, 2005; Seifert, Pascarella, Goodman, Salisbury, & Blaich, 2010). Comparing liberal arts colleges with large research universities and regional institutions helped the researcher to determine if LLC participation impacts critical thinking at different types of institutions.

Finally, this study explored the conditional effects of student background characteristics on LLC participation. Pascarella (2006) encouraged future college impact researchers to consider the conditional effects within subsamples, such as differences in race/ethnicity and socioeconomic status, to represent an increasingly diverse national student population. Students with diverse background characteristics may experience LLC participation differently, which in turn may affect the development of critical thinking for those students.

Replication and expansion of previous findings accounting for selection bias, objective measures, institutional type, and conditional effects may illustrate if LLCs are indeed a worthwhile campus intervention or if they simply cluster advantaged students predisposed for success in college. Without a rigorous examination of LLC participation, institutions may continue to make a financial investment in LLCs that show positive effects based on who chooses LLC participation rather than on the success of an effective student intervention.

Definition of Terms

Living Learning Communities (LLCs) are residential communities with intentionally designed academic and/or thematic focus (Lenning & Ebberts, 1999; Shapiro & Levine, 1999). Cluster classes, team-taught classes, and freshmen interest groups are examples of non-residential learning communities and are conceptually different from LLCs (Lenning & Ebberts, 1999; Shapiro & Levine, 1999).

[Living-] learning communities are not merely block programming, an administrative convenience that facilitates registration and use of rooms. Rather they are conscious intellectual structures that teachers create, and students participate in, to share a high quality and enduring educational experience....There are as many variations on the models of learning communities as there are institutions willing to participate. All, however, strive to provide an intense and supportive environment for intellectual growth and development. (Matthews, 1994, p. 16)

Laufgraben and Shapiro (2004) suggested that in their ideal form, LLCs "represent a scholarly community, emphasize deep learning for an engaged and diverse community, and integrate the academic and social experiences of college life" (p. 156). LLCs may differ considerably from one campus to the next and even within institutions in terms of student and faculty interaction, staff and faculty collaboration, environment, and interactive pedagogy, as well as the degree to which these areas are integrated (Inkelas, 2008). Although it is a significant limitation of this study, the researcher considered the differential exposure to principles of good practice in undergraduate education (Chickering & Gamson, 1987) as a proxy for variations in LLC type.

Critical thinking has been defined in an inconsistent manner across research studies. Bok (1997) noted that 90% of faculty members in the United States considered critical thinking to be the most important purpose of undergraduate education. Glaser (1941) described the ability to think critically as involving an attitude of being disposed to consider problems and subjects in a thoughtful way, knowledge of methods of logical inquiry and reasoning, and some skill in applying those methods. Critical thinking can also be defined by an individual's ability to "identify central issues and assumptions in an

argument, recognize important relationships, make correct inferences from data, deduce conclusions from information or data provided, interpret whether conclusions are warranted on the basis of the data given, and evaluate evidence or authority” (Furedy & Furedy, 1985, cited in Pascarella & Terenzini, 1991, p. 118). Parker and Moore (2005) defined critical thinking as the careful, deliberate determination of whether one should accept, reject, or suspend judgment about a claim and the degree of confidence with which to accept or reject that claim. This study used the well-supported and comprehensive definition from the Delphi Report, which defined critical thinking as:

...purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. Critical thinking is essential as a tool of inquiry. As such, critical thinking is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, critical thinking is a pervasive and self-rectifying human phenomenon. The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. (Facione, 1990, p. 3)

Significance of the Study

This study reexamined findings by Inkelas, Johnson, et al. (2006), Inkelas, Vogt, et al., (2006), Kohl (2009), and Schien (2005) to investigate scholarly understanding of the impact of LLC programs on critical thinking. Compared to the most recent research on LLCs, this study makes four significant contributions: (a) use of a longitudinal design with a pretest measure of the outcome variable rather than dominant cross-sectional designs to account for natural maturation of critical thinking development and self-selection of LLC programs; (b) use of a standardized measure rather than students' self-reports of critical thinking to test previous positive effects of LLCs; (c) use of a national data set to expand generalizability beyond the typical single-institution samples; and (d) exploration of conditional effects of student and institutional background characteristics on the impact of LLC participation.

This study tested the validity of previous claims of LLC impact on critical thinking development. Regardless of potential findings of positive, negative, or no effect, this study added to the understanding of the effects of LLC participation, controlling for student background characteristics using a longitudinal design with standardized responses. The purpose of this study was to test if LLCs are effective institutional interventions that promote critical thinking or if they isolate and select out students likely to succeed in college.

The next chapter explores a methodological review of the extant literature on the impact of LLCs on college outcomes. The large majority of current LLC research focuses on single institution studies with several positive outcomes including improved academic performance, persistence to the sophomore year, persistence to graduation, better social climate, transition to college, openness to differences, faculty interaction, peer interaction, and self-reported critical thinking. Multi-institution LLC research is cross-sectional and fails to control for students' choice to participate in a LLC or live in a traditional residence hall. Multi-institution, longitudinal research groups LLC with other types of learning community types such as clustered cohorts, freshmen interest groups, and team-taught programs making it impossible to parcel out the unique contributions of a residentially based learning community. There has been no previous research that explores the impact of LLC on first-year students' in a multi-institution, longitudinal research design that uses an objective measure of critical thinking.

CHAPTER II

LITERATURE REVIEW

This chapter explores the history and development of living-learning communities (LLCs) organized by research methodology: (a) single-institution, cross-sectional studies; (b) single-institution, longitudinal studies; (c) qualitative studies; (d) national, cross-sectional studies; and (e) national, longitudinal studies. Single-institution, cross sectional studies represent the majority of research on LLCs. Existing multi-institutional studies use cross-sectional research designs and self-reported gains to draw correlational relationships between residing in LLCs and experiencing desirable college outcomes. National studies that use longitudinal research designs and standardized measures of growth group LLCs with other types of learning communities (i.e., students with courses in common, team-taught programs; Engstrom & Tinto, 2008a; Engstrom & Tinto, 2008b; Zhao & Kuh, 2004), which differ substantially in structure and programmatic function (Lenning & Ebbers, 1999; Shapiro & Levine, 1999). Common themes emerged from a review of the current LLC literature, including the role of student background characteristics, the mediating influence of peer and faculty interactions, and the lack of randomized experimental research designs in LLC research.

The size and diversity of current research on LLC participation requires establishing parameters to clearly identify how researchers consider LLCs in observational studies published in recent, peer-reviewed sources. The first parameter included only previous research that empirically compared students in LLCs with a control group of students in traditional residence hall environments. For the purposes of this review, LLCs are residential communities with intentionally designed academic and/or thematic focus (Lenning & Ebbers, 1999; Shapiro & Levine, 1999). By comparison, traditional residence hall environments consist of residence halls available to students on most residential campuses that include both single-sex and coeducational living arrangements. Students in traditional residence hall environments “receive some

exposure to educational and cultural programs but usually these programs are not as comprehensive or intense as [LLCs]" (Blimling, 1993, p. 254). Qualitative studies were also explored to better understand why students choose to participate in LLCs and how they perceive the LLC environment.

The second parameter included only previous research that was peer reviewed. Literature that has undergone a peer review process includes empirical research published in journals and books, in dissertations, and in documents available through the Education Resources Information Center (ERIC). Other sources of information such as conference presentations or practitioner literature, which do not consistently have the benefit of rigorous peer evaluation, were not included in this review. Practitioner publications often focus on operational topics such as resident assistant training without addressing the outcomes associated with LLC participation. To locate the body of research on LLC programs, this researcher conducted a series of computerized searches using the following databases: Psychological Abstracts, ERIC Index, Sociological Abstracts, ProQuest Dissertations & Theses database Dissertation Abstracts, and Social Citation Index. Previous literature reviews on LLCs also helped to identify a comprehensive list of resources (Inkelas & Soldner, 2011; Kuh, Douglas, Lund, & Ramin-Gyurnek, 1994; Pascarella, Terenzini, & Blimling, 1994; Swaner & Brownell, 2008; Taylor, Moore, MacGregor, & Lindblad, 2003; Terenzini, Pascarella, & Blimling, 1996).

The third parameter identified studies conducted after 1970. Pascarella and Terenzini's (2005) meta-analysis of research on the impact of college on students noted that recent research on LLC programs presents less compelling evidence than that of previous decades regarding residential academic programs' ability to blur the boundaries of academia and to promote student success in college. The authors noted that "the living-learning experience appears to have been less intensive and comprehensive than the [LLC] experiences studied prior to 1990" (p. 422). The inconsistencies found by Pascarella and Terenzini may also be due to a more heterogeneous student population, the

enhancement of non-LLC programmatic emphasis, or the proliferation of LLC programs across the United States.

History and Development of LLC Programs

The history and development of LLC programs began in the British tutorial system of education in the late 1800s at Oxford and Cambridge universities (Blimling, 1993). The first American LLC program implementation began in the 1927 at the University of Wisconsin when Alexander Meiklejohn introduced the experimental college (Blimling, 1998; Chaddock, 2008; Ryan, 1992; Smith, 2001). The experimental college sought to create an introductory undergraduate curriculum that "dissolved the distinction between academic study and college life by placing all the students in the same dormitory, along with adviser offices and a small library room" (Meiklejohn, 1932, p. xxii). Yale and Harvard universities developed similar models "to place the student in direct and immediate contact with a portion of the faculty, a most necessary purpose in view of the size and impersonality of the university...and to furnish an opportunity for the students to know each other intimately and to exchange ideas outside of the class" (Rogers, 1952, cited in Chaddock, 2008, p. 14).

During the next four decades, both Yale and Harvard sought to bridge the gap between classroom learning and the campus environment. In the 1960s, large universities explored the potential of LLC programs to intentionally create smaller communities within the university to "humaniz[e] the scale of higher education" (Smith, 2001, p. 3). The Residential College at the University of Michigan and the Centennial Program at the University of Nebraska were examples of this effort. Many larger institutions struggled to balance innovation with the cost-effectiveness of LLC programs in the 1970s and 1980s. LLCs gained momentum across institutional sizes and types through the information distribution and assessment work of the Washington Center for Undergraduate Education at Evergreen State College (Blimling, 1998). The principal contradiction in the history of LLCs is the polarization between the focus on the research priorities of universities and

the emphasis on undergraduate education and holistic development. Many institutions struggle to sustain systematic collaboration of academic and student affairs (Inkelas & Soldner, 2011).

In the late 1980s and early 1990s, Tinto and Astin helped demonstrate the need for and structure of “highly effective learning environments” (Smith, 2001, p. 5) to promote student success in college. Residence hall environments that seamlessly bridged the gap between social and academic realms showed the greatest promise for enhancing student learning and development (Terenzini et al., 1996). Several authors noted the potential of LLCs to create seamless learning environments (The Boyer Commission, 1998; Kuh et al., 1991; National Institute of Education’s Report of the Study Group on the Conditions of Excellence in American Higher Education, 1984; ACPA, 1994; Taylor et al., 2003). These authors described the potential for LLC programs to engage students in the campus community and integrate the learning taking place in the classroom with students’ out-of-classroom experiences. To better understand these environments, Shapiro and Levine (1999) and Lenning and Ebbers (1999) each developed independent typologies that included both residential and non-residential learning communities. Zeller, James, and Klippenstein (2002) and Laufgraben and Shapiro (2004) further examined this conceptual typology of learning communities by looking specifically at LLCs.

Inkelas et al. (2004) provided the first LLC typology based on empirical evidence of 26 different LLC program themes at 34 different colleges and universities. Inkelas et al. (2007) expanded on the thematic typology with a larger sample of LLCs and institutions. The updated LLC typology was refined to include 17 primary categories grouped by program theme. Inkelas, Soldner et al. (2008) created an empirical typology for LLCs by several distinguishing program variables including size, budget source, number of program faculty, courses offered by the program, administrative affiliation of the program director, special resources, and co-curricular activities. Using cluster

analysis, 207 programs with 22 thematic emphases at 34 institutions were grouped into three distinctive LLC types distinguished by program size, available resources, and level of collaboration between academic and student affairs. Inkelas and her colleagues provided an evidence-based framework that is especially useful for national studies looking to generalize their findings among a wide variety of LLC programmatic topics and to avoid the relatively common assumption of heterogeneity of LLC experiences. This assumption of heterogeneity of LLC experiences is fueled by the large number of anecdotal studies and program evaluations that focus on LLC programs at single institutions.

Single-Institution, Cross-Sectional Studies

Previous research on LLCs focused on single-institution samples from large research universities primarily using cross-sectional research designs. Although single-institution, cross-sectional studies have demonstrated the least comparative rigor with regard to research design, the consistency of findings has suggested many desirable outcomes in either the population or the environment of LLCs.

The single institution, cross-sectional research on LLC has demonstrated some evidence for the potential to create “academically rich residential settings that...blur the boundaries between students’ academic and social lives.” (Pascarella & Terenzini, 2005, p. 421). Compared with living in a traditional residence hall environment, students participating in LLCs perform better academically (Barnes, 1977; Blackhurst & Meyer, 2001; Edwards & McKelfresh, 2002; Kanoy & Bruhn, 1996; Pasque & Murphy, 2005; Rice & Lightsey, 2000; Tokuno & Campbell, 1992; Vander Wall, 1972; Yockey & George, 1998). Students in LLC programs are more likely to persist in college and graduate (Blackhurst & Meyer, 2001; Earnest, 2002; Edwards & McKelfresh, 2002; Ellett, 2005; Hummel, 1997; Hummel & Steele, 1996; Johnson & Romanoff, 1999; Purdie, 2007). LLC students report a better social climate and transition to college (Armino, 1994; Barnes, 1977; Centra, 1968; Crimmin, 2008; Gilbert, 2004; Goebel,

1977; Inkelas, 1999; Pike, Schroeder, & Berry, 1997; Schussler & Fierros, 2008; Vander Wall, 1972; Viehe, 1977). LLC students demonstrate more openness to differences and are more likely to learn new perspectives (Inkelas & Weisman, 2003; Pike, 2002). Students in LLCs experience changes in aesthetic, cultural, intellectual attitude and values (Fisher & Andrews, 1976; Magnarella, 1975). Students in LLC programs interact more frequently with faculty (Clark, Miser, & Roberts, 1988; Gabelnick, MacGregor, Matthews, & Smith, 1990; Garrett & Zabriskie, 2004; Inkelas, 1999; Inkelas & Weisman, 2003; Johnson & Romanoff, 1999; Magnarella, 1979; Murphy, 2003a, 2003b; Pike, 1999; Pike, Schroeder, & Berry, 1997; Sriram & Shushok, 2010) and peers (Cade, 1979; Inkelas, 1999; Inkelas & Weisman, 2003; Jaffe, Carle, Phillips, & Paltoo, 2008; Kahrig, 2005; Pike, 1999; St. Onge, Peckskamp, & McIntosh, 2003) than students living in traditional residence halls.

Not all single-institution cross-sectional LLC research has reported the same significant findings. Bewley (2010) found a non-significant difference in academic achievement between LLC students and students in traditional residence halls. Kanoy and Bruhn (1996), Stassen (2000), and Vander Wall (1972) found a non-significant difference in persistence into the second year of college for LLC students compared with students in traditional residence halls. Goldman and Hood (1995) even found that LLC participation had a negative relationship with persistence. Ellett (2005) and Centra (1968) found less informal interaction between LLC students and faculty compared with students in traditional residence halls. Nosow (1975) found that students in LLCs were less satisfied with the social climate of their residence halls.

Within single-institution, cross-sectional studies, Inkelas and Weisman (2003) offered a conceptual framework that explored the impact of student demographics and within-college experiences in LLCs by stepwise regression: (a) student demographics; (b) a quasi-experimental, self-reported approximation of confidence and predisposition to learning; (c) curricular (e.g., class level, major); (d) co-curricular aspects (e.g., student

clubs, employment); (e) experiences that LLCs strive to create (e.g., studying in groups, interaction with faculty); and finally, (f) students' perceptions of their residence hall environment. Inkelas and Weisman illustrated how LLCs of varying sizes and scope impacted students differently. They compared students living in transition LLC programs, academic honors LLC programs, and curriculum-based LLC programs with students living in traditional residence halls. Inkelas and Weisman found several differences between LLCs and traditional residence halls including LLC students' using critical thinking skills in class assignments, experiencing out-of-class interactions with faculty and interactions with peers, studying in groups, and perceptions in the residence hall environment. Inkelas and Weisman also offered the only examination of the conditional effects of student background characteristics within LLC programs. A major limitation of their study, however, was the assumption of heterogeneity of student academic ability. The sample was stratified by gender, race/ethnicity, academic class, and residence hall, but not by academic ability. Students at the highly-selective institution had similar high school GPAs, demonstrating similar academic achievement; however, the authors noted that differences in SAT and equivalent scores had a potential self-selection bias of academic ability.

Danielson (2005) explored this self-selection bias of LLCs in her dissertation on the factors affecting the decision to be part of an LLC at a large, selective research university in the Midwest. Danielson used freshmen survey data from the Cooperative Institutional Research Project (CIRP) to provide pre-college information on students in LLCs and students in traditional residence halls. The purpose of her study was to determine if there was empirical evidence of self-selection into LLCs. Danielson explored differences in student background characteristics (i.e., parents' income and education, academic aptitude, gender, age, and ethnicity), Astin's (1993) student types (e.g., social activist, scholar), and intended academic field (e.g., business, education) as predictors of choice to participate in an LLC. She found several statistically significant

differences in background characteristics, with LLC students having higher high school GPAs, being predominantly female and younger, and having parents with more education beyond college. There were no statistically significant differences between parents' income and race/ethnicity. Although there were several differences between the students in LLCs and those in traditional residence halls, suggesting that participation was not random, the model did not effectively predict students' selection to participate in an LLC. Using background characteristics, her model accurately predicted only 4.8% of students participating in an LLC. Danielson's findings suggested that self-selection into a LLC is a more significant predictor of desired outcomes than the intervention of the LLC environment itself.

The weight of the evidence from single-institution, cross-sectional research suggests that LLC participation indirectly impacts students' academic performance, persistence, social climate, transition to college, openness to differences, and change in attitude and values, when mediated by the frequency and quality of interactions with faculty and peers. Several authors noted differences between students in LLCs and those in traditional residence halls by race/ethnicity, gender, socioeconomic status, degree aspirations, and pre-college academic achievement (Blimling, 1993; Inkelas & Longerbeam, 2008; Inkelas & Weisman, 2003; Pascarella et al., 1994; Pascarella & Terenzini, 1991; Pascarella & Terenzini, 2005; Pike, 1999). Student background characteristics and the mediating effects of interaction within the LLC environment complicate findings of LLC research beyond single-institution, cross-sectional studies.

