RESEARCH ARTICLE

Campus Does Matter

The Relationship of Student Retention and Degree Attainment to Campus Design

by Amir H. Hajrasouliha and Reid Ewing

Can the physical campus help universities achieve their retention and graduation objectives?

Michael Haggans, a visiting professor in the Center for 21st Century Universities at Georgia Institute of Technology and visiting scholar in the School of Architecture at the University of Minnesota, recently interviewed Amir Hajrasouliha, one of the authors of this article. In the interview, available here (https://youtu.be/t2NeqnVwTmc), Hajrasouliha, an assistant professor in urban design at the Department of City and Regional Planning, Cal Poly State University, San Luis Obispo, discusses the research that led to this article and his conclusions.

INTRODUCTION

DESIGNERS AND PLANNERS BELIEVE that design matters and plans are helpful. That is why campus master plans, generally, recommend a set of design and planning actions intended to fulfill a university's goals and objectives as a higher education institution. A review of different campus master plans shows undeniable similarities among their recommendations. However, the validity of the proposed recommendations has not been tested. Most publications about campus planning/design are by practitioners (Chapman 2006; Coulson, Roberts, and Taylor 2010, 2014; Dober 1996; Kenney, Dumont, and Kenney 2005; Toor and Havlick 2004), and few academic studies verify the default assumptions of campus planning practice. As Dober (1996, p. 12) observed, "Lacking an organized body of research or theory, campus planning is likely to be continued on a pragmatic basis." Thus, among the many methods employed to foster learning, use of the physical environment is perhaps the most neglected. This research is an attempt to evaluate the role of the campus built environment in two major concerns of universities: student retention and graduation.

Student retention and graduation rates are currently among the most discussed topics in the field of higher education, and they are critical measures of the quality of higher education institutions. Retention and graduation rates are important for students, universities, and society as a whole. They can affect the self-esteem and future career of students, the economy and reputation of the institution, and, overall, the well-being of a generation. The statistics in the United States are not very promising. According to the National Center for Education Statistics (2015), institutional retention of first-time degree-seeking undergraduates at degree-granting postsecondary institutions was around 71 percent from 2006 to 2012. The 2012 graduation rate for first-time, full-time undergraduate students who began their pursuit of a bachelor's degree at a four-year degree-granting institution and completed the degree within six years was 59 percent.

The literature on student retention focuses on different contributing factors, such as student engagement and involvement (Kuh 2001; Kuh et al. 2008; Quaye and Harper 2014; Roberts and McNeese 2010), student socioeconomic status (Ethington and Smart 1986; Lei and Chuang 2010; Naretto 1995), student expectations (Bank, Biddle, and Slavings 1992; Braxton, Vesper, and Hossler 1995), and institutional characteristics (Braxton and McClendon 2001; Eckles 2010; Lau 2003; Seidman 2005). However, the focus of the research presented here is aligned with the concept of a "supportive learning environment"[1] proposed by Kenney, Dumont, and Kenney (2005). The supportive learning environment extends beyond the classroom to embrace the entire educational environment. While "supportive learning environment" is a broad construct, the scope of this research is limited to the physical environment outside the classroom that is conducive to meeting students' social and educational needs. This is understudied territory in the student retention literature and overlaps with the practice of campus planning and design.

Our research question is: Can the physical campus help universities achieve their retention and graduation objectives? There is no established theory in the field of higher education to answer this question, but there is a rich practical understanding among campus planners and designers about how to create a well-designed campus that can support a vital learning environment. To proceed with this research, we used the theoretical framework of the "well-designed campus" (Hajrasouliha 2015) to analyze campus form dimensions. Then, we modeled student retention and graduation rates in view of that framework.

1 Kenney, Dumont, and Kenney (2005) propose a "supportive learning environment" as one of the five indicators of college student engagement. Other indicators are academic challenge, active and collaborative learning, student-faculty interaction, and enriching educational experiences.