Single-Institution, Longitudinal Studies

Pascarella (2006) wrote that “when we retreat from longitudinal research designs...we pay a substantial price in internal validity, or the ability to accurately estimate the magnitude of the socialization effects of the collegiate experience” (p. 510). The longitudinal studies described below further the argument of causal linkages, either direct or indirect, between LLC participation and desired outcomes.

Lacy (1978) used a longitudinal panel research design at a large liberal arts college to explore the impact of LLC participation on first-year students' change in values, intellectual orientation, and personal development. Although his findings supported single-institution, cross-sectional studies that indicated the potential for LLCs to impact values change, a longitudinal research framework illustrated that the direct positive impacts of LLC participation on values change became non-significant when mediated by the frequency of faculty and peer interaction. LLC students were more likely than students in traditional residence halls to describe their learning environment as academically and socially supportive. Lacy's study was part of a larger longitudinal panel study at an institution that measured a random sample of students' values before the first year of college and then conducted a posttest of another random sample at the end of the first year.

Pascarella and Terenzini (1980) were the first researchers to look at LLC participation with a quasi-experimental, longitudinal panel design at a large, private university. In this study, Pascarella and Terenzini (1980) selected a random sample of freshmen in an LLC and those in traditional residence halls to compare academic achievement, institutional persistence, and measures of intellectual and personal growth. True randomization in higher education research is extremely rare. Exploring interventions of potential benefit to students often relies on students' self-selection into the experimental (LLC) or control (traditional residence hall) groups. Pascarella and Terenzini (1980) found little correlation between students' volunteering to live in an LLC and pre-enrollment characteristics, demonstrating little difference in student background for students in LLCs compared with students in traditional residence halls. They found that students in LLCs were more likely than students in traditional residence halls to persist into the second year of college and to demonstrate positive gains in measures of intellectual and personal growth and sense of intellectual community. The contribution of Pascarella and Terenzini (1980) to LLC research demonstrated that the positive gains of

students in LLCs were mediated by the quality of interpersonal interactions with both faculty and peers. These findings suggest that the potential impact of LLC was largely indirectly influenced by interactions between students and faculty.

Pascarella and Terenzini (1981) replicated their findings in an independent sample from the previous study with more specific inquiry into the types of interactions between students and faculty. Pascarella and Terenzini (1981) again used a longitudinal panel design, sampling different first-year students at pre-enrollment and at the end of the freshman year. They found that LLC students reported significantly higher gains in retention and cognitive and personal development as a result of their interactions with peers and faculty. This replication of the 1980 study was significant to LLC research because of its consistent research questions, population, and findings using a different sample.

Felver's (1983) dissertation examined the differences in academic performance and retention at a large, research university in the Midwest using a 4-year longitudinal sample. Across LLC types, chi-square and ANOVA analyses showed mixed differences in student background characteristics including ACT scores, high school rank, and parents' education. Non-parametric methods of analysis such as chi-square, one-way ANOVA, and two sample t-tests without controls for bias through true randomized selection fail to address sampling error (Morgan & Winship, 2007; Titus, 2007). While this study had the advantage of using institutional records to avoid non-response bias, a lack of ordinary least squares regression or logistic regression analyses did not allow for controls of students' background characteristics in estimating the potential impact of the LLC environment on academic performance or persistence. The overall conclusion of this dissertation found non-significant differences between LLC students and those in traditional residence halls in both academic performance and retention.

Stassen (2003) used a longitudinal data set at a large, moderately selective institution to explore the effects of three types of LLC on academic performance and

persistence. The three LLC types were grouped into Lenning and Ebbers' (1999) residential linked courses types: residential academic program, talent advancement program, and honors college. Stassen found that "even in the least coordinated, most basic, learning community model, students showed more positive outcomes (first semester GPA, retention, first year experience) than non-learning community students" (p. 581). The pretest data included students' entering characteristics and academic preparation. The posttest survey measured different outcome variables including academic and social experiences. Stassen showed that students in LLCs and students in traditional residence halls were fundamentally different in academic ability, academic achievement, race, gender, state residence, academic major, and participation in support programs. Ordinary least squares regression demonstrated that students' high school GPAs, math SAT scores, gender (female), and involvement in all three LLC types contributed to the increased likelihood of persistence and academic achievement. Logistic regression further supported that students' academic preparation and other background characteristics played a statistically significant role in students' decisions to continue in college and their positive academic performance.

Mediating factors may also play a role in academic performance and persistence. Although mediating factors were not included in the initial regression equation, Stassen (2003) found that students in LLCs were significantly more likely to have contact with peers around academic work, engage in group projects, report positive academic behaviors, study more hours, perceive a positive learning environment, and have more course assignments that required the integration of ideas. It is interesting that there were very few differences across the three LLC types. Only honors students reported more exposure to students with different values than was reported by students in the other two LLC types.

Summary of Single-Institution Studies

Considered collectively, the LLC single-institution research using cross-sectional and longitudinal study designs was largely unsystematic. The purpose and methodology varied widely between study designs, depending on institution size and selectivity, organizational framework of the LLC, and the scientific lens of the researcher. After considering the positive outcomes (i.e., academic achievement, retention, supportive environment, openness to diversity) of LLCs in single-institution, cross-sectional designs, the effects were either non-significant or became non-significant when mediated by interactions with peers and faculty. The weight of the evidence in all LLC single-institution studies appeared to suggest that the positive outcomes were largely tied to the frequency and quality of peer and faculty interaction that occurred in the environment. The mediating influence of faculty and peer interaction was consistent with previous literature reviews of LLC studies (Kuh et al., 1994; Pascarella et al., 1994; Swaner & Brownell, 2008; Taylor et al., 2003; Terenzini et al., 1996) suggesting that LLCs may cause an indirect impact because they facilitate interaction between students and with faculty within a residential environment. It is important to note that in previous LLC research with a traditional residence hall control group, there were no longitudinal studies that measured the same outcome variable in a non-panel pretest, posttest design.

Qualitative Studies

Several qualitative studies have explored why and how LLC participation impacts student outcomes. Although these researchers acknowledged that their findings were not generalizable to other institutions, the consistency of findings with single-institution quantitative studies provides additional evidence of the potential of LLC participation to impact students.

Blackhurst, Akey, and Bobilya (2003) provided a focused qualitative study on LLC outcomes at a mid-sized public institution in the Midwest. Twenty first-year students who were members of a residential learning community were interviewed. The

benefits associated with LLC participation included easing the transition to college, facilitating social integration, developing personal relationships with faculty, facilitating in-class learning, creating a seamless environment between student learning and the out-of-class environment, and working against peer norms. The authors concluded that students did not have pre-existing expectations and motivation to participate in the LLC because of a lack of clear understanding of their LLC environment. Students “benefited from the LLC in spite of their expectations rather than because of them” (p. 53).

Some of the most relevant findings from Blackhurst et al.’s (2003) qualitative study were students’ descriptions of their interactions with faculty and peers in the LLC. Several students commented that their LLC facilitated interactions with faculty outside of the classroom in that “[faculty] know your name...it’s nice to know that they know who you are and you’re not just a number” (p. 47). This interaction helped students to see what one student described as “a human side as teachers, not like a scary monster” (p. 47). “[The faculty] made it seem like we were both working towards me getting an education instead of just me [sic] working and them judging” (p. 49). The LLC also facilitated positive peer interactions: “[the learning community] gets a lot of things started for you. It makes it easier getting to know people; you get to know them faster when you see them every day and you live close to them, eat with them, take classes with them...We all have a common ground even if we are not best friends” (p. 45). These data contributed to further understanding regarding why and how students’ interactions with faculty and peers within an LLC may influence college outcomes

Nesheim-Elkins et al. (2007) found similar LLC outcomes in site visits to 12 institutions across the nation. This study, part of the Boyer Partnership Assessment Project, explored academic and student affairs partnerships including LLCs as one example of such a partnership. These outcomes included acclimation to the institution, engagement (specifically with faculty and peers), student learning, and academic and career decisions. Students commented that the LLC environments helped to impact their

level of comfort in interacting with faculty and seeing faculty as real people. One student said, “You get to know [faculty] on a personal level so when you’re in class it’s easier to approach them for office hours. You get to know them as a human instead of just a person who talks at you” (p. 442).

Residential learning communities in Nesheim-Elkins et al. (2007) were also referenced as being able to help students with integrating in-class and out-of-class experiences and in choosing a major. Another student said, “[participating in the LLC] allowed me to see all of the resources on campus, and helped me develop my interests and explore options” (p. 445). The authors concluded that outcomes were mutually shaping and mutually reinforcing as examples of the relationship between student engagement and learning. Participation in LLCs contributed to students’ interacting with peers and faculty, which in turn helped them learn the language and expectations of college, understand how to be successful and transition to college, and take personal responsibility for learning. In LLCs, students described instances of critical thinking, integration of learning, faculty interactions, peer interactions, and improved understanding of self and others. These self-reported experiences, and in some cases gains, demonstrated the students’ perceived benefit of participating in an LLC.

Wawrzynski, Jessup-Anger, Stolz, Helman, and Beaulieu (2009) used focus groups to explore students’ perceptions of three academically based living-learning communities. This qualitative study looked at three LLCs that fit Inkelas et al.’s (2008) typology of environments that were relatively large and had substantial resources and collaboration between student affairs and academic affairs. The authors noted that even though the three LLCs fit within the same typology, they differed in structure, focus, and duration, with some students participating in the community for 4 years. The purpose of their study was to understand how students perceived the LLC environment and what aspects of the LLC environment students valued. Specifically, the researchers asked how

students in LLCs believed their experience differed from that of students in traditional residence halls.

Wawrzynski et al.'s (2009) findings suggest that despite differences in LLC type, students "used similar language to describe the three communities and conveyed parallel perceptions that cut across the communities" (p. 144). The authors noted that despite their intent to understand what students valued about the LLC, they could not identify specific elements of the LLC environment. The students in the focus groups described "the existence of a culture in each community that likely stemmed from the underlying values of the communities" (p. 144). Wawrzynski et al. identified three main themes of the culture within LLCs that promoted seamless learning, a scholarly environment, and an ethos of relatedness among faculty, staff, and peers. This was important because it supported the notion that the differences between LLCs may be the degree to which they promote student-faculty interaction and academic engagement.

In a review of research on LLCs, Taylor et al. (2003) cited several single-institution, qualitative dissertations that explored students' experiences within LLCs. These dissertations highlighted LLC students' experiences at single institutions that differed in size and location around the country. Burright (2002) found that an LLC helped business students with their social transition to the university, collaboration on academic assignments, and involvement with campus activities at a large research institution in the Midwest. Roberts (1998) explored the impact of an LLC on students at an urban community college, finding that the LLC aided students' academic and social transition, increased self-confidence, and increased the quality of interactions with faculty. Roberts's dissertation was one of the few studies that explored the impact of an LLC at a community college and also asked about faculty perceptions of the LLC. Woods (1999) conducted interviews at an LLC at a large university on the East Coast and found that the LLC helped students academically and socially adjust to college, develop relationships with peers and faculty, and find academic collaboration and assistance from

peers. Of these qualitative dissertations, Herscheid (1996) found the only negative impact of LLCs. She concluded that institutional policies that placed students in an LLC inhibited students from interacting around academic subjects at a research university in the Pacific Northwest. These dissertations described remarkably consistent student experiences that added depth to other qualitative and quantitative research, providing additional evidence of LLCs' potential to influence academic and social transitions, peer and faculty interactions, academic collaboration, and involvement (or engagement) within the campus community.

In a case study example, Schein (2005) cited an unpublished evaluation of LLCs (Grayson, 2003) by student focus groups and faculty interviews at a large research university in the Midwest. As the director of a large LLC, Schein discussed his attempt to create small, intellectual communities focused on liberal education and how he operationalized the LLC at a large research university. In the LLC, "students get a level of intellectual intensity in their everyday lives, both in and out of the classroom, that integrates their academic and personal development" (p. 87). Schein discussed positive outcomes evident in student quotes, and faculty perceptions of commitment toward learning, student engagement, developing relationships with peers and faculty, and perceived gains in critical thinking and problem solving. Schein noted differences in student background compared to students not participating in the LLC as a strength of the program: "Students are rich in their academic backgrounds, interests, ethnicities, and cultures" (p. 83).

While these studies provided yet another example of the potential of LLC participation to demonstrate desirable outcomes, qualitative studies remain unclear in determining if the interviewed students would have had a similar experience had they not participated in an LLC. In other words, the LLC may simply act to cluster students who are more open to development within the structured environment, separating out students who may be less inclined to develop. The qualitative research on LLC participation

supported the findings of single- institution research and added to the understanding of students' perceptions of the LLC environment. Across qualitative studies, students emphasized the impact of peer and faculty interaction on their transition to the university and the influence on a supportive academic and social community.

Multi-institutional Cross-Sectional Studies

The National Study of Living Learning Programs (NSLLP, 2004) was the first study to examine the impact of living-learning centers in a multi-institutional data set. Researchers developed a thematic typology of LLCs and looked at several within-college outcomes such as intellectual outcomes, cognitive development, self-confidence, diversity appreciation, alcohol behavior, overall college satisfaction, and sense of belonging. The study considered pre-college characteristics including gender, sexual orientation, race/ethnicity, parents' education, socioeconomic status, political views, and academic ability (GPA, SAT). It is noteworthy that participants and non-participants in this study of LLC participation differed significantly in academic ability.

In interpreting these findings, especially those related to students' academic performance, it must be kept in mind that LLC students oftentimes enter college with a more advantaged background than their traditional residence hall peers. This is reflected most noticeably in their better high school grades and performance on standardized exams. It is thus likely that at least some of the academic benefits that might be attributed to LLC participation are the result of the higher predisposition of LLC students to attain success in college. (p. VI – 2)

Several studies by Inkelas and her colleagues used the NSLLP data to further explore the impact of LLC participation in a national sample with a cross-sectional design. Inkelas, Vogt, et al. (2006) examined the construct reliability and validity of the NSLLP scales on differences in student backgrounds, college environments, and cognitive outcomes such as critical thinking. Using a self-reported measure, Inkelas, Vogt, et al. suggested that LLCs may impact growth in critical thinking. The study used non-randomized data from four large-research institutions in a cross-sectional research design to compare students in LLCs to students in traditional residence halls. The large sample of 5,437 students included first-year, sophomore, junior, and senior students. The

authors used non-parametric analyses (i.e. chi-square and one-way ANOVA) to compare student background characteristics, with the only difference in background characteristics being that LLC students had significantly higher high school GPAs and average ACT and SAT test scores. Non-parametric analysis without controlling for sampling error may simply reflect advantaged student backgrounds rather than effective programmatic intervention of LLCs (Morgan & Winship, 2007; Titus, 2007). Inkelas, Vogt, et al. (2006) found that compared to students in traditional residence halls, students in LLCs reported significantly higher scores ($p < .001$) in their own critical thinking/analysis abilities. Inkelas and her associates also found that students in LLCs compared to traditional residence halls differed by gender, race, and parents' educational level in their perceptions of their critical thinking skills. This means that males and females, students from historically underrepresented groups, and students from different socioeconomic statuses may have different experiences within LLCs that shape their self-perceptions of growth in critical thinking.

Inkelas, Johnson, et al. (2006) explored how LLCs impacted intellectual growth at three large public research institutions. Responding to the Boyer Commission's (1998) recommendation for large universities to create smaller communities of learners within the larger whole, Inkelas and her associates sought to provide empirical evidence of the potential for LLCs to impact academic outcomes across different institutional contexts. They used data from the NSLLP (2004) to compare students living in LLCs to a randomized sample of students living in traditional residence halls. This cross-sectional research design used ordinary least squares regression to control for student background characteristics, academic ability, and a quasi-experimental measure of students' expectations of the importance of intellectual development. Even after separating curricular and co-curricular environments in the regression blocks, there were no statistically significant differences between LLC students' and traditional residence hall students' perceptions of their growth in cognitive complexity. Key findings of Inkelas,

Johnson, et al. (2006) were the variations in the contributions of LLC environments on students' growth in cognitive complexity in the three universities. "It is clear from the study's findings that [LLCs] are not the same on any two campuses even among those that share similar institutional characteristics" (p. 138).

Dong's (2005) dissertation conducted secondary data analysis from the NSLLP (2004) to look at the impact of LLC participation compared with living in a traditional residence hall on self-reported levels of civic engagement at five large universities in the Midwest. Dong found that students who participated in LLCs demonstrated greater levels of civic engagement, volunteerism and service to the community, responsibility to the common good, and civic empowerment. Dong acknowledged the extremely small effect size of LLCs, yet noted many of the indirect effects of LLC participation (i.e., diverse peer interaction, use of residence hall peer, faculty, and co-curricular resources) as the composite experience of living and interacting within an LLC.

Other studies using the NSLLP (2004) data helped to parcel out the conditional effects of LLC participation on specific groups. Inkelas, Daver, Vogt, and Leonard (2007) found that first-generation students in LLCs reported a more successful academic and social transition to college than their first-generation peers living in traditional residence halls. Johnson et al. (2007) controlled for the impact of LLCs, finding between 0.0% and 1.0% variance between first-year students from different racial or ethnic groups on students' sense of belonging. Longerbeam, Inkelas, Johnson, and Lee (2007), using LLC participation as a covariate with ANCOVA analysis, found significant differences in co-curricular involvement and college interactions and environments between students with different sexual orientations. In a separate data set from the NSLLP, Longerbeam, Inkelas, and Brower (2007) found second-hand benefits of a supportive peer environment and positive diversity interactions for students living in traditional residence halls with an LLC in the same building at large research universities

Inkelas, Soldner, Longerbeam, and Leonard (2008) used multivariate regression to control for student background characteristics, such as academic ability, to assess the impact of LLC participation on student-learning outcomes such as growth in critical thinking. Inkelas and her associates used students' self-reported measures of growth in critical thinking. Students participating in LLCs reported significantly greater gains in critical thinking ($p \leq .001$) compared to students living in traditional residence hall environments. While Inkelas et al. (2008) focused on developing a typology for LLCs, the differences in LLC type accounted for 16.6% of the variance in students' self-reported critical thinking ability scores. Students' background characteristics predicted 87% to 99% of students' critical thinking.

Kohl's (2009) dissertation used a cross-sectional research design to explore self-reported critical thinking in honors LLCs compared to civic/social leadership LLCs compared with living in a traditional residence hall. Kohl offered the most recent evidence of the impact of LLC participation on self-reported critical thinking at eight institutions across the United States. Similar to other authors who explored critical thinking using the NSLLP data set, Kohl used pre-college confidence in cognitive skills as a proxy for a pretest of critical thinking. The author controlled for students' race/ethnicity, gender, parents' education, parents' income, high school grades, and pre-college confidence in cognitive skills. Kohl found that LLC participation accounted for 1.6% of the variance in self-reported critical thinking. Kohl found that gender, parents' education, pre-college confidence in cognitive skills, institutional selectivity, institutional size, involvement in varsity sports, social interaction with peers, and non-participation in LLC were all statistically significant predictors of critical thinking.

In a follow-up to the 2004 NSLLP, the 2007 NSLLP (Inkelas, Szelenyi, et al.) expanded their inquiry to 49 colleges and universities. The cross-sectional component of the 2007 NSLLP explored the outcomes of 617 LLCs at 52 institutions for 22,258 students. The 2007 NSLLP found several consistent findings with the 2004 synthesis for

first-year students with relatively small effect sizes (Inkelas, Soldner, & Szelenyi, 2008). Students in LLCs were more likely than students in traditional residence halls to report academic and social discussions with peers, positive faculty mentoring relationships, smooth transition to college, lower levels of binge drinking with serious consequences, commitment to civic engagement, perceive the residence hall climate as academically and socially supportive, and experience growth in critical thinking and application of knowledge (Inkelas, Szelenyi, et al., 2007).

Multi-institution, cross sectional studies on LLCs all used data from the NSLLP. The NSLLP was administered in 2004 and again in 2007. The goals of the NSLLP were to explore the outcomes of LLC participation compared to living in a traditional residence hall and to provide a national database of LLCs intended to offer generalizability of findings on LLCs (Inkelas & Soldner, 2011). Participating institutions in the NSLLP were entirely large research universities. Although the outcomes reported by the NSLLP were self-reported, it is currently the only available multi-institution data set available that offers specific information about the LLC environment. The overall findings of multi-institutional, cross-sectional research appear to be similar to single-institution research with the most consistent results being that the primary influence of LLC participation is to promote interaction with faculty and peers.

Multi-institutional Longitudinal Studies

Longitudinal studies allow researchers to identify individual variations of data and/or to establish causal relationships between variables (Bauer, 2004).

The most recent synthesis of the National Study of Living-Learning Programs (Inkelas, Szelenyi, et al., 2007) had a smaller longitudinal component that provided the only multi-institution, longitudinal study focusing on LLC participation. The 2007 study followed up with 1,509 students from their first year (NSLLP, 2004) to their senior year. Using students' self-reported responses, the 2007 NSLLP provided "the most definitive statements to date about the myriad of relationships between students' experiences in

[LLC] and the outcomes they achieve” (Inkelas, Soldner, & Szelenyi, 2008, p. 56). The 2007 NSLLP followed the same students between their freshmen and senior years, but did not measure the same outcome variables from pretest to posttest. The inputs collected in the pretest included student demographics, high school achievement, and pre-college perceptions of the importance of involvement and students’ self-confidence. The longitudinal component of the 2007 NSLLP found that students participating in LLCs were more likely than their peers in traditional residence halls to report a commitment to civic engagement, lower levels of health problems associated with binge drinking, higher levels of academic self confidence, and being a mentor or tutor for other students (Brower, 2007).

Other longitudinal, national studies on the effectiveness of academic and student affairs partnerships aggregated residential and non-residential learning communities without parceling out the potentially unique impact of LLCs (Engstrom & Tinto, 2008a, 2008b; Zhao & Kuh, 2004).

The lack of multi-institution, longitudinal research on LLC participation creates an over-reliance on conclusions from single-institution research and emphasizes the need for future studies to use longitudinal research designs.

Student Choice to Participate in LLC

It is important to identify what factors influence a student’s choice to participate in an LLC. When a student selects to participate in an LLC, he or she is making a choice to participate in the experimental group rather than in random selection by the researcher. Students who choose to participate in LLCs often come to college with a greater likelihood of success because of their advantaged academic and economic backgrounds. Random experimental designs in higher education are rare because students cannot be required to participate in programs such as LLCs. This lack of random assignment may increase the presence of Type I errors, determining a significant finding when it is actually not significant. This point represents a significant dilemma that is present in

much of higher education research (Titus, 2007). Selection bias occurs when techniques other than simple random sampling are used to identify samples of interest (Heckman, 1979). Several authors noted that selection bias has not been adequately addressed in higher education literature (DesJardins, McCall, Ahlburg, & Moye, 2002; Porter, 2006; Thomas & Perna, 2004). The causal effect of LLC participation may be a reflection of students' innate ability or family background rather than unique effects of the intervention (Willis & Rosen, 1979, as cited in Morgan & Winship, 2007).

Danielson's (2005) dissertation explored the contributing factors of background characteristics, intended academic field, and Astin's (1993) student typology influence on a student's choice to participate in an LLC at a large, selective institution in the Midwest. Danielson found significant differences in gender, ethnicity, and parents' education between students in LLCs and students in traditional residence halls. Only choice of engineering as an academic field was a significant difference between LLC students and students in traditional residence halls. There were several significant differences in student typology including status striver, social activist, artist, leader, and scholar. Only the hedonist student type was not significant in the model. Danielson's model described 11.5% of the variance in students' choice and accurately predicted only 4.8% of students' choice to participate in an LLC. This low predictability suggests that a student's individual characteristics may not play a significant role in the choice to participate in an LLC. Blackhurst et al.'s (2003) qualitative study at a single institution suggested that a student's choice to participate in an LLC cannot be explained by the student's pre-existing expectations and motivation levels. One student's account described this trend: "I really didn't know what to expect. I really didn't know what the [living-] learning community was all about. I read about the [living-] learning community, but I didn't really understand what it was" (p. 53). Blackhurst et al. concluded that students benefit from LLC participation "in spite of vague – or, in some cases, erroneous expectations about the program" (p. 55).

In Lacy's (1978) study, a sub-group of students who applied to an LLC were randomly assigned to a traditional residence hall and subsequently reported a pattern of interpersonal relationships similar to other students in traditional residence halls and not like that of students who were assigned to the LLC. This finding represents a truly unique component of LLC research: one that empirically accounts for students' self-selection to participate in LLCs by withholding the treatment effect of the LLC and the subsequent non-impact on the outcome. A study of LLC impact that accounts for self-selection by including a pretest measure of the outcomes variable may have substantially different findings than previous studies that controlled for student and institutional background characteristics.

Single-institution research on LLC participation demonstrated several positive outcomes including academic performance, persistence, social climate, transition to college, openness to differences, and change in attitude and values. Using student self-reported responses, multi-institution research demonstrated several other benefits of LLCs including growth in critical thinking, civic engagement, openness to diversity experiences, fewer health problems associated with binge drinking, academic self-confidence, and being a mentor or tutor for other students. Previous studies that used regression analysis found that all of these LLC outcomes were reduced to non-significance when mediated by frequency and quality of interactions with faculty, supportive peer interactions, academic engagement, collaborative learning, co-curricular involvement, and/or diversity experiences. Research on the impact of college interventions on college outcomes suggested that the positive experiences may be indirect, mediated by principles of good practice in undergraduate education (Chickering & Gamson, 1987; Cruce, Wolniak, Seifert, & Pascarella, 2006; Pascarella & Terenzini, 2005; Pike, 2008). Previous LLC qualitative studies provided additional support for this finding, especially in regard to faculty and peer interactions.

The following sections use the existing LLC literature to outline the relevant variables for a study of the impact of LLC participation on the development of critical thinking for first-year undergraduate students.

Dependent Variable – Critical Thinking

Previous research consistently found a positive relationship between participation in LLCs and self-reported growth in critical thinking during the first-year of college (Inkelas, Johnson, et al., 2006; Inkelas, Vogt, et al., 2006; Kohl, 2009; Schein, 2005). It is clear from previous research that LLC students perceive their own growth in critical thinking to be greater than that of traditional residence hall students during the first year of college. Pascarella (2001) and Pike (1996) discussed the problems of reliability in using student self-reported gains compared with using standard measures. Pascarella (2006) recommended that future research replicate previous findings on experiences that affect college students.

A reasonable next step for LLC research would be to expand on previous findings of students' self-reported growth in critical thinking using an objective measure. The Collegiate Assessment of Academic Proficiency (CAAP) is an example of a standard measure of critical thinking. The CAAP, administered by ACT, has an internal consistency reliability between .81 and .85, measured by Cronbach's alpha (ACT, 1990). Inkelas, Soldner, et al. (2008) and Inkelas, Vogt, et al. (2006) reported a Cronbach's alpha reliability of .725 for their self-reported measure of critical thinking. Inkelas, Soldner, et al. defined growth in critical thinking as "students' perceptions of their critical questioning and reflection abilities" (p. 500). Using a standard measure of critical thinking may more accurately demonstrate the relationship between LLC participation and changes in students' critical thinking during the first year of college.

Independent Variables – Student and Institutional Characteristics

Previous research demonstrated the impact of student background characteristics on critical thinking. Gender, race/ethnicity, parents' educational attainment, and pre-

college academic ability contributed to students' intellectual development during the first year in a residential setting (Pascarella et al., 1996; Terenzini, Springer, Pascarella, & Nora, 1995). Inkelas et al. (2006) found that students' gender, race/ethnicity, and parental education were significant to development of critical thinking in LLCs.

For outcomes related to critical thinking in general, Pascarella, Pierson, Wolniak, and Terenzini (2004) found small, but statistically significant differences in students' educational aspirations on several college outcomes. Pascarella (1980) and Pace (1984) found that quality of academic effort and motivation positively affected development in critical thinking. Inman and Pascarella's (1998) findings suggested that pre-college involvement might be a confounding influence on critical thinking scores. Kohl (2009) found a moderate to large effect of pre-college confidence in cognitive skills on a self-reported measure of critical thinking in LLCs.

Institutional characteristics may also be a factor in students' experiences and growth in critical thinking. Institutional characteristics, such as 2-year or 4-year, size, and percentage of students living on campus, will be associated with different student background characteristics, which influence how individual students interact with and influence the college environment (Pantages & Creedon, 1978; Pascarella, 1980, as cited in Pascarella & Chapman, 1983; Tinto, 1975). Students attending the same institution tend to have similar characteristics and behave in a more similar manner than students across institutions, making institutional type an important variable in any multi-institutional study (Pascarella & Chapman, 1983).

Mediating Variables – Interaction and Student Effort

Several studies have shown that student effort in studying, out-of-class involvement, and faculty and peer interaction influence student learning and intellectual development such as critical thinking (Astin, 1993; Pascarella, 1980; Pascarella & Terenzini, 2005). Inman and Pascarella (1998) found that pre-college involvement may be a confounding influence on critical thinking scores. Other studies further support the

influence of involvement (Astin, 1977), engagement (Kuh et al., 1991), and quality of effort (Pace, 1984) on gains in critical thinking and cognitive development. Especially in an LLC environment, peer and faculty interactions have a positive, direct impact on gains in learning and development (Garrett & Zabriskie, 2004; Inkelas et al., 2006; Lacy, 1978; Pascarella & Terenzini, 1981; Pike, 1999). The interaction that occurs between peers appears to be particularly impactful. Johnson, Johnson, and Smith (1998) reported the results of a meta-analysis of more than 300 studies as indicating that cooperative learning environments (broadly defined) promote both academic and social engagement and success. Lenning and Ebbers (1999) recommended that working in groups and students' perceptions that their living environment is supportive of their endeavors will impact cognitive development and critical thinking. With demonstrated direct and positive impact on critical thinking, the mediating factors of interaction with faculty and peers and academic effort appear to be essential components to consider in the investigation of LLC impact on critical thinking.

Summary of the Current Literature

The disproportionately fewer number of studies showing no impact of LLC participation on desirable outcomes may be a result of what Blimling (1998) described as the "file drawer" or "publication bias" problem. This refers to the lack of contradictory research available as a result of researchers or journal editors keeping non-significant findings hidden in a file drawer because of an assumed lack of interest. Publication bias may stem from the reluctance of researchers to submit studies that do not show significant results. Although Blimling's meta-analysis of research on LLC found consistent positive effects with single institution, cross-sectional LLC research, the effect sizes of LLC participation were all very small. LLC participation accounted for only 2.7% of the variance for academic performance. Students in LLCs were 2% more likely to remain in college than students in traditional residence halls. The variance accounted for in LLC participation creating positive social environments was 0.8%. The true

potential for LLCs may be in their ability to encourage interactions with peers and faculty.

There is relatively little empirical evidence that LLCs impact desirable college outcomes using objective measures. Previous research on LLCs used primarily single-institution samples with cross-sectional and longitudinal research designs. Existing multi-institutional studies used cross-sectional research designs and self-reported gains to draw correlational relationships between residing in an LLC and desirable college outcomes. National studies that used longitudinal research designs and standardized measures of growth imprudently grouped LLCs with other types of learning communities (e.g., students with courses in common, team taught programs) which differ substantially in structure and programmatic function (Lenning & Ebbers, 1999; Shapiro & Levine, 1999). There is a lack of randomized, causal studies in a national sample that use a longitudinal research design and objective measures to estimate the direct and indirect effects of LLC participation while controlling for the confounding effects of student background characteristics in a national sample. Accounting for the conditional effects of differences in student background may illustrate if LLCs are indeed a worthwhile campus intervention or if they simply cluster advantaged students predisposed for success in college.

CHAPTER III

CONCEPTUAL FRAMEWORK AND METHODOLOGY

This study explored if participating in an LLC compared with living in a traditional residence hall environment results in significant changes in critical thinking due to the unique experiences that occur in living environments intentionally designed to facilitate interaction and academic engagement. Participants included first-year students at the 4-year institutions selected to take part in the Wabash National Study of Liberal Arts Education (WNSLAE). The ontological assumption was that campus residential environments designed to facilitate faculty and peer interaction can influence intellectual development. The epistemological assumption was that by evaluating the potential impact of intentionally designed environments, institutions can improve the effectiveness of higher education (Strange & Banning, 2001). The unit of analysis was individual students participating in LLCs and students living in traditional residence halls. The scope conditions limited findings only to institutions participating in the WNSLAE due to the purposive, non-random sampling of the colleges and universities. This study adds to the current LLC literature by exploring the direct and indirect effects of LLC participation on critical thinking using a multi-institutional, longitudinal research design.

It is clear from the current literature that something is happening within LLCs that facilitates desirable college outcomes. It is still not clear, however, if the catalyst for these outcomes can be accurately assigned to the clustering of advantaged students, the interaction and mediating effects that occur within LLCs, or the LLC environment itself. This problem introduces the recommendation for future research to explore the direct and indirect effects of LLC on a previously self-reported positive outcome of LLC participation such as critical thinking (Inkelas, Vogt, et al., 2006; Kohl, 2009; Schein, 2005). Pascarella (2006) advocated for future research to focus on replicating findings and bringing systematic inquiry to bear on the rational myths of higher education. He encouraged future researchers to focus on the quality of data by using longitudinal

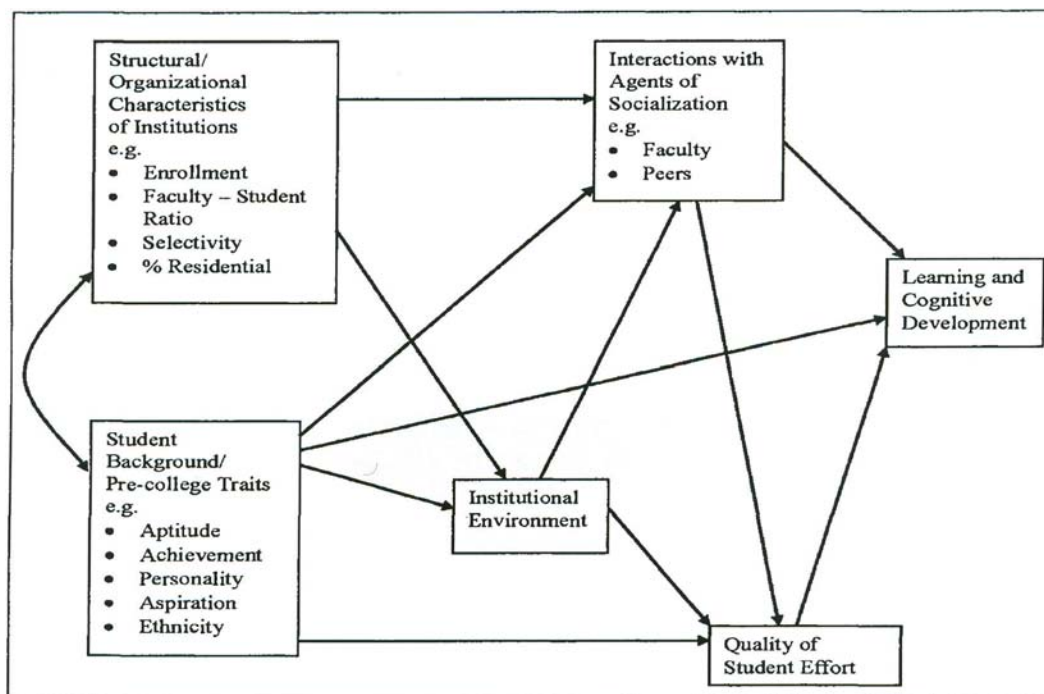
research designs with objective measures of growth rather than self-reported measures, which are prevalent in LLC research. This chapter describes the conceptual framework, research hypotheses, and methodology for a longitudinal study of the impact of LLC participation on an objective measure of critical thinking using a national sample of first-year undergraduate students.

Conceptual Framework

The conceptual framework for this study was based on Astin's (1993) input-environment-output (I-E-O) model and Pascarella's (1985) general causal model for assessing the effects of differential environments on student learning and cognitive development. The I-E-O model conceptualizes a longitudinal framework to assess the unique impact of students' background characteristics (e.g., gender, race/ethnicity, ability) and the environmental effects of LLC participation on students' outcomes (e.g., critical thinking). Pascarella's model, illustrated in Figure 3.1, provides a theoretical foundation for multi-institutional studies and allows for estimating the direction and effect size of independent variables (e.g., academic ability, LLC) or mediating variables (e.g., interaction with faculty, academic effort) on the dependent variable of critical thinking.