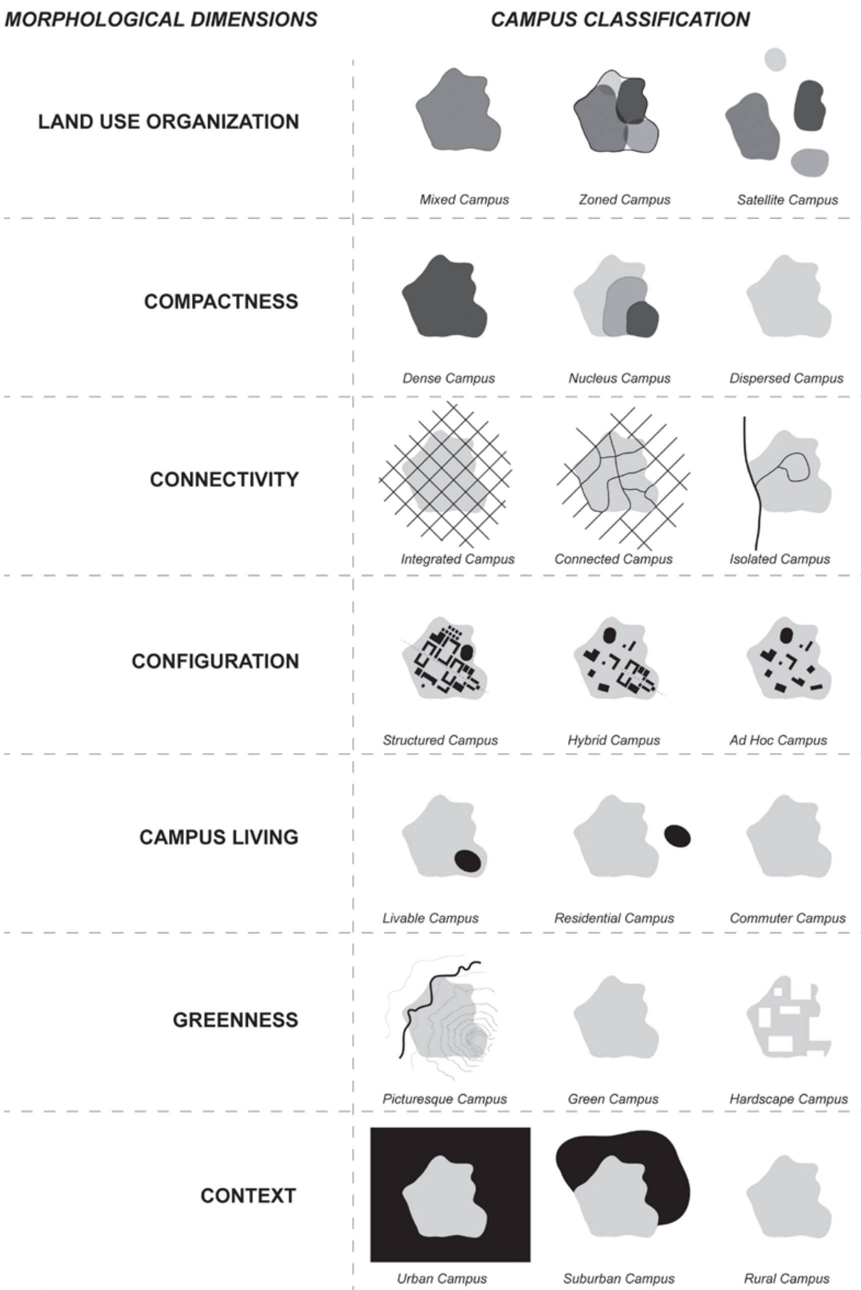
CAMPUS FORM DIMENSIONS

A campus is not a city, a neighborhood, or a block. Therefore, describing and analyzing campus form should be different from analyzing other aspects of the built environment. To construct a theoretical framework for analyzing campus form, a content analysis of 50 randomly selected university campus master plans in the United States was conducted by Hajrasouliha (2015). This analysis showed that there are significant similarities among plans in terms of challenges, objectives, and recommendations. To avoid a subjective definition of the "well-designed" campus, the top 100 common recommendations in the selected master plans were identified. Based on these recommendations, seven dimensions of campus form were suggested:

1. *Land-use organization*: the degree to which sport, research, residence, and different academic facilities are mixed
2. *Compactness*: the density of campus and proximity of buildings
3. *Connectivity*: the degree of street network connectivity within campus and between campus and the surrounding area
4. *Configuration*: the strength of campus spatial structure
5. *Campus living*: the degree of on-campus living
6. *Greenness*: the degree of naturalness/greenness
7. *Context*: the degree of urbanization in the surrounding area

According to these morphological dimensions, the well-designed campus is conceptualized as a mixed, compact, well-connected, well-structured, inhabited, and green campus in an urbanized setting (figure 1). These dimensions are measurable; therefore, it is possible to test their relationship to the desired outcomes quantitatively.

Figure 1 **Morphological Dimensions of the University Campus**



We operationalized the morphological dimensions of campus as described in figure 2. Five dimensions were operationalized quantitatively with one or more variables. However, we had to rate two, land-use organization and configuration, qualitatively.[2]

2 To test the reliability of the qualitative measures, two persons rated 40 campuses according to the principles described in figure 2. We used intra-class correlation coefficients (ICCs) representing the ratio of between-group variance to total variance of counts to test for inter-rater reliability. The values for our internal tests were .865 for land-use organization and .875 for configuration. ICC measures of inter-rater reliability lie on a scale of 0 to 1. Results indicated a high degree of consistency between the two raters. There was almost perfect agreement (ICCs > 0.8) between the raters on the two scales (Landis and Koch 1977).

Figure 2 **Operationalizing the Campus Morphological Dimensions**

Dimension	Variable	Description	Computation Process	Data Source
(1) Land-Use Organization Dimension	MIX	Land-use mix	Rating land-use mix on campus from 1 to 10. 10 = All uses are mixed on campus; however, the major athletic fields, greenhouses, barns, and surface parking areas are not located at the campus core. 1 = Campus has segregated areas away from the campus core for sport, research, residence, and some academic disciplines.	The researcher's rating
(2) Compactness Dimension	DEN1	Mass density	Computing the total area of building footprints divided by campus area.	OpenStreetMap, Google Earth images
	DEN2	Proximity	Conducting average nearest neighborhood distance using ArcGIS. The input data are building footprints.	OpenStreetMap, Google Earth images
	GRN2	Pervious open spaces	Computing the percentage of pervious open spaces in a quarter-mile buffer around campus buildings.	NLCD 2011
	GRN3	Surface parking	Computing the total area of surface parking divided by the campus area.	OpenStreetMap, Google Earth images
(3) Connectivity Dimension	CON1	Campus connectivity (within campus and to the surrounding area)	(1) Downloading census street lines at the county level; (2) refining the maps according to Google Earth images; (3) exporting maps as dxf files from ArcGIS and opening them in Depthmap (Space Syntax Software); (4) conducting angular integration analysis with radius of 3, weighted by segment length; (5) averaging integration values of campus street segments.	Census Tiger 2010, street lines
	CON2	Campus connectivity (relative to county)	Dividing the average integration value of campus street segments with radius 3 by the average integration value of county street segments with same radius.	Census Tiger 2010, street lines
(4) Configuration Dimension	STRU	Campus spatial structure	Rating the strength of campus spatial structure from 1 to 10. 10 = The entire campus has organized around most of these principles: buildings are defining open spaces; campus spaces are connected through main corridors, courtyards, or quads; campus has a main central space such as a plaza or lawn, long-view corridors with a landmark at the focal point, or enclosed open spaces; and the entire master plan is relatively symmetric and geometric. 1 = The campus has a disorganized layout.	The researcher's rating

	Variable	Description	Computation Process	Data Source
(5) Campus Living Dimension	INHB	On-campus living	Computing the percentage of students living on-campus.	*U.S. News & World Report*
(6) Greenness Dimension	GRN1	Tree canopy	Computing the average percentage of tree canopy in a quarter-mile buffer around campus buildings.	NLCD 2011
	GRN2	Pervious open spaces[a]	*Described under compactness dimension*	
	GRN3	Surface parking[b]	*Described under compactness dimension*	
(7) Context Dimensionc	URB1	Activity density	Computing the density of population and employment of all census tracts neighboring the campus.	Longitudinal Employment Household Dynamic 2010- Census 2010
	URB2	Land-use entropy	Computing land-use entropy of all census tracts neighboring the campus. Land-use entropy was computed with the formula Entropy = - [residential share*ln (residential share) + retail share*ln (retail share) + office share*ln (office share)]/ LN (3).	LED 2010
	URB3	Intersection density	Computing intersection density of all census tracts neighboring the campus, computed as the number of intersections within all census tracts neighboring the campus divided by the area of census tracts.	Census Tiger 2010, street lines and census tracts

Notes

a. "*Pervious open spaces*" is a shared variable among the greenness and compactness dimensions, but with a different loading sign. More pervious open space means more greenness, but less compactness.

b. "*Surface parking*" is a shared variable among the greenness and compactness dimensions, with the same loading sign. More surface parking area means less greenness and compactness.

c. We operationalized the context dimension with three common indicators, known as 3Ds: density, diversity, and design (Cervero and Kockelman 1997; Ewing and Cervero 2010).

MODELING FRESHMAN RETENTION RATE AND SIX-YEAR GRADUATION RATE

We used structural equation modeling (SEM) to model freshman retention rate and six-year graduation rate in terms of the campus morphological dimensions, accounting for a set of control variables.

SAMPLE

This research involved universities in the United States with high or very high research activities according to the 2010 Carnegie Classification; there are a total of 206 such universities. We randomly selected 103 campuses for this research stratified by census regions—Northeast, South, Midwest, and West—and type—Research 1 (very high research activity) and Research 2 (high research activity). Universities that have more than one campus with campuses that are formally very different were not selected. The University of Michigan in Ann Arbor was the only case with this quality in the sample and therefore was replaced by another university.

We had two reasons to constrain our statistical population to research-intensive universities. First, it was essential to control for institutional type since retention rates vary significantly among different types of higher education institutions. Research-intensive universities tend to have a higher retention percentage compared to, for example, community colleges; yet, retention and graduation rates are major concerns for research-intensive universities. Second, in general, research-intensive universities have bigger and more complex campuses and are likely to invest more in their campus master plans. Therefore, the findings of this research may have a larger audience among research university administrators and planners.

For the selected sample, on average, the total enrollment in 2013 was 24,809 students and the campus size was 797 acres. Public universities made up 76 percent of the total; the median founding year was 1875. The average acceptance rate was 58.4 percent with a standard deviation of 23.2. The average freshman retention rate was 85.6 percent with a standard deviation of 9.2. And finally, the average six-year graduation rate was 68.4 percent with a standard deviation of 18.3. Although we focused only on research-intensive universities, there was enough variance in retention and graduation rates for our modeling purposes.

DATA AND MEASURES

The first step in measuring the morphological dimensions of campus was mapping the figure-ground of all 103 campuses in ArcGIS. We used the base maps of OpenStreetMap in ArcGIS to map main physical features, such as building footprints, campus boundaries, surface parking, pitches, paths, and roads. We then used Google Earth images to increase the accuracy of the base maps. We used the spatial statistic tools in ArcGIS, Space Syntax software (for more information on Space Syntax see Hillier 2007; Hillier and Hanson 1984), and other techniques (described in figure 2) to measure the morphological dimensions. Overall, creating different analytical maps for each campus was the fundamental step in measuring the morphological dimensions. These maps were produced for all 103 cases.

The endogenous (outcome) variables in this study were freshman retention and six-year graduation rates in 2013. The source of these data was the National Center for Education Statistics. We also considered a number of control variables. For quantifying the quality of universities, we took into account *student selectivity* and *university resources*. As proxy variables, we used the most common measures in the literature, which are *the percentage of classes with fewer than 20 students, the average faculty pay*, and *the average SAT score* (Belfield and Bailey 2011; Black and Smith 2004, 2006; Black, Smith, and Daniel 2005; Daniel, Black, and Smith 1997). To control for institutional characteristics, we considered seven variables: *age of university; campus size; research type* (Research 1 = 1, Research 2 = 0); *university type* (dummies for public, private for-profit, private not-for-profit); *enrollment profile classification* from Carnegie Classification 2010; *percentage of undergraduate enrollment*; and *average total indebtedness of 2013 graduating class* from *U.S. News & World Report* to control for institutional affordability.

We also considered three variables to control for the contextual differences among universities: *median household income* 2009–2013 at the city level from the U.S. Census Bureau to control for the socioeconomic status of cities; *heating and cooling degree days* from NOAA's National Climatic Data Center to control for climate; and *crime rates* of cities in 2013 from the FBI Uniform Crime Reports.