Pascarella's model allows for an estimate of growth in critical thinking as a function of direct and indirect effects. The conceptual framework considers participation in an LLC as a causal mechanism for growth in critical thinking during the first year of college, controlling for student background and institutional characteristics, and the potential mediating effects of interactions within the college environment. Figure 3.2 represents the conceptual model used for this study, organizing Pascarella's model within the I-E-O model. The general causal model for assessing the effects of differential environments on student learning and cognitive development is primarily concerned with five main sets of variables.

Figure 3.1 General Causal Model for Assessing the Effects of Differential Environments on Student Learning and Cognitive Development



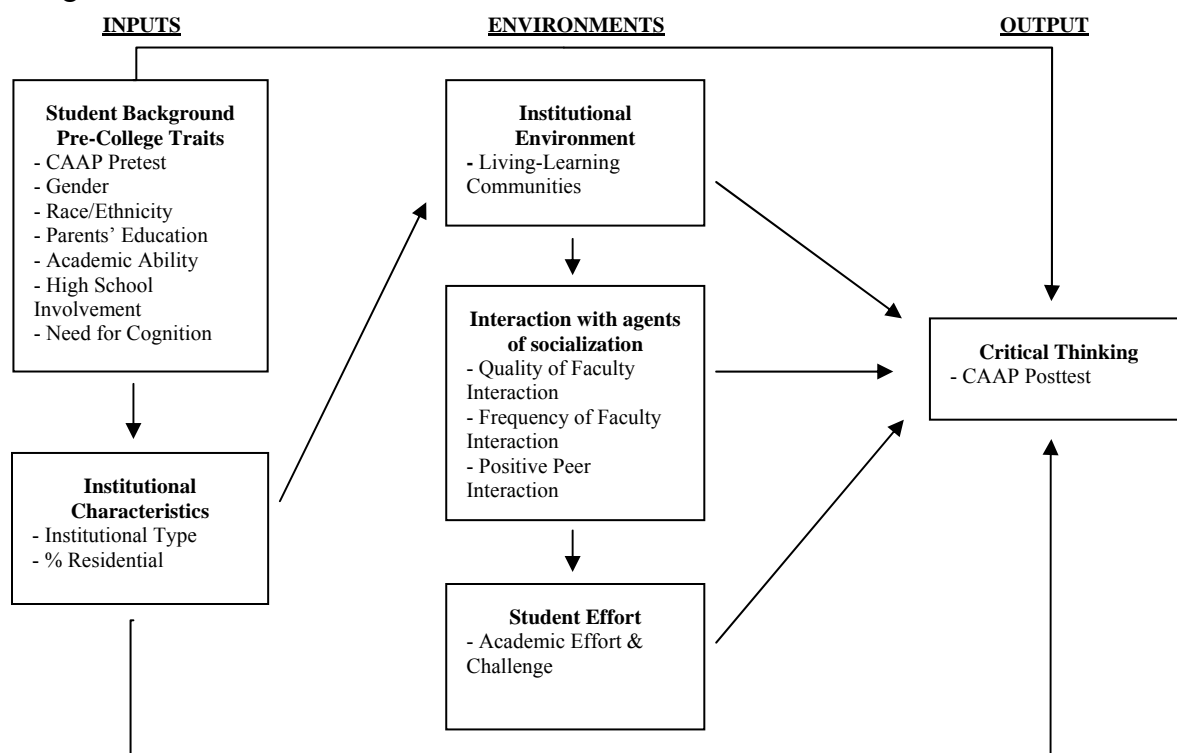
Source: Pascarella, E. T. (1985). College environmental influences on learning and cognitive development: A critical review and synthesis. *Higher Education: Handbook of Theory and Research*, 1, 1-61.

The input variable blocks included both institutional characteristics and student backgrounds and pre-college traits. Student background and pre-college traits represented the first set of variables. Student background characteristics included gender, race/ethnicity, parents' education, pre-college academic ability, high school involvement, and need for cognition. Students' pretest and posttest critical thinking scores were measured by the Collegiate Assessment of Academic Proficiency (CAAP) test, administered by ACT. Students' pretest scores on critical thinking were also included as a pre-college trait.

The second set of variables was the structural/organizational characteristics of institutions. The organizational characteristics of the institution were represented by the percentage of all undergraduate students on campus and also by separating the 19

institutions in the sample by Carnegie classification. The institutional types included in the sample were research universities, regional universities, and liberal arts colleges.

Figure 3.2 General Effects Model



The institutional environment in Pascarella's model was considered the third set of variables, expressed in this study as a binomial variable: participation in an LLC or living in a traditional residence hall environment.

Pascarella's causal model assumed that institutional environments are largely indirect effects mediated by interactions and effort within the institutional environment. This study used four composite scales derived from Chickering and Gamson's (1987) principles of good practice in undergraduate education relevant to out-of-classroom experiences to estimate mediating effects. Specifically, the following experiences were assessed: (a) quality of interactions with faculty, (b) frequency of interactions with faculty, (c) degree of positive interactions with peers, and (d) academic effort and

challenge. The fourth set of variables was faculty and peer interaction. The fifth set of variables was individual student academic effort and challenge. These composite scales helped to estimate direct and indirect effects of student and institutional background characteristics and LLC participation on growth in critical thinking.

The outcome variable was end-of-year critical thinking. In this study, the posttest of the CAAP estimated a standard measure of critical thinking at the end of the first year of college.

Figure 3.2 provides an illustration of the conceptual model of this study. Specifically, the first regression equation estimated the direct impact of student background and pre-college traits on end of first-year critical thinking. The second regression equation explored the influence of institutional characteristics on end-of-year critical thinking. The third regression equation addressed the unique impact of LLC participation on critical thinking. The fourth and fifth regression equations investigated if any effects in the first, second, and third equations became non-significant when mediated by faculty and peer interactions or student effort and challenge, respectively. In this study, change in critical thinking was considered as a function of student background and institutional characteristics, participation in LLCs, and other college experiences.

Research Hypotheses

In this study, three research hypotheses were explored.

Hypothesis 1: Net of background characteristics (e.g., pre-college academic ability, demographic characteristics) and other influences (i.e., faculty and peer interactions, academic effort and engagement), students who participate in LLCs will demonstrate greater gains on a standardized measure of critical thinking than their peers in traditional residence hall environments.

Hypothesis 2: Any significant positive effects of participation in LLCs will be conditional on student background, institutional characteristics, degree of interaction with faculty and peers, and academic effort.

Hypothesis 3: Students participating in LLCs are more likely than students in traditional residence halls to be exposed to principles of good practice in undergraduate education.

Methodology

This study used a longitudinal (pretest and posttest) cohort research design in the first phase of data analysis and a post-hoc analysis of conditional effects in the second phase of data analysis. The experimental group included first-year students who self-identified as participating in an LLC. The control group was first-year students who lived in on-campus residence halls and did not identify as participating in an LLC. Selection of groups was non-randomized due to students' self-selecting to live in either LLCs or traditional residence hall environments.

Institutional Sample

The WNSLAE was a large, multi-institutional study that used a longitudinal research design to “explore critical factors that affect the outcomes of a liberal arts education” (www.liberalarts.wabash.edu). The WNSLAE had two fundamental goals: (a) to learn what teaching practices, programs, and institutional structures support liberal arts education; and (b) to develop methods of assessing liberal arts education (www.liberalarts.wabash.edu). The WNSLAE focused on seven outcomes associated with a liberal arts education: (a) effective reasoning and problem solving (including critical thinking), (b) inclination to inquire and lifelong learning, (c) integration of learning, (d) intercultural effectiveness, (e) leadership, (f) moral reasoning, and (g) well-being (Seifert et al., 2008).

Sixty institutions responded to a national invitation to participate in the WNSLAE. Beginning in 2006, the WNSLAE included a purposive sample of 19 colleges and universities. The WNSLAE continued in 2007 and 2008 and included a total of 53 colleges and universities and over 17,000 respondents. The multi-institutional sample represented 20 different states from the Northeast, Southeast, Midwest, and Pacific Coast

regions of the United States. Institutional types represented large research universities, regional comprehensive universities, liberal arts colleges, and community colleges. These institutions represented national differences in institutional types, selectivity, control, size, location, and patterns of student residence. The WNSLAE focused primarily on liberal arts outcomes, so there was an over sampling of liberal arts colleges. Undergraduate enrollments varied between 750 and 23,000, with entering classes between 225 and 5,300 students.

Including data from the 2006, 2007, and 2008 cohorts of the WNSLAE allowed for adequate statistical power to estimate both general and conditional effects. Community colleges were excluded from the current study because of a lack of representative residential students in both the experimental and the control groups. Twenty-three institutions without an adequate number of students in both the control group and the experimental group were also excluded from the analysis. Thirty institutions had at least five students who identified as participating in LLC and at least 5 students who lived in traditional residence halls who also completed the CAAP. Because participation in the LLC was a self-reported variable, follow-up calls were made to residence life offices at each of the remaining colleges to request information about the LLC environment. An additional 11 institutions were dropped from the sample because of limited or no information regarding a formal LLC program during the cohort year. According to the 2005 Carnegie classification of institutions, the final institutional sample included six institutions considered as research universities, five as regional universities (non-doctoral granting), and eight as liberal arts colleges. Table 3.1 illustrates the institutional characteristics of the final sample including cohort year, geographic region of the United States, 2005 Carnegie classification, and general information about LLC participation available to first-year students.

Table 3.1 Institutional Sample

School ID	Cohort	Geographic Region (U.S.)	2005 Carnegie Classification (IPEDS)	Selectivity (IPEDS)	% Undergrads On-Campus (IPEDS)	Student-Faculty Ratio (IPEDS)
5	2006	Southeast	Research Universities (very high research)	More Selective	33%	18:1
3	2006	Great Lakes	Research Universities (very high research)	Most Selective	37%	12:1
41	2007	Southeast	Research Universities (very high research)	Least Selective	41%	18:1
51	2008	Southeast	Research Universities (high research)	Most Selective	63%	7:1
66 (same as 35)	2008	New England	Research Universities (high research)	Selective	45%	21:1
35 (same as 66)	2007	New England	Research Universities (high research)	Selective	40%	21:1
15	2006	Great Lakes	Master's Colleges and Universities (larger programs)	More Selective	61%	11:1
18	2006	Southeast	Master's Colleges and Universities (larger programs)	More Selective	27%	19:1
49	2008	Mid East	Master's Colleges and Universities (larger programs)	Selective	32%	21:1
33	2007	New England	Master's Colleges and Universities (larger programs)	More Selective	80%	12:1
17	2006	Far West	Master's Colleges and Universities (medium programs)	Selective	12%	23:1
34	2007	Great Lakes	Baccalaureate Colleges--Arts & Sciences	Less Selective	77%	13:1
61	2008	New England	Baccalaureate Colleges--Arts & Sciences	Less Selective	79%	14:1
13	2006	Great Lakes	Baccalaureate Colleges--Arts & Sciences	More Selective	80%	11:1
70	2008	Mid East	Baccalaureate Colleges--Arts & Sciences	More Selective	92%	11:1
10	2006	New England	Baccalaureate Colleges--Arts & Sciences	More Selective	99%	8:1
53	2008	Great Lakes	Baccalaureate Colleges--Arts & Sciences	More Selective	88%	15:1
45	2008	Plains	Baccalaureate Colleges--Diverse Fields	Most Selective	89%	9:1
11	2006	Plains	Baccalaureate Colleges--Diverse Fields	More Selective	80%	11:1

Note: IPEDS = Integrated Postsecondary Education Data System

Student Sample

The students who completed the WNSLAE were first-year, full-time undergraduate students at each of the colleges and universities. For the large research universities, the initial student sample was randomly selected from the incoming first-year class at each institution. For the largest institution, the sample was selected randomly from the incoming class in the College of Arts and Sciences. For the regional, liberal arts, and community colleges, the sample consisted of the entire incoming first-year class.

The students in the sample were invited to take part in a longitudinal study examining how college education affects students, with the goal of improving the undergraduate experience. Students received a monetary stipend each time they participated in the study. Students were assured that their responses would be kept confidential and would not become part of their institutional records.

Table 3.2 illustrates how the initial WNSLAE student sample differed from the final sample. The 2006, 2007, and 2008 cohorts represent a total original sample of 17,504 students.

Table 3.2 Student Sample

	Living-Learning Communities	Traditional Residence Halls	Off-Campus Students	Total Sample
Starting Sample	1,556	5,543	10,405	17,504
Live-On Campus	1,556	5,543	0	7,099
Critical Thinking T1	757	2,635	0	3,392
Critical Thinking T2	690	2,409	0	3,099
Final Sample	435	1,282	0	1,717

These students were asked, “Which of the following best describes where you are living now while attending college?” Forty-one percent ($n = 7,099$) of the original sample responded “dormitory or other campus housing (not fraternity/sorority).” Students were

also asked to “indicate if you have or have not participated in a living-learning community where your residence was connected to an academic program.” Twenty-one percent ($n = 1,556$) of students indicating “yes” to this question were placed in the experimental group. Seventy-six percent ($n = 5,543$) responding “no” to this question were placed in the control group. Two percent ($n = 164$) of students did not respond or gave multiple responses and were excluded from analysis.

The CAAP test was administered to half of the original sample selected by simple random sampling. Forty-nine percent ($n = 757$) of students in the experimental group and 48% ($n = 2,635$) of students in the control group completed the initial CAAP. Follow-up data collection yielded an 8.6% mortality response rate with a sub-sample population of 3,099, with 690 students in the experimental group and 2,409 students in the control group. Institutions without adequate representation in both the experimental and the control groups were eliminated from the sample. The final sub-sample included 435 (25%) students in the experimental group (students participating in LLCs) and 1,282 (75%) students in the control group (students living in traditional residence halls).

The instrument did not control for non-response bias; however, a weighting algorithm was developed to adjust for potential response bias by gender, race/ethnicity, and academic ability.

Data Collection

In the 2006, 2007, and 2008 cohorts, 17,504 students from the 53 institutions completed the WNSLAE precollege survey that sought information on student background characteristics, family background, high school experiences, political orientation, educational degree plans, and other relevant demographic information. Entering first-year students were surveyed at the beginning of the fall semester and again at the end of the spring semester. Survey collection was conducted by computer at each student's home institution. The fall semester determined the cohort assignment. For example, students who took the WNSLAE pre-college survey in the fall 2006 semester

and were surveyed again in the spring 2007 semester were assigned to the 2006 cohort. This pattern continued for the 2007 and 2008 cohorts.

At the time of the initial and follow-up surveys, all students were considered first-time freshmen enrolled for at least 12 credit hours. The WNSLAE instrument took approximately 90-100 min to complete, and students received \$50 for each time they completed the survey. Students were asked to “indicate if you have or have not participated in a learning community where you and a group of students took two or more classes together.” To clarify between a learning community and a living-learning community, students were then asked to answer yes or no to the statement: “Indicate if you have or have not participated in a living-learning community where your residence was connected to an academic program.” Multiple responses and non-responses were discarded because of unclear student responses

To minimize the time required of each student in the data collection, and because another outcome measure was used that required approximately the same administration time, the CAAP critical thinking test was randomly assigned to half the sample. The CAAP is a 40-min, 32-item standardized measure of critical thinking. The CAAP was administered as one component of the 90-min test. The CAAP 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 test requires students to read passages commonly found in higher education curricula. After reading the passages, students are required to choose a multiple-choice response that best supports a general conclusion about the series of arguments presented in the passage. The test is divided into three sections: analysis of elements of an argument, evaluation of an argument, and extension of an argument.

Variables

The conceptual framework was operationalized by assigning specific variables to represent institutional and student characteristics, behaviors, and experiences. Table 3.3 outlines the student and institutional independent variables used in the data analysis. These variables were coded by research assistants from the Center for Research in Undergraduate Education at The University of Iowa.

Students' beginning-of-college score on the CAAP was a continuous variable. Students' gender was a dummy variable distinguishing male and female students. Race/ethnicity was also a dummy variable distinguishing White and minority students. Socioeconomic status was considered as parents' education, measured by a continuous scale, with a higher number representing average years of school completed. Instead of considering COMPASS, ACT, and SAT scores separately, the WNSLAE used a common metric of academic ability. Student background characteristics included two composite scales: high school involvement ($\alpha = .596$) and need for cognition ($\alpha = .892$). The high school involvement scale represented a mean score of student's pre-college interactions with faculty and peers and participation in activities. Need for cognition represented the degree to which students "engage in and enjoy effortful cognitive activities" (Cacioppo, Petty, Feinstein, & Jarvis, 1996, p. 197). The higher need for cognition score denoted a greater need to engage in and enjoy cognitive activities.

Respondents were coded by home institution and then grouped by the institution's Carnegie classification for all cohort years. Institutions represented three separate groups of Carnegie classifications coded as three separate dummy variables. The three groups of cohort year were also coded as three separate dummy variables.

Students self-reported LLC participation. LCC participation was a dummy variable indicating a student's choice to participate or not participate in an LLC. All students in the final sample lived in university- or college-owned residence halls and not in Greek housing.

Table 3.3 Summary of Independent Variables

Student Background Characteristics	
Beginning of First-year Critical Thinking	Individual score on the CAAP Critical Thinking pretest
Gender	0 = female, 1 = male
Race/Ethnicity	0 = minority, 1 = white
Average Parents' Education (At least one parent)	Continuous variables averaged by year of school (for example, 16 = College Graduate)
Academic Ability	Common metric of precollege academic ability
High School Involvement Alpha = .596	7-item composite scale for high school involvement
Need for Cognition Alpha = .886	Degree to which one enjoys engaging in effortful cognitive activities
Organizational Characteristics of Institutions	
Variable Label	Variable Definition
Institutional Type	Research university Liberal arts college Regional university
% Residential	Institutional percent of total undergraduates living in on-campus housing
Cohort	2006 2007 2008
Institutional Environment	
Residential Status	0 = Traditional Residence Hall, 1 = Living-Learning Community

Students' interactions with faculty and peers and their individual academic challenge were considered to be mediating rather than moderating influences between LLC participation and critical thinking. Moderating variables define when a relationship does or does not exist between an independent variables (e.g., LLC) and a dependent variable (e.g., critical thinking), whereas mediating variables define the extent to which a relationship exists when considered through an intervening influence (Baron & Kenny, 1986). Students experienced varying degrees of interaction and effort within the LLC. It was assumed that non-classroom faculty and peer interaction as well as academic

challenge and effort occurred within both LLCs and traditional residence halls. Figure 3.4 outlines the mediating variables used in the data analysis.

Table 3.4 Summary of Mediating Variables

Interaction and Effort	
Quality of non-classroom interactions with faculty Alpha = .865	A 5-item composite scale of the frequency of interaction with faculty
Frequency of non-classroom interaction with faculty Alpha = .732	A 4-item composite scale of the quality of non-classroom interactions with faculty
Degree of positive peer interactions Alpha = .857	A 8-item composite scale of the degree of positive peer interactions
Academic challenge and high expectations Alpha = .868	A 31-item composite scale that assesses academic challenge and effort

The mediating variables were considered as composite scales, aggregated by factor analysis, of students' interaction and effort in the college environment. All of the mediating (continuous) variables were collected in the follow-up survey. Internal consistencies (α) were calculated for the subsample of LLC students and students in traditional residence halls. The mediating variables were the quality of out-of-classroom interactions with faculty ($\alpha = .865$), frequency of out-of-classroom interactions with faculty ($\alpha = .732$), degree of positive peer interaction ($\alpha = .857$), and academic challenge and effort ($\alpha = .868$).

Reliability

Reliability refers to respondent's performance consistency on a specified measure. Estimates of reliability give an approximation of the degree of measurement error. Measurement error is the difference between the actual value of a characteristic or behavior and the value attributable to random chance or systematic implementation of an

instrument. This section discusses the reliability of each variable included in the conceptual framework.

The most common estimate of reliability is the internal consistency reliability, which measures the level of agreement between generally unobservable student characteristics and traits. Osborne, Christensen, and Gunter (2001) found that the average internal consistency (Cronbach's alpha) in top educational and psychology journals was .83. The critical thinking portion of the CAAP, administered by ACT, had an internal consistency reliability range between .81 (Spearman-Brown) of .85 (Kuder-Richardson) for multiple populations of first-year students (ACT, 2007). ACT did not report test-retest reliability for the CAAP. Test-retest reliability refers to the reliability of a measure over time. The critical thinking portion of the CAAP has previously demonstrated a mean difference score of 1.7 from the beginning of freshman year to sophomore year.

Responses to the CAAP pretest and posttest were weighted up to each institution's undergraduate population by gender, race/ethnicity, and ACT quartile or equivalent. This weighting algorithm, developed by ACT, makes the overall sample more similar but does not account for non-response bias.

School files provided information on each student's gender and race/ethnicity. The school file responses were checked for consistency against a self-reported response in the WNSLAE: students' self-reported mother's and father's years of schooling completed. Although the evidence is somewhat dated, Kayser and Summers (1973) found in an investigation of socioeconomic status indicators that students' self-reports of parents' education were stable over time and were better indicators than parents' income or occupation. The WNSLAE used a common metric of students' academic ability by using school file information from students' ACT, SAT and COMPASS test scores. Pike (1989) found that ACT scores accounted for 30% of the variance in critical thinking. These tests have been widely used as a measure of academic ability at colleges and universities across the United States.

It is also important to note that internal consistency measures, such as a Cronbach's alpha, are sample specific. Reducing the sample from 17,504 to 1,717 made it appropriate to calculate and compare Cronbach's alphas between the WNSLAE sample and the subsample used in this study, illustrated in Table 3.5. The researchers involved in the WNSLAE previously completed calculations of Cronbach's alphas. The composite scales resulted in the following alpha reliability for high school involvement ($\alpha = .584$), need for cognition ($\alpha = .886$), quality and frequency of non-classroom interactions with faculty ($\alpha = .865$ & $.702$, respectively), degree of positive peer interaction ($\alpha = .871$), and academic challenge and effort ($\alpha = .879$). Cronbach's alphas were recalculated for the sample used in this study and demonstrated trivial differences in internal reliability compared to the WNSLAE sample. Sample-specific internal consistencies for the composite scales were .596 for high school involvement, .892 for need for cognition, .865 for quality of faculty interaction, .702 for frequency of faculty interaction, .871 for positive peer interaction, and .879 for academic challenge and effort. It is reasonable to conclude that the reliability of the sample for this study did not differ greatly from the reliability of the larger WNSLAE sample.

Table 3.5 Internal Consistencies of Composite Scales

	WNSLAE Sample	Final LLC/TRH Sample
Sample Size	n = 17,504	n = 1,717
High School Involvement	.584	.596
Need for Cognition	.886	.892
Quality of Faculty Interaction	.854	.865
Frequency of Faculty Interaction	.702	.732
Positive Peer Interaction	.871	.857
Academic Challenge and Effort	.879	.868

Note: WNSLAE = Wabash National Study of Liberal Arts Education; LLC = living learning community; TRH = traditional residence hall.

Students self-reported whether they participated in an LLC. Students were asked to indicate whether they participated in an LLC in which residence was connected to an academic program. Although the final sample included 435 students responding that they did participate in an LLC, an additional 137 students were excluded from the final sample because even though they identified as participating in an LLC, their college or university did not have a formal LLC program. To make a more conservative estimate of the reliability of participation in an LLC, the final sample included only students who attended institutions with formal LLC programs at the time of data collection.

The general effects model for this study offered an overall tradeoff in reliability compared to the current LLC literature. Previous studies used institutional data to identify LLC participation and self-report outcome variables like critical thinking, whereas this study used a self-report of LLC participation and a standardized measure of critical thinking.

Validity

Validity refers to the accuracy of representing the respondent's experiences relative to a desired outcome. Despite a significant limitation in internal validity with regard to the lack of information about the LLC environment, by using a standardized measure of critical thinking, a longitudinal research design, and a multi-institutional sample, this study makes several contributions to an understanding of the relationship between LLC and critical thinking.

Lack of Information About the LLC Program Type

Students self-reported whether they participated in an LLC in which their residence was connected to an academic program. A significant limitation of this study was the lack of data on the LLC program type and intent. Secondary analysis of the WNSLAE forces the assumption that all LLCs in this study had the same purpose, function, resources, and collaboration between academic and student affairs. Inkelas and Soldner (2011) argued that "combining multiple LLC together...in a LLC versus non-

LLC comparison...may mask differences among programs, as well as stimulate erroneous inferences" (p. 82). They cautioned that aggregating LLC participation into a binomial variable threatens the internal validity of the LLC literature and increases the likelihood of comparing apples to oranges.

It is a fair conclusion that it may not be appropriate to compare the outcome of change in critical thinking as analogous between an LLC focused on wellness issues and an LLC focused on a specific academic discipline, such as engineering. Several studies have tried to develop programmatic and structural typologies with results grouping LLCs into three types (Schoem, 2004), five types (Zeller et al., 2002), to as many as 41 types (Inkelas et al., 2004) later refined to 17 types (Inkelas et al., 2007). To build support for an LLC typology, Inkelas et al. (2008) categorized the 26 programmatic themes into three LLC types differing by size, financial and staff resources, and collaboration between academic and student affairs. Inkelas and her colleagues showed differences in student outcomes between LLC types. Students in large, comprehensively resourced LLCs with high collaboration between student affairs and academic affairs demonstrated statistically lower ($p \leq .01$) self-reported growth in critical thinking ability than students in small and medium sized programs. Although these studies compared LLC students with other LLC students, the findings showed small differential effects among LLC types. This study adds to the literature by attempting to expand on the findings of LLC students' self-reported growth in critical thinking using a longitudinal research design and a standard measure of critical thinking.

Standardized Measure of Critical Thinking

Previous research reported a positive relationship between LLC participation and a self-reported measure of critical thinking (Inkelas, et al., 2006; Kohl, 2009; Schein, 2005). This study used the CAAP as an objective measure of critical thinking. Pascarella (2001) and Pike (1996) discussed the positive correlation between students' self-reports compared with standard measures but noted the disparate internal validity of student self-

reports of college outcomes. Additionally, Bowman (2010) provided empirical evidence that first-year students' self-reports of critical thinking differed from longitudinal standardized measures of critical thinking. Thus, it is possible that although students perceived they were developing critical thinking skills, they may have been overestimating that growth.

Longitudinal Research Design

In higher education research, students' choice to participate or not participate is a problem in evaluating educational programs (Pascarella & Terenzini, 2005). When a student selects to participate in a program, he or she is making a choice to participate in the experimental group rather than in random selection by the researcher. This lack of random assignment may increase the presence of Type I errors (that is, false positives), determining a significant finding when it is actually not significant. Selection bias or students' choice to participate in an LLC versus living in a traditional residence hall threatens the internal validity of LLC research. Reynolds and DesJardins (2009) and Schneider et al. (2007) advocated for research in higher education to address issues of selection bias with methods such as propensity score matching to improve the precision and accuracy of the impact of college on students (cited in Titus, 2007). Propensity score matching uses logistic regression to estimate a composite score using known observed values. The primary benefit of using propensity score matching compared with conventional matching is that propensity scores match subjects on one score rather than on multiple variables (Rosenbaum & Rubin, 1984). Students who choose to participate in an LLC may be fundamentally different from their peers who choose not to participate.

More recent research suggests that propensity scores matching may only be needed in cross-sectional research using non-parametric analyses such as chi-square, one-way ANOVA, paired t-tests, or other statistical comparisons of means or variance. Shah et al. (2005) found that traditional regression in observational studies gave similar results to propensity scores matching. A longitudinal research design that includes a pretest

measure of the outcome variable may be more important in obtaining an unbiased estimate of the impact of critical thinking than other statistical procedures (e.g., propensity score matching, covariate adjustment) that approximate adjustment for students' advantaged backgrounds (Padgett et al., 2011). Including a pretest measure of critical thinking in the regression equation reduces the selection effect and allows for an approximation of general effects of LLC participation on posttest critical thinking.

The longitudinal research design also allows for an estimate of change in critical thinking. Pascarella, Wolniak, and Pierson (2003) found that by regressing the pretest measure in addition to other independent variables on the posttest measure, it was possible to estimate gains in the critical thinking. Therefore, by including a pretest measure of critical thinking in the regression equation, it was possible to approximate if students who participated in an LLC made greater gains or change in critical thinking than did students who did not participate in an LLC.

Multi-Institutional Sample

Table 3.6 illustrates the LLC programs available in each of the 19 institutions in the final sample. Research universities offer a wide variety of LLC types compared to liberal arts colleges, which may offer only one LLC type focused on wellness or the transition to college.

This study is the first national LLC study to include liberal arts colleges in the institutional sample. Other national LLC studies, such as the NSLLP, included only large research universities and mid-sized regional institutions. Liberal arts colleges, compared to larger institutions, consistently demonstrate institutional learning environments that facilitate greater exposure to the principles of good practice in higher education, including effective teaching, interactions with faculty, and high expectations.(Pascarella, Wolniak, et al., 2004; Pascarella et al., 2005; Seifert et al., 2010). Comparing liberal arts colleges with large research universities and regional institutions will help to explain if LLCs can influence critical thinking at different types of institutions.

Table 3.6 LLC by Institution

School ID	2005 Carnegie Class	LLCs Available to First-Year Students by Institution
5	Research Universities (very high research)	Civic/Social Leadership Programs, Cultural Programs, Disciplinary Programs, Fine & Creative Arts Programs, General Academic Programs, Honors Programs, ROTC Programs, Wellness Programs
3	Research Universities (very high research)	Civic/Social Leadership Programs, Cultural Programs, Disciplinary Programs, Fine & Creative Arts Programs, General Academic Programs, Honors Programs, Research Programs, Residential College, Women's Programs
41	Research Universities (very high research)	Civic/Social Leadership Programs, Cultural Programs, Disciplinary Programs, Honors Programs, Umbrella Programs
51	Research Universities (high research)	Civic/Social Leadership Programs, Cultural Programs, Disciplinary Programs, Transition Programs
66 (same as 35)	Research Universities (high research)	Disciplinary Programs, Fine & Creative Arts Programs, General Academic Programs, Umbrella Programs
35 (same as 66)	Research Universities (high research)	Disciplinary Programs, Fine & Creative Arts Programs, General Academic Programs, Umbrella Programs
15	Master's Colleges and Universities (larger programs)	Transition Programs
18	Master's Colleges and Universities (larger programs)	Cultural Programs, Honors Programs
49	Master's Colleges and Universities (larger programs)	Transition Programs
33	Master's Colleges and Universities (larger programs)	Wellness Programs, Women's Programs
17	Master's Colleges and Universities (medium programs)	Cultural Programs, Disciplinary Programs, Fine & Creative Arts Programs, Honors Programs
34	Baccalaureate Colleges- Arts & Sciences	Cultural Programs
61	Baccalaureate Colleges- Arts & Sciences	Transition Programs
13	Baccalaureate Colleges- Arts & Sciences	Civic/Social Leadership Programs
70	Baccalaureate Colleges- Arts & Sciences	Transition Programs
10	Baccalaureate Colleges- Arts & Sciences	Wellness Programs
53	Baccalaureate Colleges- Arts & Sciences	Civic/Social Leadership Programs, Cultural Programs, Women's Programs
45	Baccalaureate Colleges- Diverse Fields	Cultural Programs, Women's Programs
11	Baccalaureate Colleges- Diverse Fields	Civic/Social Leadership Programs, Cultural Programs, Wellness Programs

The general effects model contributes to the current LLC research by using a standardized measure of critical thinking, a longitudinal research design, and a multi-institution sample. These strengths of the present study do not trivialize the weakness of a binomial LLC variable, but they do add to the internal and external validity by illustrating if LLC participation, considered as a general institutional intervention, can significantly influence growth in critical thinking.

Data Analysis

To address the research hypotheses, Ordinary Least Squares (OLS) regression was used to analyze the impact of student background characteristics, LLC participation, interaction with faculty and peers, and academic effort on end-of-year critical thinking. Heck and Thomas (2001) recommended using Hierarchical Linear Modeling (HLM) to address the nested nature of students being clustered within institutions. HLM statistical analysis is used to account for institutional-level differences, and because the research questions in this study focused on student-level experiences, statistical procedures outlined by Groves et al. (2004) were used to adjust for standard errors and account for the clustering effect of multi-institutional data.

The first step in data analysis was to limit WNSLAE data to the desired sub-sample of residence hall students who completed the CAAP pretest and posttest. The desired residential sub-sample was obtained by selecting cases of students who responded to Question 17 of the WNSLAE, "Which of the following best describes where you are living now while attending college?" Respondents were asked to choose between dorms/on-campus or off-campus. Additional criteria for case selection were students living in on-campus residences who completed both the CAAP pretest and posttest.

End of first-year critical thinking scores were regressed on LLC, controlling for pretest scores, gender, race/ethnicity, parents' education, precollege academic ability, high school involvement, and need for cognition. A second regression equation with the addition of institutional characteristics identified the unique impacts of institutional type,

percentage of students living on campus, and WNSLAE cohort years. Inkelas and Soldner (2011) recommended stepwise inclusion of LLC variables to account for parameter invariance and to parcel out the regression coefficients of LLC that may be significantly different from the rest of the regression equations. A third regression model including LLC in the second regression equation identified the unique effects of LLC participation on end-of-year critical thinking. A fourth regression equation included the three composite scales of faculty and peer interaction and allowed for estimates of direct and indirect effects of LLC participation. Finally, the fifth regression equation included the composite measure of students' academic challenge and effort as the last mediating variable. The general effects model estimated the statistical significance of the indirect effect of LLC through interaction with faculty, peers, and academic challenge and effort using Sobel's procedure for the significance of mediated effects (Preacher & Leonardelli, 2001).

The second part of data analysis tested if the net effects of LLC on end-of-year critical thinking were conditional on student background and pre-college traits, institutional characteristics, or the degree to which students interacted with faculty and peers, and experienced academic challenge. Comparing outcomes of critical thinking between students in LLCs and students in traditional residence halls created a conditional stratification of comparing students with similar backgrounds and abilities. Estimating conditional effects identified for which students LLCs were the most effective in developing critical thinking skills. To test for the presence of conditional effects, cross-product terms for each independent and mediating variable were added to the general effects model. Any additional statistically significant increase in explained variance (R^2) indicated the presence of conditional effects, which were examined further (Pedhazur, 1982).

CHAPTER IV

RESULTS

The purpose of this study was to estimate the direct and indirect effects of first-year student participation in an LLC compared with living in a traditional residence hall on an objective measure of critical thinking. This was the first LLC study to (a) use a longitudinal design with a pretest measure of the dependent variable, (b) use a standardized measure of critical thinking, (c) include liberal arts colleges in the institutional sample, and (d) control for the selection effect of student's choice to participate in an LLC. This chapter explores the general effects of LLC participation on end-of-first-year critical thinking, controlling for students' pre-college characteristics, institutional type, interaction with faculty and peers, and individual academic engagement. Next, data analysis explores whether the effects of LLC on critical thinking were conditional on advantaged student background and ability, institutional type and percentage of students on campus, or the degree to which LLCs facilitate interaction and academic engagement. Finally, this chapter explores whether students in LLCs were more likely than students in traditional residence halls to experience principles of good practice in undergraduate education.

Sample Profile

This study used data from the Wabash National Study of Liberal Arts Education (WNSLAE) from the 2006, 2007, and 2008 cohort years. The final sample included 1,717 first-year students who lived in on-campus housing and completed the CAAP pretest early in the fall semester and the CAAP posttest late in the spring semester. The experimental group within the final sample included 435 students who identified that their residence was connected to an academic program. The control group included 1,282 students who did not identify that their residence was connected to an academic program. Students participating in LLCs, the experimental group, represented 25.3% of the final sample. The final sample included institutions with adequate representation in both the

experimental and control groups. Table 4.1 illustrates weighted mean and standard deviations for all variables included in this study.