RESEARCH STEPS AND STRUCTURAL EQUATION MODELING

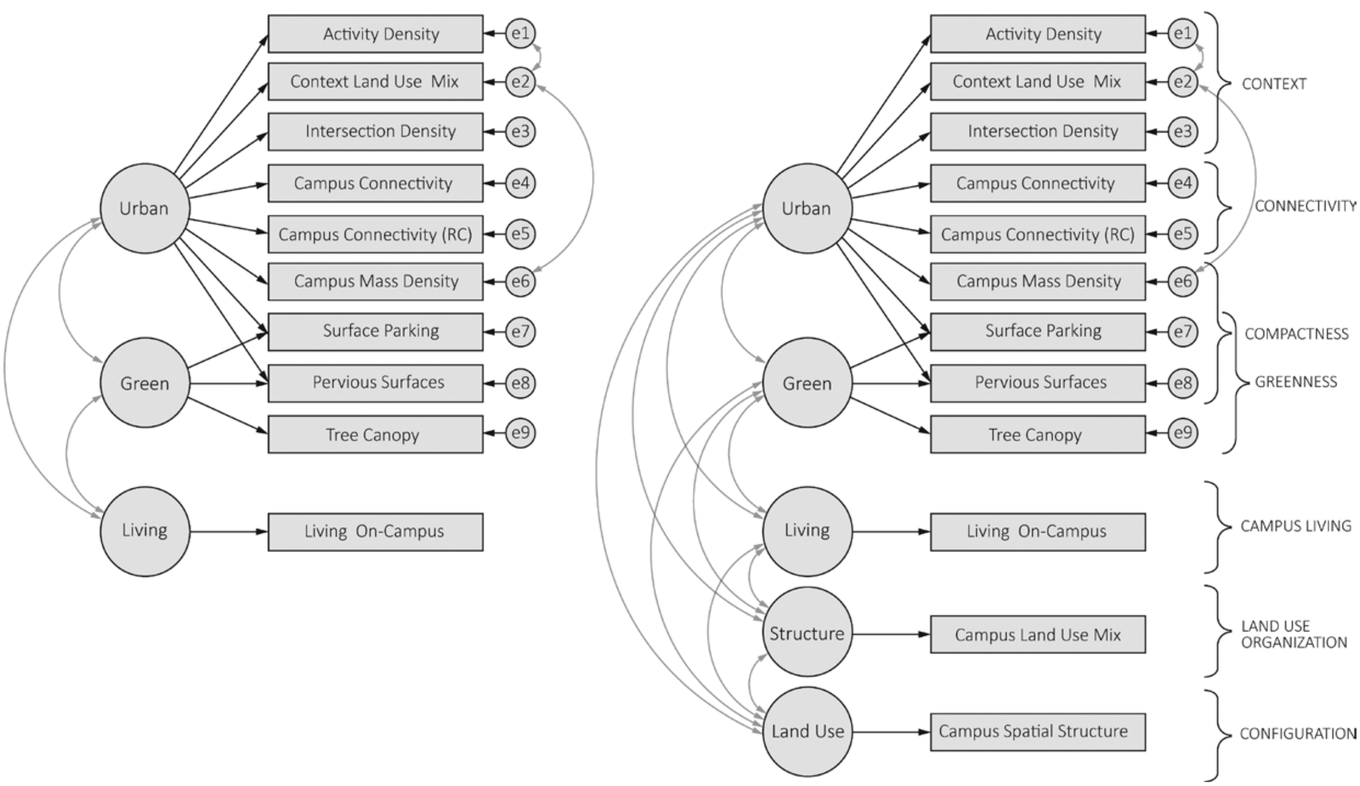
The modeling process had three steps: first, computing the seven morphological dimensions of the 103 university campuses and collecting the data on outcome and control variables; second, using SEM to identify the interactions among the morphological dimensions; and third, using SEM to evaluate the influence of campus form on the desired outcomes. Here, we present a brief definition of SEM and its application to this research.

Structural equation modeling is a powerful statistical tool because it can account for complex interrelationships among variables where some variables are both cause and effect. Byrne (2010, p. 3) explains the term “structural equation modelling” based on two important aspects of the procedure:

> (a) that the causal processes under study are represented by a series of structural (i.e., regression) equations, and (b) that these structural relations can be modelled pictorially to enable a clearer conceptualization of the theory under study. The hypothesized model can then be tested statistically in a simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data. If goodness-of-fit is adequate, the model argues for the plausibility of postulated relations among variables; if it is inadequate, the tenability of such relations is rejected.

Figure 3 shows the causal path diagram of one of the SEM models estimated in this research. Causal paths are represented by straight lines with an arrowhead pointing from the cause to the effect. Curved lines with arrowheads at both ends represent correlations. Rectangles represent observed variables. Ovals represent latent variables: variables that are not measured directly, but are estimated in the model from several measured variables.

Figure 3 **Modeling Campus Form**



Note: Right column: the interaction of all dimensions. Left column: all dimensions without land-use organization and configuration. The remaining latent variables are as follows: Urban = the degree of urbanism; Green = the degree of greenness; and Living = the degree of on-campus living.

RESULTS

MORPHOLOGICAL MEASURES

We measured the seven morphological dimensions of 103 campuses with high research activities though 13 variables. Basic descriptive statistics—mean and standard deviation—show morphological differences among universities based on their region and type of institution. Specifically, on average, Research 1 (very high research activity) universities in the northeast region obtain superior values for most morphological measures (see figure 4).