Table 4.1 Weighted Means and Standard Deviations

<u>Variable Name</u>	<u>Mean</u>	<u>Standard Deviation</u>
End of First-year Critical Thinking	61.20	5.78
Beginning of First-year Critical Thinking	60.78	5.39
Gender – Male	0.42	0.49
Race/Ethnicity – White	0.73	0.45
Average Parents' Education	15.09	2.09
Academic Ability	24.12	4.25
High School Involvement	3.66	0.57
Need for Cognition	3.28	0.59
Institutional Type – Research	0.57	0.49
Institutional Type – Regional	0.24	0.43
Institutional Type – Liberal Arts	0.18	0.39
% Residential	0.47	0.23
Cohort – 2006	0.52	0.50
Cohort – 2007	0.26	0.44
Cohort – 2008	0.22	0.41
Living-Learning Community	0.38	0.49
Quality of non-classroom interactions with faculty	-0.17	0.82
Frequency of non-classroom interaction with faculty	-0.04	0.70
Degree of positive peer interactions	-0.05	0.70
Academic Engagement	-0.11	0.43

The results in Table 4.1 illustrate a gain in average critical thinking ability, increasing from 60.78 (SD=5.39) in the pretest to 61.20 (SD=5.78) in the posttest. The final sample had more female students (58%) than male and included a larger proportion of White students (73%). The average parents' education was 15.09 (SD=2.09), representing a mean of approximately 15 years of school, with some college but no degree. The degree to which students enjoyed engaging in effortful cognitive activities had a mean score of 3.28 (SD=0.59), and students' mean high school involvement was 3.66 (SD=0.57). Most students (57%) attended the six research universities, 24% of

students attended the five regional universities, and 19% of students attended the eight liberal arts colleges. The mean percentage of total undergraduates on campus for all institutions was 47% (SD=0.23). The average ACT or equivalent test score was 24.12 (SD=4.25). Students participating in the 2006 WNSLAE represented 52% of the final sample, 26% in the 2007 cohort, and 22% in the 2008 cohort. The good practice scales were standardized across all WNSLAE respondents (N=17,504). Positive composite good practice scales represented a greater degree of exposure to good practice scales. The mean good practice scales in the sample were all negative, likely indicating that the students in the sample experienced less average exposure to good practice than the entire WNSLAE sample. The mean quality of faculty interaction was -0.17 (SD=0.82). The mean frequency of faculty interaction was -0.04 (SD=0.70). The mean positive peer interaction was -0.05 (SD=0.70). The mean academic challenge and high expectations was -0.11 (SD=0.43).

Further analysis compared representation in the experimental and control groups. Chi-square analysis was used to examine differences between binomial variables (i.e., institution type, cohort, gender, race/ethnicity). Students in LLCs represented the experimental group and students in traditional residence halls represented the control group. Within the sample, males were overrepresented in the experimental group and underrepresented in the control group ($\chi^2(1, N=1,716) = 7.95, p<.01$). Students identifying their race/ethnicity as minority were underrepresented in the experimental group and overrepresented in the control group ($\chi^2(1, N=1,716) = 13.28, p<.001$). Students in research universities were overrepresented in the experimental group and underrepresented in the control group ($\chi^2(1, N=1,716) = 26.58, p<.001$). There were no significant differences between the experimental and control groups in regional universities. Liberal arts college students were underrepresented in LLCs and overrepresented in traditional residence halls ($\chi^2(1, N=1,716) = 20.82, p<.001$). No significant differences existed between the experimental and control groups in the 2007

cohort; however, the experimental group was overrepresented in the 2006 cohort ($\chi^2(1, N=1,716) = 9.22, p<.01$) and underrepresented in the 2008 cohort ($\chi^2(1, N=1,716) = 18.33, p<.001$). Although there were several statistically significant differences between groups, the effect sizes of the binomial variables were all extremely small ($d < .004$).

Differences between continuous variables (i.e., student ability and background, percentage of students on campus, and good practice scales) were examined by using independent sample t-tests. Table 4.2 illustrates the independent sample t-test analyses. No statistically significant differences were found between students in LLCs and students in traditional residence halls on measures of parental education, academic ability, high school involvement, quality of faculty interaction, or academic student effort. Students in traditional residence halls had higher pretest and posttest CAAP scores with smaller effect sizes than students in LLC. Students in LLCs were more likely than students in traditional residence halls to enjoy engaging in effortful cognitive activities prior to coming to college. Students in LLCs were more likely to attend schools with a lower percentage of total students in on-campus housing. Students in LLCs reported a higher frequency of faculty interaction but lower positive peer interaction. The effect sizes for all continuous variables were small, with the highest effect size being .12 for frequency of faculty interaction. Some authors identified the threshold for moderate effect sizes to be .20 or higher (Urdan, 2005).

Chi-square and t-test analyses demonstrated differences within the sample between students and institutional characteristics. Although these differences could be described as trivial, they provided additional context for understanding how the sample represented the population of students in both LLCs and traditional residence halls. To accurately understand the impact of LLC participation on critical thinking, it was important to control for the influence of student inputs, institutional characteristics, interaction with others, student effort, and LLC environment (Allison, 1999; Meyers, Gamst, & Guarino, 2005). Regression analysis allowed for an estimation of the impact of

each independent variable and blocks of independent variables on the dependent variable of critical thinking.

Table 4.2 Independent Sample t-test

<i>Unequal Variance</i>			
<u>Variable Name</u>	<u>F</u>	<u>Prob> F</u>	
End of First-year Critical Thinking	23.90	.000	
Beginning of First-year Critical Thinking	17.88	.000	
High School Ability	6.65	.010	
% Residential	31.88	.000	
Frequency of Faculty Interaction	13.37	.000	
<u>Variable Name</u>	<u>Mean Difference</u>	<u>Sig.</u>	<u>Effect Size</u>
End of First-year Critical Thinking	-1.64	***	Small
Beginning of First-year Critical Thinking	-1.28	***	Small
High School Ability	-0.63	*	Small
% Residential	-0.07	***	Small
Frequency of Faculty Interaction	0.15	***	Small
<i>Equal Variance</i>			
<u>Variable Name</u>	<u>Mean Difference</u>	<u>Sig.</u>	<u>Effect Size</u>
Positive Peer Interaction	-0.76	*	Small

*** <.001; ** <.01; * <.05

General Effects Model

Hypothesis 1 of this study stated that net of background characteristics (e.g., pre-college academic ability, demographic characteristics) and other influences (i.e., faculty and peer interactions, academic effort and engagement), students who participate in LLCs will demonstrate greater gains on a standardized measure of critical thinking than their peers in traditional residence hall environments.

Ordinary least squares (OLS) regression was used to explore the relationships among critical thinking, student and institutional characteristics, the residence hall environment, interaction with faculty and peers, and individual student engagement. In multi-institutional studies, students are more likely to have similar backgrounds, abilities,

and experiences within each institution than across institutions. This clustering or nesting of similar students within each institution can result in type II errors of underestimating standard errors in the regression equation (Ethington, 1997; Raudenbush & Bryk, 2001). Heck and Thomas (2008) recommended using Hierarchical Linear Modeling (HLM) as the statistical technique to account for clustering of students within each institution. Because this study used individual students as the unit of analysis, and HLM was used to account for institutional-level differences, there was no conceptual justification for using HLM. This study used Stata 11.0 to control for clustering by assigning an importance weighting algorithm to adjust for standard errors, similar to HLM, and to account for any nesting or clustering of students within each institution (Groves et al., 2004).

Astin and Denson (2009) suggested using OLS regression when there is interest in the temporal order of longitudinal data and when the emphasis is on estimating the direct and indirect effects of independent variables. OLS regression is the most widely used (Allison, 1999) and the best method (Meyers et al., 2005) to predict a quantitatively measured dependent variable using several independent variables. As such, this study used OLS regression to identify direct and indirect effects of student and institutional characteristics, LLC participation, and principles of good practice in undergraduate education on growth in critical thinking during the first year of college. To understand the direct effects of student background, institutional characteristics, and participation in LLCs on critical thinking, as well as the indirect effects of these variables mediated by interaction with faculty and peers and individual student effort, the researcher input blocks of independent variables into the regression equation. As noted earlier, the final sample included 19 colleges and universities throughout the United States. Although Stata 11.0 controlled for clustering within each institution, the OLS analysis was limited to using 18 variables (that is, $N-1$). The general effects model included 17 variables with the last available variable used in post-hoc analysis of conditional effects by including cross products of LLC and all other input variables.

Assumptions of OLS Regression

Prior to running OLS regression, the researcher used data analysis to test four assumptions to examine co-linearity between variables. The four assumptions were (a) a normal distribution of variables, (b) an existing linear relationship between the independent and dependent variables, (c) reliability of measuring variables, and (d) homoscedasticity or even distribution of variance of errors across all levels of the CAAP posttest (Osborne & Waters, 2002).

The normality assumption was addressed by using the large sample from the WNSLAE data set. The central limit theorem holds that an infinite number of samples will form around a normally distributed true population and that the random disturbances will be normally distributed. Allison (1999) suggested that sample sizes greater than 200 can confidently assume that the central limit theorem applies and the study meets the normality assumption. The final sample size for this study was 1,716.

The shape of scatter plots and the presence of multicollinearity tested the linear assumption of OLS regression. Scatter plots of all continuous variables on the x-axis and CAAP posttest on the y-axis did not show bow tie or fan shapes, which suggests that heteroscedasticity was not a problem and that linear relationships existed between end-of-year critical thinking and each independent variable. This study tested for multicollinearity by running a correlation analysis in Stata 11.0 among all independent variables. Table 4.3 further examines the presence of multicollinearity between the dependent and independent variables. Multicollinearity creates large standard errors by relationships between two or more of the independent variables distorting the effect on the dependent variable. Allison (1999) suggested that correlations above 0.80 and Variance Inflation Factors (VIF) greater than 5 would create problems of multicollinearity (O'Brien, 2007). The results shown in Table 4.3 suggest that multicollinearity was not a problem in this study. Research universities and the cohort 2006 were used as the reference variables in the regression equation because of VIF

greater than 5 but less than 10. End-of-year critical thinking highly correlated with both beginning-of-year critical thinking ($r=.724$) and academic ability ($r=.623$), but did not reach the tolerance level for multicollinearity. The relatively high correlation did not affect the reliability of the regression model; however, it did impact the interpretation of findings by reducing the argument for causation (O'Brien, 2007).

Table 4.3 Variance Inflation Factors and Correlations

	VIF	1	2	3	4	5	6	7	8	9	10
1 End of First-year Critical Thinking	DV	1.000									
2 Beginning of First-year Critical Thinking	2.18	0.724	1.000								
3 Gender – Male	1.08	-0.014	0.026	1.000							
4 Race/Ethnicity – White	1.12	0.185	0.185	-0.094	1.000						
5 Average Parents' Education	1.22	0.206	0.268	0.043	0.153	1.000					
6 Academic Ability	2.38	0.623	0.704	0.030	0.233	0.384	1.000				
7 High School Involvement	1.22	-0.032	0.007	-0.214	0.009	0.035	0.038	1.000			
8 Need for Cognition	1.27	0.294	0.348	0.007	0.018	0.154	0.308	0.162	1.000		
9 Institution – Percent on Campus	4.32	-0.171	-0.157	0.003	-0.124	-0.036	-0.149	-0.002	-0.054	1.000	
10 Institutional Type – Research	ref	-0.010	0.010	-0.023	0.082	-0.078	-0.008	-0.002	-0.024	-0.459	1.000
11 Institutional Type – Regional	1.38	0.188	0.157	0.016	0.061	0.103	0.163	0.004	0.076	-0.667	-0.355
12 Institutional Type – Liberal Arts College	4.61	0.116	0.181	0.050	0.050	0.176	0.237	0.051	0.098	-0.625	-0.191
13 Cohort – 2006	ref	0.352	0.322	-0.077	0.168	0.090	0.279	0.074	0.135	-0.234	0.162
14 Cohort – 2007	1.80	-0.186	-0.177	0.107	-0.151	-0.123	-0.231	-0.082	-0.113	0.211	0.084
15 Cohort – 2008	1.72	-0.198	-0.176	-0.012	-0.042	0.012	-0.088	-0.006	-0.042	0.060	-0.232
16 Living-Learning Community	1.19	-0.166	-0.207	0.017	-0.042	-0.077	-0.175	0.043	-0.087	0.273	-0.138
17 Quality of interactions with faculty	1.45	0.034	0.038	-0.030	0.018	0.032	0.013	0.208	0.205	-0.147	-0.016
18 Frequency of interaction with faculty	1.53	-0.232	-0.157	0.000	-0.075	-0.008	-0.167	0.252	0.101	0.015	-0.071
19 Degree of positive peer interactions	1.17	0.088	0.076	-0.053	0.081	0.069	0.107	0.172	0.110	-0.126	0.040
20 Academic Engagement	1.65	0.017	0.041	-0.060	-0.045	0.072	0.000	0.282	0.251	-0.072	-0.070
	11	12	13	14	15	16	17	18	19	20	
1 End of First-year Critical Thinking											
2 Beginning of First-year Critical Thinking											
3 Gender – Male											
4 Race/Ethnicity – White											
5 Average Parents' Education											
6 Academic Ability											
7 High School Involvement											
8 Need for Cognition											
9 Institution – Percent on Campus											
10 Institutional Type – Research											
11 Institutional Type – Regional	1.000										
12 Institutional Type – Liberal Arts College	0.818	1.000									
13 Cohort – 2006	0.110	-0.092	1.000								
14 Cohort – 2007	-0.292	-0.136	-0.416	1.000							
15 Cohort – 2008	0.132	0.206	-0.656	-0.414	1.000						
16 Living-Learning Community	-0.172	-0.199	-0.263	0.149	0.139	1.000					
17 Quality of interactions with faculty	0.168	0.197	-0.031	-0.038	0.062	-0.013	1.000				
18 Frequency of interaction with faculty	0.044	0.090	-0.147	0.009	0.140	0.112	0.416	1.000			
19 Degree of positive peer interactions	0.099	0.095	0.075	-0.032	-0.049	0.004	0.262	0.097	1.000		
20 Academic Engagement	0.135	0.169	-0.026	-0.042	0.060	0.026	0.464	0.482	0.299	1.000	

To address the reliability of students' identifying participation in an LLC where their residence was connected to an academic program, only institutions with formal LLC programs in the corresponding cohort year were included in the study. The reliability assumption was discussed in detail in Chapter III. Data on student gender, race/ethnicity and academic ability were collected from school files. Institutional types were based on the widely used 2005 Carnegie classification. The composite scales in this study had relatively high reliability: quality and frequency of non-classroom interactions with faculty ($\alpha = .85$ & $.70$, respectively), degree of positive peer interaction ($\alpha = .87$), and academic challenge and effort ($\alpha = .88$). The reliability was $.80$ for the CAAP pretest and $.81$ for the posttest (ACT, 1990). Student background characteristics included composite measures of high school involvement ($\alpha = .584$) and need for cognition ($\alpha = .886$).

To explore the homoscedasticity assumption, continuous independent and dependent variables were converted to z-scores to reduce heteroscedasticity (Osborne & Waters, 2002). OLS regression assumes a homoscedastic distribution of variables or equal distribution of random effects across independent variables. Converting continuous variables into z-scores also allows for a uniform comparison of continuous variables. For example, an increase in one standard deviation of academic ability corresponds to an increase in one standard deviation of CAAP score.

Random sampling is the preferred method to address the assumptions of OLS regression and problems of bias in educational research (Allison, 1999). Students' choice to participate in LLC, rather than researcher assignment or random selection, made it important to test the assumptions of OLS regression prior to data analysis to avoid biased standard errors and Type I errors. The regression analyses in this study met the criteria and assumptions required of OLS regression.

Table 4.4 General Effects Model

Outcome: End of First-Year Critical Thinking	Unstandardized Coefficient (Std. Error)				
Controlling for clustering	Student Inputs	Institutional Characteristics	LLC Environment	Interaction	Student Effort
Variable Name	<u>Equation 1</u>	<u>Equation 2</u>	<u>Equation 3</u>	<u>Equation 4</u>	<u>Equation 5</u>
Beginning of First-Year Critical Thinking (Z)	.554*** (.031)	.528*** (.036)	.524*** (.036)	.516*** (.035)	.515*** (.035)
Gender – Male	-.090* (.041)	-.090* (.041)	-.083 (.041)	-.075 (.043)	-.074 (.043)
Race/Ethnicity – White	.022 (.060)	.021 (.052)	.016 (.051)	.013 (.050)	.014 (.049)
Average Parents' Education (Z)	.013 (.024)	.004 (.022)	.004 (.022)	.005 (.021)	.005 (.020)
Academic Ability (Z)	.226*** (.044)	.237*** (.042)	.241*** (.042)	.233*** (.040)	.234*** (.040)
High School Involvement (Z)	-.037* (.015)	-.038* (.014)	-.037* (.014)	-.024 (.014)	-.025 (.016)
Need for Cognition (Z)	.015 (.012)	.020 (.010)	.022 (.010)	.026 (.013)	.025 (.012)
Institutional Type – Regional		-.194 (.107)	-.190 (.106)	-.192 (.104)	-.192 (.105)
Institutional Type – Liberal Arts		.228 (.193)	.236 (.193)	.227 (.190)	.226 (.190)
Percent on Campus (Z)		-.089 (.087)	-.097 (.088)	-.093 (.087)	-.093 (.087)
Cohort – 2007		-.084 (.079)	-.078 (.079)	-.077 (.078)	-.077 (.078)
Cohort – 2008		-.210 (.122)	-.195 (.122)	-.185 (.118)	-.185 (.117)
Living-Learning Community			-.074 (.073)	-.072 (.068)	-.071 (.068)
Quality of non-classroom interactions with faculty (Z)				.037 (.028)	.036 (.028)
Frequency of non-classroom interaction with faculty (Z)				-.082*** (.015)	-.084*** (.018)
Degree of positive peer interactions (Z)				-.015 (.015)	-.016 (.015)
Academic Engagement (Z)					.005 (.022)
R ²		.583***	.600***	.607***	.607***
ΔR ²		.583***	.017	.007**	.000
F		104.32	151.07	1625.35	1057.03

*** <.001; ** <.01; * <.05

Equation 1: Student Backgrounds/Precollege Traits

The general effects model groups independent variables into blocks to understand the direct effects of student background, institutional characteristics, and LLC participation on critical thinking as well as the indirect effects of these variables mediated by interaction with faculty and peers and individual student effort. Astin and Denson (2009) recommend that OLS regression blocks start with student inputs followed by institutional characteristics and then the environmental variables to parcel out the unique impact of institutional level variables on student outcomes. The results indicated that the first block of variables including student background and pre-college characteristics explained a substantial proportion of variance in end-of-year critical thinking for first-year students ($R^2 = .583$, $p < .001$). The variables that significantly contributed to the explained variance in end-of-year critical thinking were beginning-of-first-year critical thinking (unstandardized regression coefficient = .554, $p < .001$), academic ability (unstandardized regression coefficient = .226, $p < .001$), male students (unstandardized regression coefficient = -.090, $p < .05$), and high school involvement (unstandardized regression coefficient = -.037, $p < .05$). The continuous variables were standardized, so with an increase in one standard deviation in academic ability, end-of-year critical thinking also increased 4.42 ($1/.226$) standard deviations.