Figure 4 **The Mean and Standard Deviation of Campus Morphological Measures for All Samples and for Research 1 Universities in the Northeast Region**

Campus Morphological Dimensions	Variable	Description	All Universities		Research 1 Universities in Northeast Region	
			Mean	Std. Deviation	Mean	Std. Deviation
Campus Land-Use	MIXD	Land-use organization	6.48	2.262	7.38	1.981
Compactness	DEN1	Mass density	.205	.083	.247	.128
	GRN2	Percentage of pervious open spaces	24	17	28	21
	GRN3	Percentage of surface parking area	10.14	5.06	5.96	3.87
Connectivity	CON1	Campus connectivity	.30	.52	.50	.97
	CON2	Campus connectivity relative to county connectivity	1.07	1.21	1.56	1.75
Configuration	STRU	Spatial structure	5.75	2.392	6.85	2.882
Campus Living	INHB	Percentage of students living on-campus	38.70	23.915	66.69	19.653
Campus Greenness	GRN1	The average percentage of tree canopy	13.71	12.26	18.03	10.13
	GRN2	Percentage of pervious open spaces	*Shared with Compactness dimension*			
	GRN3	Percentage of surface parking area				
Context	URB1	Activity density	12578	13479	21833	23045
	URB2	Land-use entropy	.74	.12	.74	.14
	URB3	Intersection density	110	66	132	90

MODELING CAMPUS FORM

The interaction among the different morphological variables of university campuses has not been explored in prior studies. We used Amos 22, a SEM software, to model campus morphological dimensions with the observed variables described in figure 2. We created latent variables to represent morphological dimensions based on the proposed hypothesis. We had to slightly modify our original hypothesis to generate the best model (in terms of goodness-of-fit indices). We found significant interaction among the compactness, connectivity, and context dimensions. Instead of creating three distinct latent variables, all related observed variables could be loaded on a broader latent variable that represents the degree of urbanism of a campus. In other words, campuses that are more compact, better connected internally and to their surroundings, and located in a more urban context have a higher degree of urbanism. The other option that we had was creating a second-order latent variable of urbanism based on the three latent variables of compactness, connectivity, and context. However, the first option—directly loading observed variables on the urbanism latent variable—had a better model fit.

Figure 3 shows the path diagram of our proposed hypothesis.[3] On the left side, the interaction of all dimensions is presented. However, we found no significant interaction between two morphological dimensions (the two qualitatively rated dimensions, configuration and land-use organization) and either of the outcome variables (freshman retention rate and six-year graduation rate). Therefore, we decided to model campus form without these two dimensions. Although we tested for the reliability of these measurements, the possibility of a substantial measurement error contributing to the observed results is likely, since these two dimensions, unlike the other five, were rated qualitatively. It is also very much possible that these factors truly have no significant association with the outcome variables. On the right side of figure 3, the path diagram of the remaining three latent variables is presented.

We used maximum likelihood procedures for estimation and to evaluate model goodness of fit. Because of the relatively small number of sampled universities, we also conducted Bayesian estimates (Riginos and Grace 2008) using Amos for confirmatory purposes since these estimates do not depend on large-sample theory. While using maximum likelihood estimation generated a good model fit, using Bayesian estimates generated a good model fit only when the outliers were removed from the sample.[4]

The following results were obtained by removing outliers: The structural equation model obtained through maximum likelihood estimation had 29 degrees of freedom and a X^2 value of 18.80 with a P value of 0.926. This P value, along with all model fit indicators (CFI is 1 and RMSEA is .000), indicates good model fit. In Bayesian estimation, the Posterior Predictive P value has to be close to 0.5 to have good model fit. This model had a Posterior Predictive P value of 0.51, which indicates good model fit. Figure 5 shows the regression weights in maximum likelihood and Bayesian estimation. All regression paths possessed coefficients with significance level of 0.05 or beyond in both maximum likelihood and Bayesian estimations. Coefficient estimates were close to each other with both techniques, which confirms the model.

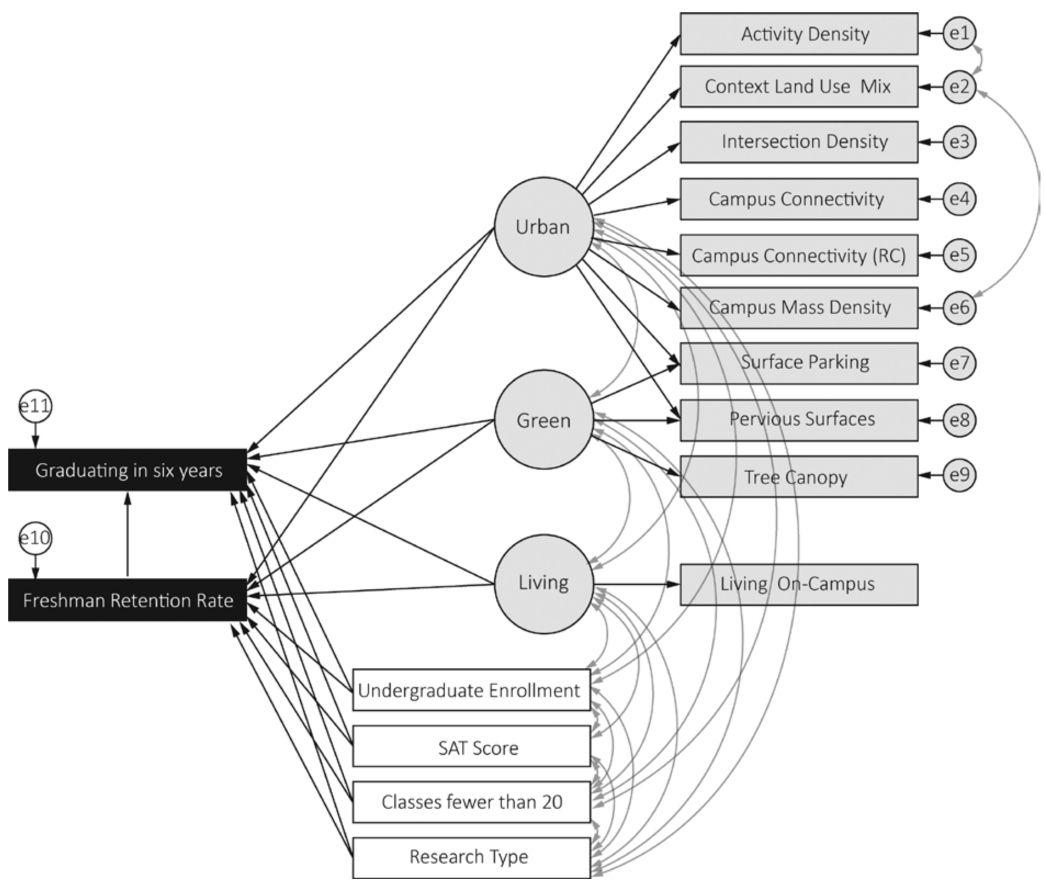
3 Dropping the correlations among error terms changes the coefficients very little and does not change their signs or the significance levels of campus form variables; however, it decreases the goodness of fit of the model. Chi-square = 29.119, Degrees of freedom = 31, Probability level = .563.