Equation 2: Institutional Characteristics

The inclusion of institutional type, percentage of students living on campus, and cohort year resulted in a total R^2 of .600 ($p < .001$), which represented a 0.017 increase in the variance in critical thinking explained by student background characteristics and pre-college traits. The introduction of institutional characteristics into the model explained only an additional 1.7% of the variance in end-of-year critical thinking; however, none of the institutional characteristics were significant in this equation. It is possible that controlling for clustering by institution may have masked the influence of institutional

type, making it appropriate to conduct post-hoc analysis of OLS regression for each institutional type.

Equation 3: LLC Environment

Adding LLC to the regression equation results did not increase R^2 , but did more than double the F-ratio from 151.07 to 397.40. It is notable that when the researcher controlled for student background and institutional characteristics, the primary independent variables of interest, LLC was statistically non-significant ($p < .323$).

Equation 4: Interaction

Introducing the interaction block into the regression equation resulted in an R^2 of .607 ($p < .01$), which represented an additional 0.7% increase in the variance explained by the general effects model on end-of-year critical thinking. Frequency of faculty interaction (unstandardized regression coefficient = $-.082$, $p < .001$) significantly contributed to explained variance of end-of-year critical thinking. High school involvement and gender became non-significant when controlling for quality and frequency of faculty interaction and the degree of positive peer interaction.

Equation 5: Academic Effort and Challenge

Students' individual academic effort and challenge did not have an effect on the variance of end-of-year critical thinking and did not change the significance of other variables in the model.

Student background accounted for the most substantial increase ($R^2 = .583$) in variance of end-of-year critical thinking. Considered collectively, the remaining blocks of institutional characteristics, LLC, and principles of good practice accounted for an additional 2.4% of variance in end-of-year critical thinking. This suggests that the greatest influence on end-of-year critical thinking was a student's precollege characteristics during the first year of college rather than the type of institution, interactions and effort within the institution, or a residence hall environment intended to facilitate integration between academic and social experiences.

Effect of the Pretest on the General Effects Model

With the high correlation between pretest and posttest critical thinking ($r=0.724$) and because this is the first LLC study to include a pretest measure of the outcome variable, it was appropriate to parcel out unique effects of the pretest on end-of-year critical thinking by comparing the summary of the general effects model with and without the pretest. Table 4.5 illustrates the model summary of the regression model both with and without the pretest measure of critical thinking.

Table 4.5 Contributions of Pretest Critical Thinking

Outcome: End of First-Year Critical Thinking	End-of-Year Critical Thinking			
	With Pretest		Without Pretest	
	R^2	ΔR^2	R^2	ΔR^2
1. Student Inputs	.583	.583***	.413	
2. Institutional Characteristics	.600	.017	.455	.413***
3. LLC Environment	.600	.000	.459	.042*
4. Interaction with Faculty & Peers	.607	.006**	.469	.004
5. Academic Effort & Challenge	.607	.000	.470	
				.010***
				.001
Final model R^2	.607***		.470**	
F-test, df	1057.03, 18		36.80, 18	

*** <.001; ** <.01; * <.05

The pretest measure of critical thinking increased the significance of the general effects model and also increased the variance accounted for in the model by 13.7%, from .470 to .607. Including the pretest measure in the regression equation increased the F-ratio from 36.80 to 1057.03. The larger F-ratio indicated less likelihood that the differences in means were due to chance. In other words, including the pretest measure in the regression equation greatly improved the ability of the general effects model to predict end-of-year critical thinking.

Conditional Effects

Hypothesis 2 in this study stated that any significant positive effects of participation in LLCs will be conditional on student background, institutional characteristics, degree of interaction with faculty and peers, and academic effort. Although the general model did not identify any positive effects of LLC participation on end-of-year critical thinking, it is possible that this relationship was conditional on student precollege traits, institutional type, and the degree to which LLC facilitated good practice in undergraduate education.

Conditional Effects – LLC x Student's Pre-College Traits

To explore the presence of conditional effects by precollege traits, individual cross-products were generated between LLC and each pre-college characteristic. Table 4.6 illustrates the results of the analysis for conditional effects of student's background. All of the cross product terms of LLC and student precollege traits were not significant. The non-significance of the cross-product terms suggests that, in general the impact of LLC on end-of-year critical thinking does not differ among students' characteristics, background and ability.

Table 4.6 LLC x Precollege Conditional Effects

Outcome: End of First-Year Critical Thinking	Beginning of Year Critical Thinking	Gender – Male	Race/Ethnicity – White	Average Parents' Education
Equation #5	General Effects Model ($R^2 = .607$) +			
LLC X Student Characteristics	.057 (.030)	-.125 (.108)	.006 (.141)	-.018 (.047)
Adjusted Wald Test (F)	3.44	1.35	0.00	0.14

Outcome: End of First-Year Critical Thinking	Academic Ability	High School Involvement	Need for Cognition
Equation #5	General Effects Model ($R^2 = .607$) +		
LLC X Student Characteristics	-.029 (.029)	.039 (.029)	-.008 (.039)
Adjusted Wald Test (F)	1.00	1.84	0.04

Conditional Effects – LLC x Institutional Type

Table 4.7 illustrates the effects of LLC participation within each institutional type and the percentage of the total undergraduate population in on-campus housing.

Conditional effects of institutional characteristics did not add additional explanation of the variance of end-of-year critical thinking. The general effects model used a weight algorithm to control for nested data within each of the 19 institutions. Controlling for nesting by institution, with different institutions represented in the sample, may potentially mask differences across institutional types.

Table 4.7 LLC x Institutional Interaction Effects

Outcome: End of First-Year Critical Thinking	Institutional Type – Research	Institutional Type – Regional	Institutional Type – Liberal Arts Colleges	Percentage On Campus
Equation #5	General Effects Model ($R^2 = .607^{***}$) +			
LLC X Institutional Type	.077 (.122)	-.103 (.126)	.009 (.098)	-.027 (.045)
Adjusted Wald Test (F)	.040	0.67	0.01	0.35

To explore whether controls for clustering masked conditional effects by institutional type, separate general effects model regression analyses were run for each group of students by research universities, regional colleges, and liberal arts colleges. Table 4.8 illustrates regression analysis by institutional type. Because separating institutional type reduced the number of aggregates available in the analysis, the reliability alpha used to determine significance was changed to .10 for a more generous estimate of impact. OLS analysis by institutional type did not control for clustering within each institution.

Table 4.8 Regression Coefficients by Institutional Type

Outcome: End of First-Year Critical Thinking	n = 796	n = 337	n = 584
<u>Variable Name</u>	<u>Research University (6)</u>	<u>Regional University (5)</u>	<u>Liberal Arts Colleges (8)</u>
Beginning of First-year Critical Thinking (Z)	.440*** (.009)	.618*** (.042)	.530*** (.039)
Gender – Male	-.006 (.017)	-.267*** (.077)	.052 (.029)
Race/Ethnicity - White	-.037 (.044)	.007 (.063)	.012 (.086)
Average Parents' Education (Z)	.008 (.027)	.081 (.052)	-.077** (.024)
Academic Ability (Z)	.289*** (.012)	.101 (.121)	.257*** (.045)
High School Involvement (Z)	-.027 (.029)	-.035 (.024)	-.040 (.041)
Need for Cognition (Z)	.053*** (.013)	.007 (.012)	.007 (.023)
% Residential (Z)	-.523*** (.086)	.091 (.041)	.047 (.065)
Cohort – 2007	.040 (.061)	-.674*** (.074)	-.451*** (.050)
Cohort – 2008	-.128 (.074)	.500*** (.064)	-.137* (.061)
Living-Learning Community	-.033 (.091)	-.089 (.090)	-.075 (.081)
Quality of non-classroom interaction with faculty (Z)	-.010 (.046)	.041 (.023)	.058* (.024)
Frequency of non-classroom interaction with faculty (Z)	-.102*** (.020)	-.020 (.033)	-.083* (.035)
Degree of positive peer interactions (Z)	-.011 (.018)	-.039 (.025)	-.003 (.036)
Academic Effort & Engagement	.014 (.030)	.027 (.033)	.030 (.039)
Adjusted R ²	.648	.595	.629

*** <.01; ** <.05; * <.10

Comparing institutional types in the sample, there were no differences in the non-significance of LLCs reported in the general effects model between research universities, regional colleges, and liberal arts colleges. Differences that did exist between institutional types were found in gender, average parents' education, percentage of students on campus, frequency of non-classroom faculty interaction, and cohort groups.

Conditional Effects – LLC x Good Practice

A limitation of this study is the accuracy of students' self-report data on whether they lived in an LLC. The overall effectiveness and operation of an LLC may vary both

within and between institutions. Inkelas et al. (2008) empirically demonstrated that despite differences in organizational structure and thematic focus, LLCs significantly differed by program size, availability of financial resources, or degree of partnership with academic and student affairs both within and between four research universities. Specific information about the LLC environments was not available in the WNSLAE data.

Including cross product LLC and good practices variables into the general effects model made it possible to explore differences within LLCs in faculty and peer interaction and effort and the result on end-of-year critical thinking. Table 4.9 illustrates the impact on end-of-year critical thinking conditional on the degree of interaction with faculty and peers and individual student academic effort and challenge within the LLC environments.

Table 4.9 LLC x Good Practice Interaction Effects

Outcome: End of First-Year Critical Thinking	Quality of Interaction with Faculty	Frequency of Interaction with Faculty	Positive Peer Interaction	Academic Effort & Challenge
Equation #5	General Effects Model ($R^2 = .607^{***}$) +			
LLC x Good Practice Scales	.040 (.063)	-.054 (.059)	-.061 (.046)	.051 (.024)
Adjusted Wald Test (F)	0.41	0.84	1.72	4.33

*** <.001; ** <.01; * <.05

The interaction terms for all four good practice measures were also non-significant and did not add additional understanding of the variance in end-of-year critical thinking. These non-significant findings suggest little to no differences in the degree to which students experience faculty interaction, peer interaction, and academic challenge between LLCs in the sample. The lack of statistical significance of the conditional effects of LLC and good practice composite scales did not necessarily indicate that students in LLCs were not exposed to quality interactions with faculty and peers. To better understand the impact of LLCs to facilitate the principles of good practice in

undergraduate education, it was appropriate to conduct further analysis with each good practice scale as an outcome variable.

LLC Influence on Principles of Good Practice

Hypothesis 3 in this study stated that students participating in LLCs are more likely than students in traditional residence halls to be exposed to principles of good practice in undergraduate education. The final stage of analysis regressed LLC participation on each good practice scale used as a mediating variable in this study, controlling for student traits, institutional characteristics, and clustering within institutions. Post-hoc analysis of good practice scales using the general effects model for end-of-year critical thinking creates threats to the mean independence assumption of OLS regression. It is likely that important independent variables were not included in the good practice regression equations; however, it demonstrates the presence or lack of presence of a relationship between LLCs and each good practice scale. Table 4.10 illustrates the third equation of the general effects model regressed on quality of faculty interaction, frequency of faculty interaction, positive peer interaction, and academic effort and challenge.

The results of Table 4.10 indicate that LLC participation had a statistically significant positive effect on the quality of faculty interaction (unstandardized regression coefficient = .166, $p < .05$) and frequency of faculty interaction (unstandardized regression coefficient = .122, $p < .05$), as well as a negative effect on positive peer interaction (unstandardized regression coefficient = -.104, $p < .05$). Without pretest measures of the good practice scales, however, the positive and negative effects may simply reflect a selection effect, that is, that students who chose to participate in LLCs were more open to interacting with faculty and less willing to engage with peers in the residence halls. Future studies should explore the relationships between LLCs and principles of good practice in undergraduate education with more intentional inclusion of independent variables as control factors.

Table 4.10 Regression Coefficients with Good Practice Scales as Outcomes Variables

<u>Variable Name</u>	Good Practice Scale as Outcome Variable			
	<u>Quality of Faculty Interaction</u>	<u>Frequency of Faculty Interaction</u>	<u>Positive Peer Interaction</u>	<u>Academic Effort & Challenge</u>
Beginning of First-year Critical Thinking (Z)	.051 (.054)	-.069 (.071)	-.054 (.043)	.023 (.035)
Male	-.022 (.122)	.106 (.060)	-.070 (.046)	-.027 (.039)
White	.027 (.059)	-.044 (.093)	.152 (.075)	-.061 (.080)
Average Parents' Education (Z)	-.013 (.030)	.003 (.032)	-.018 (.039)	.018 (.041)
Academic Ability (Z)	-.110* (.039)	-.155* (.056)	.078** (.024)	-.148* (.068)
High School Involvement (Z)	.213*** (.052)	.225*** (.031)	.151*** (.022)	.217*** (.035)
Need for Cognition (Z)	.202*** (.033)	.129*** (.033)	.013 (.047)	.247*** (.040)
Institutional Type – Regional	.047 (.112)	-.033 (.098)	.133** (.046)	-.048 (.067)
Institutional Type – Liberal Arts	.038 (.159)	-.124 (.133)	.143 (.128)	.045 (.155)
% Residential (Z)	.204* (.077)	.133* (.052)	.035 (.049)	.136 (.071)
Cohort – 2007	.122 (.079)	.085 (.068)	-.039 (.073)	.026 (.100)
Cohort – 2008	.071 (.090)	.175 (.076)	-.128 (.075)	-.040 (.107)
Living-Learning Community	.166* (.069)	.122* (.160)	-.104* (.046)	.028 (.106)
R ²	.155***	.140**	.058*	.172***
F-Ratio	42.07	14.21	7.27	22.67

*** <.001; ** <.01; * <.05

Results Summary

The results of this study suggested that net of academic ability and background and institutional characteristics, students who participated in LLCs did not demonstrate greater gains on a standardized measure of critical thinking than their peers in traditional residence hall environments. The influence of LLC participation on critical thinking was generally not conditional on student background, institutional characteristics, or the degree faculty and peer interaction. Lastly, students participating in LLCs were more

likely to experience a greater degree of both quality and frequency of faculty interaction and less positive peer interaction than students living in traditional residence halls.

CHAPTER V

DISCUSSION AND IMPLICATIONS

The intent of this study was to explore the direct and indirect relationships between participating in LLCs and critical thinking for first-year students. Previous studies demonstrated a link between LLC participation and self-reported critical thinking skills (Inkelas, Johnson, et al., 2006; Inkelas, Vogt, et al., 2006; Inkelas & Weisman, 2003; Kohl, 2009; Schein, 2005); however, the most recent literature on LLC participation focused on single-institution studies, and the few multi-institution studies used cross-sectional research designs. The absence of pre-test measures did not allow for controls for students' attitudes and behaviors at the beginning of college, suggesting that previous findings associated with positive experiences of LLC may represent the selection bias of advantaged and high-ability students choosing to participate in LLCs rather than the unique impact of the living environment. This analysis presented in the previous chapter was the first to examine the impact of LLCs on a standardized measure of critical thinking controlling for self-selection bias by using a longitudinal research design in a multi-institution sample. The results of data analysis suggest that net of academic ability/background and institutional characteristics, students who participated in LLCs did not demonstrate greater gains on a standardized measure of critical thinking than their peers in traditional residence hall environments.

To explore the relationship between LLC participation and critical thinking, data from the Wabash National Study of Liberal Arts Education (WNSLAE) were analyzed for this study. The WNSLAE is a longitudinal investigation of student experiences during the first year of college. The WNSLAE investigated outcomes theoretically associated with a liberal arts education and included over 17,000 students from 53 colleges and universities across the United States. This study focused on a conservative subsample from 19 institutions with public information available about campus LLCs during the cohort year. Using statistical controls for pre-test critical thinking, student background

and ability, institutional characteristics, and mediating influences of faculty interaction, peer interaction, and academic engagement, this study estimated the direct and indirect effects of LLC participation on a standardized measure of critical thinking. This chapter discusses the results, reveals implications, reviews study limitations and concludes with recommendations for future research.

Discussion of Findings

Research Hypothesis 1: Net of background characteristics (e.g., pre-college academic ability, demographic characteristics) and other influences (i.e., faculty and peer interactions, academic effort and engagement), students who participate in LLCs will demonstrate greater gains on a standardized measure of critical thinking than their peers in traditional residence hall environments.

The findings from this investigation did not support previous studies that explored the relationship between LLC participation and a self-reported measure of critical thinking. In a single-institution study, Inkelas and Weisman (2003) found that students in LLCs self-reported greater use of critical thinking skills than students in traditional residence halls. Inkelas, Johnson, et al. (2006) found that students in LLCs were statistically more likely than students in traditional residence halls to self-report feeling competent in their critical thinking skills. In a different analysis, Inkelas, Vogt, et al. (2006) found that LLC students self-reported an increased use of abstract critical thinking in their coursework compared to students in traditional residence halls. Controlling for student traits and school characteristics in a multi-institution sample, Kohl (2009) found that living in a traditional residence hall had a negative impact on a self-reported measure of critical thinking compared to participating in an honors LLC. It is important to note that all of the previous studies on critical thinking in LLCs used self-reported measures and only Kohl (2009) employed the use of statistical procedures to control for students' background, institutional characteristics, and interactions within the LLC environment. Previous studies support the conclusion that students in LLCs perceive themselves to

have greater use of critical thinking skills than students in traditional residence halls (Inkelas, Johnson, et al., 2006; Inkelas, Vogt et al., 2006; Inkelas & Weisman, 2003; Kohl, 2009; Schein, 2005). The findings from the current investigation demonstrate that after controlling for pre-college critical thinking, students' background, ability, and openness to cognitive activities, LLC participation did not significantly influence end-of-year critical thinking among students in a multi-institution sample. The lack of statistical significance in the current investigation does not directly contradict previous studies of self-reported growth in critical thinking. Although students perceived that LLCs positively affected growth in critical thinking, their actual growth was essentially the same whether they chose to participate in an LLC or chose to live in a traditional residence hall.