4 Seven cases had leverage value more than 2: Columbia University, Temple University, Fordham University, Boston University, Brandeis University, New York University, and Miami University.

Figure 5 **The Regression Weights (Maximum Likelihood and Bayesian) in Modeling Campus Form**

			Maximum Likelihood		Bayesian		
			Regression Weights	P value	Regression Weights	95% Lower bound	95% Lower bound of
GRN1	<---	Green	1.000		1.000		
GRN3	<---	Green	-.286	.000	-.295	-0.467	-0.154
GRN2	<---	Green	1.149	.000	1.159	0.771	1.649
CON1	<---	Urban	1.000		1.000		
CON2	<---	Urban	.878	.020	1.050	0.271	1.845
URB1	<---	Urban	34.132	.000	37.117	27.220	51.123
URB2	<---	Urban	.117	.048	.129	0.044	0.233
URB3	<---	Urban	150.570	.000	164.637	117.294	232.034
DEN1	<---	Urban	20.385	.000	22.356	16.391	30.852
GRN3	<---	Urban	-10.127	.002	-11.241	-17.536	-6.538
GRN2	<---	Urban	-15.798	.002	-17.271	-30.207	-5.286

Figure 6 **Modeling Students' Satisfaction and Learning Outcomes**



Note: FRR = freshman retention rate; GRA6 = percentage of students graduating in six years; UnderGrad = total number of undergraduate enrollments (1 equals 1,000 students); SAT = average SAT score; Faculty = percentage of classes with fewer than 20 students; Research = type of university (Research 1 or Research 2).

RETENTION, GRADUATION, AND CAMPUS FORM

After modeling campus form through three distinct latent variables, we investigated the relationship between campus form, freshman retention rate, and six-year graduation rate. Figure 6 shows the path diagram of our model. The three latent variables—degree of urbanism, greenness, and campus living—were generated from 10 observed variables according to the model confirmed in the previous step. Similar to the previous step, we used a marker variable strategy to specify the scale of latent variables based on one observed variable. The latent variables are fixed to have means of 0, but their variances are not fixed.

Our hypothesis is that the morphological dimensions (latent variables) can have direct effects on students' satisfaction with their college experience and their overall academic performance. Also, students' satisfaction with their college experience can have a direct effect on their graduation. We considered four control variables for this model: (1) the total number of undergraduate enrollments to control for the size of the university; (2) the average SAT score to control for the student selectivity of the university; (3) the percentage of classes with fewer than 20 students to control for the faculty resources of the university; and (4) the Research 1 or Research 2 university dummy variable to control for the level of research activity. We also tested other control variables such as enrollment profile, university type (private or public), climate, crime rate, and the average total indebtedness of graduates; they had no significant effect on either outcome variable. In addition, we assumed that the exogenous variables are not orthogonal. Therefore, we estimated the covariance between all exogenous variables.

Because our sample size was relatively small, similar to the previous step we examined our model using both maximum likelihood and Bayesian estimations. The structural equation model obtained through maximum likelihood estimation had 71 degrees of freedom and a X^2 value of 70.206 with a P value of 0.504. This P value, along with all model fit indicators (CFI is 1 and RMSEA is .000), indicates good model fit. The structural equation model obtained through Bayesian estimation had a Posterior Predictive P value of 0.45, which indicates good model fit as well.

Figure 7 shows the direct regression weights with both maximum likelihood and Bayesian estimation. The results show that all three campus form variables have a significant positive correlation with freshman retention rate. To the best of our knowledge, this is the first time that a significant correlation between the morphology of university campuses and freshman retention rates has been reported. One unit increase in the urbanism latent variable (with the range of 1.90) is associated with an increase in freshman retention of 4.8 percent. One unit increase in the greenness latent variable (with the range of 37.75) is associated with an increase in freshman retention of 0.2 percent. Also, one percent increase in on-campus residents is associated with an increase in freshman retention of almost 0.1 percent. Note that even a one percent increase in the freshman retention rate has an important effect, considering the fact that it may change the future of 200 people per year in a university with 20,000 students.

To the best of our knowledge, this is the first time that a significant correlation between the morphology of university campuses and freshman retention rates has been reported.