Given the absence of a standardized measure of critical thinking and the lack of controls for clustering and self-selection bias, the extant literature on LLCs and critical thinking might be prone to Type I error – rejecting the null hypothesis when it is actually true. In these cases, the threats to the internal validity of the research might have led previous researchers to conclude that LLCs had a statistically significant influence on critical thinking when they actually did not. The results from this investigation add to the current literature by using a standardized measure of critical thinking, rather than students self-reported gains in critical thinking, and controlling for the confounding influences of clustering and self-selection bias. Net of background characteristics and other influences, students who participate in LLCs do not differ in their level of critical thinking from students living in traditional residence halls. The conclusion of non-significance of LLCs and a standard measure of critical thinking compared with self-reported gains in critical thinking found in previous research further supports the need for researchers to use objective measures in the assessment of the impact of college on students.

Research Hypothesis 2: Any significant positive effects of participation in LLCs will be conditional on student background, institutional characteristics, degree of interaction with faculty and peers, and academic effort.

Similar to the general effects model, a particularly salient finding was that the influence of LLC participation on critical thinking was generally not conditional on student background, institutional characteristics, or the degree of faculty and peer interactions. Conditional effects refer to analysis of subsamples to detect differences between groups, such as differences between males and females or differences across institutional types. To detect the presence of conditional effects, cross-product terms for each independent variable and LLCs were introduced separately into the general effects model. Significant cross-product terms in conditional effect analysis indicate the relative difference in variance explained between the two variables. Cross-product terms of LLC and each independent variable were not significant and did not add to the understanding of variance in end-of-year critical thinking, which suggests that students participating in LLCs with different backgrounds and academic ability at different institutional types do not experience differential gains in critical thinking.

It is likely more informative to both research and practice that no differences were detected across students' initial critical thinking, gender, race/ethnicity, parents' education, academic ability, high school involvement, need for cognition, percentage of students on-campus, quality of faculty interaction, frequency of faculty interaction, positive peer interaction, and academic challenge and effort. As the first LLC study to include liberal arts colleges in the sample, it is notable that no differences emerged comparing the impact of LLC participation on end-of-year critical thinking at research universities, regional universities, and liberal arts colleges.

Research Hypothesis 3: Students participating in LLCs are more likely than students in traditional residence halls to be exposed to principles of good practice in undergraduate education.

Controlling for student inputs and institutional characteristics, this study explored the impact of LLC participation on each good practice measure in the general effects model as an outcome variable. Four separate regression analyses investigated the impact of LLCs on quality of faculty interaction, frequency of faculty interaction, the degree of positive peer interaction, and students' academic challenge and effort. This stage of analyses loses the methodological strength of the general effects model by using self-reports of students' interactions and academic engagement and the lack of pre-test measures of the outcome variables. The four good practice outcomes are self-reported measures collected during follow-up data collection at the end of students' first year. Without pre-test measures of the outcome variables, statistical differences may simply reflect self-selected students in LLCs as being more open to interacting with faculty and peers and being more motivated to engage in academic activities. Notwithstanding the relatively reduced rigor of this step in data analysis, the findings are informative in understanding the context of any mediating influences of good practice measures within LLCs.

With the assumption that many LLCs focus on creating opportunities for students to interact with faculty in residence hall environments (Blimling, 1993; Dewey, 1944; Inkelas et al., 2008; Meiklejohn, 1932; Schoem, 2004), the findings from this study are not surprising in that LLCs were positive predictors of both quality and frequency of faculty interaction. This finding is consistent with almost all of the extant literature, suggesting that increase faculty interaction is an outcome of LLC participation (Garrett & Zabriskie, 2004; Inkelas et al., 2006; Lacy, 1978; Pascarella & Terenzini, 1981; Pike, 1999). Increased faculty interaction in LLCs, however, did not have a mediating impact on increased growth in critical thinking.

The regression equations used in this stage of analyses were built to explain critical thinking, not necessarily interaction or academic challenge and effort outcomes, so it is important to exercise caution in interpreting these findings. The amount of

variance explained by each good practice equation is relatively low compared to the general effects model. For example, the regression model for positive peer interaction explained only 0.6% of the variance, whereas the general effects model explained 60.7% of the variance in critical thinking. Allison (1999) cautioned against being dismissive of low R-squared values and suggested that a low R-squared value with a significant F-ratio may not have predictive value but may add to the understanding of a correlational relationship between variables. Although LLCs may not predict or cause positive faculty interaction, these outcomes are more likely to be found in LLCs than in traditional residence halls. Participating in LLCs had moderate and statistically significant effect sizes for quality of faculty interaction and frequency of faculty interaction. Again noting the threat of self-reports and self-selection bias, LLCs increased quality of faculty interaction 16.6% and increased frequency of faculty interaction 12.2%. These increases in faculty interaction have a trade off of a decrease in positive peer interaction of 10.4%.

The findings of this study demonstrate markedly different conclusions from previous LLC studies exploring the outcome of critical thinking. LLC participation did not have a direct or indirect effect on end-of-year critical thinking. There were no conditional differences in the impact of LLC on critical thinking across student background and institutional characteristics. Finally, the findings from this study demonstrate that LLC students experience greater faculty interaction compared to their traditional residence hall peers, but they experience less positive peer interaction and similar academic challenge and effort.

Implications

The general conclusion of this study suggests only that LLCs do not impact students' critical thinking differently than traditional residence halls on *all* campuses. It would be improper to conclude that LLCs do not have the capacity to influence critical thinking on *any* campus. The purposive sampling procedures of the institutional sample do not allow for generalization to all colleges and universities. It is possible that some

LLC programs not included in this sample, which clearly identify growth in critical thinking as an outcome and design programs that specifically address cognitive development, may still include educationally effective practices that promote student learning.

Kuh (2008) suggested that educationally effective practices may differ between institutions. In other words, what works on one campus might not work on another campus. LLCs on different campuses may differ in both intent and effectiveness to promote growth in critical thinking. LLC differentiation in programmatic focus (Inkelas, et al., 2004), size, resources, and collaboration (Inkelas et al., 2008) within the same institution and between institutions may lead to differences in the desired outcomes of LLCs. For example, LLCs that focus on cultural programs may be characterized by experiences designed to foster openness to differences and cultural appreciation with minimal emphasis on developing students' critical thinking skills. It may not be surprising then that the results from this study, which aggregated all LLC types, did not demonstrate growth in critical thinking.

It may not be concerning if a program such as LLCs that may not focus activities on intellectual development does not lead to an increase in critical thinking skills. There are discrepancies among both practitioners and researchers as to what defines an LLC (Inkelas & Soldner, 2011). A LLC that does not have a common classroom component may not be considered a LLC at all. This study considered LLCs as residential communities with an intentionally designed academic and/or thematic focus (Lenning & Ebbers, 1999; Shapiro & Levine, 1999). Without a clearinghouse of information or set of professional standards for LLCs, the lack of a common understanding of what defines an LLC and the variability in LLC type will likely only increase. Increased variability in LLC type without clear definition, purpose, and empirical evidence of effectiveness may exacerbate inefficiencies to influence student learning.

It is possible that the LLC environments differ in their intent and effectiveness to influence critical thinking. It is more likely that a commonly accepted intent of LLC participation is to facilitate greater interaction between faculty and peers (Blimling, 1993; Dewey, 1944; Inkelas et al., 2008; Meiklejohn, 1932; Schoem, 2004). This study used faculty interactions, peer interactions, and academic engagement as proxies for program-level information in an attempt to understand if LLCs influence interaction and academic engagement, which in turn influence growth in critical thinking. Significant evidence supports the conclusion that LLCs facilitate increased faculty and peer interaction (Garrett & Zabriskie, 2004; Inkelas et al., 2006; Lacy, 1978; Pascarella & Terenzini, 1981; Pike, 1999). Other non-LLC researchers have found that faculty and peer interactions had modest, but statistically significant, positive impact on growth of critical thinking skills (Terenzini et al., 1994; Whitt et al., 1999). Given this previous evidence linking LLCs to faculty and peer interaction and evidence linking this interaction to gains in critical thinking, it is a reasonable assumption that despite programmatic differences in LLCs, LLC participation may influence critical thinking mediated by the degree of faculty and peer interaction.

Using the theoretical transitive relationship that if A implies B and B implies C, then A implies C, the findings from this study suggest that for the colleges and universities in this sample, the non-significant relationship between LLC (A) and critical thinking (C) was in part due to the non-significant relationship between LLC (A) and faculty involvement (B). Although students in LLCs did experience greater quality and frequency of faculty interaction, there were no differences in growth of critical thinking between students in LLCs and in traditional residence halls. These findings do not support the conclusion that a direct or indirect relationship exists between LLCs and critical thinking. Pascarella (1989) suggested that the impact of college on critical thinking development may be more cumulative and interrelated among students' academic and social experiences rather than specific to any particular kind of experience.

Consistent with recommendations from previous studies, the potential for LLCs to influence desirable outcomes, such as critical thinking, may be the extent to which they promote faculty and peer interaction (Kuh et al., 1994; Pascarella et al., 1994; Swaner & Brownell, 2008; Taylor et al., 2003; Terenzini et al., 1996).

Limitations

Limitations of this study include a lack of program-level information, generalizability, and clustered or nested data. The limitations, described below, do not eliminate this study's methodological contributions to the understanding of the relationships between LLCs and critical thinking. The results of this study should be viewed as additional evidence of the systematic inquiry to evaluate the relationship between LLC participation and critical thinking and not as the final evaluation of the potential educational effectiveness of LLCs.

Lack of Program Information

Arguably the most significant limitation of this study is the lack of available information about the LLC environments. Using Inkelas and associates' (2007) typology and the program descriptions on institutional websites, LLC students could have potentially participated in 12 different LLC types across the 19 colleges and universities in the final sample. Some institutions offer only one LLC type, but grouping the sample by LLC type may represent institutional differences rather than programmatic differences. Also, at large institutions with several LLC types available to first-year students, it was not possible to identify in which LLC type students participated. Inkelas and Soldner (2011) argued that aggregating different LLCs into a single measure of participation or non-participation can mute or accentuate differences in outcomes between LLC environments and traditional residence halls. They cautioned that combining various LLCs into one amorphous group may potentially mask differences among programs and lead to erroneous inferences. Grouping LLCs with thematic emphases of honors, cultural, wellness and other programs and measuring their collective

impact on critical thinking may indeed be comparing apples to oranges. As a proxy to differences in LLC type, this study controlled for mediating influences of quality of faculty interaction, frequency of faculty interaction, degree of positive peer interaction, and individual academic challenge and effort.

Generalizability

The second limitation of this study is its generalizability. The final sample included 19 institutions from six different geographic regions in the United States, selected through purposive sampling. The lack of simple random sampling of the colleges and universities does not allow for generalizability to all institutions of higher education in the United States. When considered in addition to the National Study of Living-Learning Programs (Inkelas et al., 2004; Inkelas, et al., 2007), this study adds to the understanding of the impact of LLC participation at almost 100 colleges and universities throughout the United States. The oversampling of liberal arts colleges in this study provides additional insight into the development of critical thinking, an outcome theoretically associated with a liberal arts education.

Clustered or Nested Data

To increase the sample size, multiple cohorts were used in this study to allow for adequate statistical controls of student background, institutional characteristics, and the direct and indirect effects of LLC participation on critical thinking. Including multiple institutions in the study increased the external validity of the study by expanding the institutional sample, but it also introduced the problem of student data being clustered or nested within each institution. This clustering or nesting effect refers to students being more likely to have similar backgrounds, behave in similar ways, and share similar experiences with students at the same institution when compared to students from different institutions (Pascarella & Terenzini, 2005). The influence of the clustering or nesting effect often reduces standard errors in regression analysis and erroneously identifies significant negative relationships between coefficients. Ordinary least squares

regression assumes that student observations are independent of each other. The nested nature of multi-institution data can violate the parameter invariance assumption by creating correlated error terms and underestimate standard errors in regression estimates. The intraclass correlation coefficient (ICC) of end-of-year critical thinking across the 19 institutions in this study was 0.297, indicating that 29.7% of the variance in end-of-year critical thinking took place between institutions. The ICC of growth from beginning-of-year to end-of-year critical thinking was 0.06, which suggests 0.6% variance in growth of critical thinking between institutions. It could be argued that hierarchical linear modeling (HLM) should have been used as the statistical technique to control for clustering. Heck and Thomas (2008) recommended using HLM when the ICC is greater than 0.05. Unfortunately, HLM is not able to disaggregate the unique effects of LLC from student background, institutional characteristics, or any mediating influences within the LLC. The primary focus of this study was to explore the direct and indirect effects of LLC participation on individual student change in critical thinking. Using a conservative prediction model that controlled for pre-college critical thinking and regression procedures that adjusted standard errors by sample weight, it was possible to control for clustering through “svyset” commands in Stata 11.0 (Groves et al., 2004) while also estimating the correlational structure between LLCs and critical thinking.

Summary of Contributions

Despite limitations, this study adds to the literature on LLC impact for several reasons. First, this study expanded on a limited body of research on LLC participation compared with living in traditional residence halls, using a rigorous longitudinal research design and an objective measure of critical thinking previously attributed by students' self-reports. Second, this study isolated the direct and indirect effects of LLCs on critical thinking from student or institutional structural characteristics and the mediating influence of out-of-classroom environmental experiences. Finally, this study provided greater insight into how the LLC environment affects students with different background

characteristics by exploring conditional effects. This study could potentially aid administrators, student affairs staff, and faculty to collaborate and design LLCs with clearly defined learning and developmental outcomes.

Directions for Future Research

LLC studies should continue to develop a systematic approach of inquiry by developing research questions that retest previous findings in multi-institutions samples and address significant limitations in current LLC research, such as selection bias, self-reported data, lack of program-level data, and generalizability, expand examination of student characteristics, and explore impact of LLC participation over time.

The problem of selection-bias plagues much of the previous LLC research. It is possible that despite being lauded nationally as an effective institutional intervention, LLCs may simply cluster students predisposed to be more engaged with their environment, more academically prepared, and more open to growth compared with traditional residence hall peers. Students who choose to participate in LLCs often come to college with a greater likelihood of academic performance and skill development because of their advantaged academic and economic backgrounds compared with traditional residence hall peers (Danielson, 2005; Inkelas et al., 2004; Inkelas et al., 2007; Pike et al., 1997). Padgett et al. (2011) found that including a pretest measure of the outcome variable in the regression equation resulted in similar findings to other statistical controls for selection bias such as propensity score matching. Future LLC studies should explore outcomes using longitudinal cohort research designs to control for selection bias.

Future LLC studies should also include more specific information regarding the residence hall environment. There is evidence that LLCs differ in structural design by program size, resources, and collaboration between academic and student affairs (Inkelas et al., 2008). Grouping LLCs with different structural design, programmatic focus, and intended outcomes into a bimodal variable of participation or non-participation may artificially inflate or cancel out the real impact of LLCs on the measured outcome

(Inkelas & Soldner, 2011). Including program-level information in addition to clear intent of program outcomes in multi-institution studies will help to assess the effect of operational effectiveness of LLCs on desired college outcomes. Clearly defining operational effectiveness may also help to identify a standard of empirically based LLC best practices that are missing from practitioner literature.

Future research should test the validity of previous findings by comparing the impact of LLC participation with living in traditional residence halls on standardized outcome measures across institutional types and between similar institutions. LLCs have been associated with self-reported growth in both cognitive and affective outcomes. It is clear from previous studies that students in LLCs believe their living environment has many advantages compared to traditional residence halls. Further study is needed to determine if perceived outcomes are indeed actual outcomes and also to assess the magnitude of those outcomes.

Future studies should continue to explore the impact of LLC participation at institutions with different missions, student populations, and campus environments. LLC research is dominated by single-institution studies. Other multi-institution studies include only large research universities. Single-institution studies and multi-institution studies that do not control for students' entering characteristics may simply represent the recruitment effect of who chooses to attend the institution rather than the actual environmental differences. Non-parametric analysis such as mean comparisons without controls for differences in student characteristics fail to address the differences in the type of student attracted to each institution.

The institutional sample size in this study limited data analysis to 18 variables. Future research that explores the impact of LLC participation on critical thinking should also include controls for educational aspirations, academic motivation, co-curricular involvement, engagement, collaborative learning, and diversity experiences. For outcomes related to critical thinking in general, Pascarella et al. (2004) found small but

statistically significant differences in students' educational aspirations on several college outcomes. Pascarella (1980) and Pace (1984) found that quality of academic motivation positively affected development in critical thinking. Other studies supported the influence of co-curricular involvement (Astin, 1977) and engagement (Kuh et al., 1991) on gains in critical thinking and cognitive development. Lenning and Ebbers (1999) suggested that students working in groups and their perceptions that their living environment is supportive of their endeavors would positively influence cognitive development and critical thinking. Hurtado's (2001) findings support a positive correlation between diversity experiences and critical thinking. Loes (2009) specifically recommended that future research explore the impact of diversity experiences in LLCs. Including more variables in the analysis may uncover greater insight into the relationship between LLC participation and growth in critical thinking.

Given the current study's finding of non-significance of LLC participation on critical thinking, it is possible to conclude that some traditional first-year students may not be ready to develop critical thinking skills. Perry's (1970, cited in Bruning, 1994) theory of intellectual and ethical development situated critical thinking in the stage of late multiplicity (stage 4) transitioning to contextual relativism (stage 5), representing a fundamental shift from dualistic perspectives to ownership of independent thought in the context of one's experiences. According to Perry, traditional aged, 18- to 19-year-old, first-year students may not be ready to develop their critical thinking skills. This study included only first-year students in the final sample. LLCs are available on many campuses beyond the first year, however. Future studies should explore the impact of LLC participation on critical thinking during all 4 years of college. It is possible that LLCs have a delayed impact on critical thinking that manifests later in a student's collegiate experience or that LLCs may have a pronounced difference in influencing critical thinking compared with living in traditional residence halls for sophomores, juniors, or seniors.

Both the methodological strengths and the limitations of this study provide guidance for the direction of future research. This study did not find a statistically significant relationship between LLC participation and growth in critical thinking during the first year of college. Implementing LLCs on campus requires a great deal of institutional commitment, staff organization, and faculty time. Fully engaging the potential of LLCs requires communication with stakeholders regarding how their investment and time influences student outcomes. Rigorous longitudinal research designs, such as the one employed in this study, that assess the relationship between LLCs and desirable outcomes will help to determine if LLCs are high-impact educational practices or personal projects that drain institutional resources.

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