Figure 7 **The Regression Weights (Maximum Likelihood and Bayesian) in Modeling Students' Satisfaction and Learning Outcomes**

			Maximum Likelihood			Bayesian		
			Regression Weights	Standardized Regression Weights	P value	Regression Weights	95% Lower bound	95% Lower bound of
FRR	<--	Urban	4.809	.177	.034	5.101	.393	10.877
FRR	<--	Green	.206	.215	.023	.208	0.429	0.449
FRR	<--	Living	.097	.251	.004	.097	0.026	0.167
FRR	<--	Research	-2.773	-.151	.022	-2.827	-5.364	-0.339
FRR	<--	Faculty	-.135	-.199	.005	-.134	-0.235	-0.034
FRR	<--	SAT	.046	.629	***	.045	0.031	0.059
FRR	<--	UnderGr	.162	.169	.015	.164	0.023	0.305
GRA6	<--	FRR	1.355	.068	***	1.365	1.084	1.640
GRA6	<--	Urban	3.662	.146	.210	3.848	-2.415	11.651
GRA6	<--	Green	.278	.144	.023	.276	0.022	0.583
GRA6	<--	Living	.111	.007	.010	.111	0.018	0.203
GRA6	<--	SAT	.017	.036	.094	.016	-0.004	0.037
GRA6	<--	Research	.252	.116	.871	.281	-3.012	3.494
GRA6	<--	Faculty	.048	.078	.442	.051	-0.085	0.180
GRA6	<--	UnderGr	.148	.681	.082	.152	-0.027	0.335

Note: Dropping the covariates/control variables increases the coefficients, but does not change their signs or the significance levels of campus form variables. The coefficient estimates are Urban -> FRR 9.764; Green -> FRR .376; Living -> FRR .168; Urban -> GRA6 4.50; Green -> GRA6 .285; Living -> GRA6 .106.

The impact of the freshman retention rate on the six-year graduation rate is very strong and significant. A one percent increase in freshman retention can increase the six-year graduation rate by 1.355 percent. Since all variables (three latent variables and four control variables) showed significant impact on the freshman retention rate, and the freshman retention rate has a significant impact on the six-year graduation rate, we can conclude that all variables have a significant indirect impact on the six-year graduation rate. However, only two variables (greenness and campus living) other than freshman retention rate show a significant direct impact on the six-year graduation rate. The total standardized effects of campus living on the graduation rate is .315, and the total standardized effects of greenness is .292 (figure 8). A 10 percent increase in on-campus residents is associated with an increase in the six-year graduation rate of 2.43 percent, considering both direct and indirect effects. Also, a 10 unit increase in the greenness measure is associated with an increase in the six-year graduation rate of 5.58 percent, again considering both direct and indirect effects.

A 10 percent increase in on-campus residents is associated with an increase in the six-year graduation rate of 2.43 percent.

Figure 8 **The Total Effects of Exogenous Variables on Six-Year Graduation Rate**

	Maximum Likelihood		Bayesian	
	Total Effects	Standardized Total Effects	Total Effects	Standardized Total Effects
Urban	10.181	.189	10.754	.189
Green	.558	.292	.558	.291
Living	.243	.315	.245	.315
Research	-3.507	-.096	-3.575	-.098
Faculty	-.135	-.100	-.132	-.097
SAT	.078	.544	.078	.542
UnderGr	.367	.193	.377	.198
FRR	1.355	.681	1.365	.685

CONCLUSION

It became clear from the literature review that although campus planning and design have received extensive attention from the profession in recent years, this field is understudied in academia. This research is an attempt to provide new insight into the field of campus planning, using the campus environment to address certain institutional missions. We used a sample of 103 research-intensive universities to highlight the association of three campus qualities—urbanism, greenness, and campus living—with the two major concerns of higher education institutions: retention and graduation rates. Because of the limitations of this study,[5] we are cautious about claiming causality between a "well-designed" campus and students' retention and graduation. However, the strength of these associations is intriguing.

An interesting finding of this research is that although *greenness* and *urbanism* are negatively correlated with each other, both are positively associated with students' satisfaction with their college experience, controlling for other university qualities. This finding can shed light on a classic debate among campus planners and designers: the dichotomy between a green and pastoral campus and an urban campus. The results show that campuses must have a fair amount of both qualities to get a high design score. A green campus can create a pleasant "college experience" and encourage students to spend time and "socialize" on campus. At the same time, an urban-feeling campus can act as a "supportive environment" for increasing students' perception of "social connectedness." These constructs were shown to be associated with student retention in previous studies (Ashar and Skenes 1993; Berger and Braxton 1998; Lounsbury and DeNeui 1995; Naretto 1995; Roberts and Styron 2010). It is important to note that greenness is measured in a quarter-mile buffer around campus buildings and not just on the campus grounds since accessibility is more important than ownership. Therefore, universities located in an urban setting should be sensitive to not only the greenness of their campus, but also the accessibility of local parks and green spaces. Likewise, universities with rural and suburban campuses should plan for and support more activities in their adjacent urban areas.

The other major finding is the strong association of on-campus living with student retention and graduation rates, after controlling for other influential factors. This finding is in accordance with previous studies that have shown

5 For example, it is a cross-sectional study, not a longitudinal study. Sample size, data availability, and the use of aggregated data at the campus level are other limitations of this study.

that students who live on campus have a greater sense of community and higher retention rates (Lounsbury and DeNeui 1995; Thompson, Samiratedu, and Rafter 1993). As described in the results section, a 10 percent increase in on-campus residents is associated with an increase in the six-year graduation rate of 2.43 percent. This finding suggests that campus housing may not just provide a convenient residence for students, but also largely impact their quality of life and education. Most importantly, improving this aspect of campus form is more feasible and economical than improving greenness or urbanism. We should note that while the number of students living on campus is important, the quality of their living is even more so. While we could not measure the quality of students' living in university housing on the selected campuses, in the reviewed master plans certain aspects were highlighted. For example, student housing should be close enough to the campus core to make it convenient for students to walk or bike to major campus destinations. Students should also have reasonable housing choices with respect to type, style, and cost. In addition, universities should pursue innovative living-learning communities (LLCs) as a recruitment and retention tool. For example, the University of Utah has launched a plan to recruit the "400 best student entrepreneurs" to live in a $45 million residential building starting fall 2016. The goal is to create a place where student entrepreneurs "live, create, launch."[6]

Finally, it is important to understand that we have evaluated a number of broad qualities of the "well-designed" campus and not any specific recommendation. For example, this research does not specifically assess the effect of a recommendation such as "encouraging mixed-use development along a street corridor at the campus border;" however, this specific recommendation may increase the degree of urbanism on campus, which has proved to be a positive quality. If we want to further translate our findings into lessons for practitioners, we should stress those recommendations that are shown to have strong associations with students' experience and performance. The first and foremost recommendation is to increase campus housing. The second recommendation is to decrease surface parking area, which can increase campus greenness or urbanism or both. And the third recommendation depends on the campus setting. For urban campuses, it is to invest in green spaces on and adjacent to campus. For suburban and rural campuses, it is to encourage infill and mixed-use development on or adjacent to campus.

Overall, the proposed theoretical framework can be related to different research topics in regard to university campuses. For example, research on the impact of university interventions in surrounding neighborhoods is limited. There have been some detailed case studies on campus expansion and neighborhood revitalization in the past decades; some of these projects were successful, some were not. However, whether the morphology of the campus, its surrounding neighborhood, and their physical interaction are the influential factors in the success of university interventions is an unexplored research area. To conduct systematic research in this area, the proposed theoretical framework for analyzing campus form can be applied.

6 For more information about this project, see http://lassonde.utah.edu/u-of-utah-recruiting-the-400-best-student-entrepreneurs/.

REFERENCES

Ashar, H., and R. Skenes. 1993. Can Tinto's Student Departure Model Be Applied to Nontraditional Students? *Adult Education Quarterly* 43 (2): 90–100.

Bank, B. J., B. J. Biddle, and R. L. Slavings. 1992. What Do Students Want? Expectations and Undergraduate Persistence. *Sociological Quarterly* 33 (3): 321–35.

Belfield, C. R., and T. Bailey. 2011. The Benefits of Attending Community College: A Review of the Evidence. *Community College Review* 39 (1): 46–68.

Berger, J. B., and J. M. Braxton. 1998. Revising Tinto's Interactionalist Theory of Student Departure through Theory Elaboration: Examining the Role of Organizational Attributes in the Persistence Process. *Research in Higher Education* 39 (2): 103–19.

Black, D. A., and J. A. Smith. 2004. How Robust Is the Evidence on the Effects of College Quality? Evidence from Matching. *Journal of Econometrics* 121 (1–2): 99–124.

———. 2006. Estimating the Returns to College Quality with Multiple Proxies for Quality. *Journal of Labor Economics* 24 (3): 701–28.

Black, D., J. Smith, and K. Daniel. 2005. College Quality and Wages in the United States. *German Economic Review* 6 (3): 415–443.

Braxton, J. M., and S. A. McClendon. 2001. The Fostering of Social Integration and Retention through Institutional Practice. *Journal of College Student Retention: Research, Theory & Practice* 3 (1): 57–71.

Braxton, J. M., N. Vesper, and D. Hossler. 1995. Expectations for College and Student Persistence. *Research in Higher Education* 36 (5): 595–612.

Byrne, B. M. 2010. *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*. 2nd ed. New York: Routledge.

Cervero, R., and K. Kockelman. 1997. Travel Demand and the 3Ds: Density, Diversity, and Design. *Transportation Research Part D: Transport and Environment* 2 (3): 199–219.

Chapman, M. P. 2006. *American Places: In Search of the Twenty-First Century Campus*. Westport, CT: Praeger.

Coulson, J., P. Roberts, and I. Taylor. 2010. *University Planning and Architecture: The Search for Perfection*. New York: Routledge.

———. 2014. *University Trends: Contemporary Campus Design*. New York: Routledge.

Daniel, K., D. Black, and J. Smith. 1997. College Quality and the Wages of Young Men. UWO Department of Economics Working Papers, University of Western Ontario Department of Economics, London, Ontario.

Dober, R. P. 1996. *Campus Planning*. Ann Arbor, MI: Society for College and University Planning.

Eckles, J. E. 2010. Evaluating the Efficiency of Top Liberal Arts Colleges. *Research in Higher Education* 51 (3): 266–93.

Ethington, C. A., and J. C. Smart. 1986. Persistence to Graduate Education. *Research in Higher Educatio*n 24 (3): 287–303.

Ewing, R., and R. Cervero. 2010. Travel and the Built Environment: A Meta-Analysis. *Journal of the American Planning Association* 76 (3): 265–94.

Hajrasouliha, A. H. 2015. The Morphology of the "Well-Designed Campus": Campus Design for a Sustainable and Livable Learning Environment. Ph.D. diss., University of Utah.

Hillier, B. 2007. *Space Is the Machine: A Configurational Theory of Architecture*. Electronic ed. London: Space Syntax.

Hillier, B., and J. Hanson. 1984. *The Social Logic of Space*. Cambridge: Cambridge University Press.

Kenney, D. R., R. Dumont, and G. Kenney. 2005. *Mission and Place: Strengthening Learning and Community through Campus Design*. Westport, CT: Praeger.

Kuh, G. D. 2001. Assessing What Really Matters to Student Learning: Inside the National Survey of Student Engagement. *Change: The Magazine of Higher Learning* 33 (3): 10¬–17.

Kuh, G. D., T. M. Cruce, R. Shoup, J. Kinzie, and R. M. Gonyea. 2008. Unmasking the Effects of Student Engagement on First-Year College Grades and Persistence. *Journal of Higher Education* 79 (5): 540–63.

Landis, J. R., and G. G. Koch. 1977. The Measurement of Observer Agreement for Categorical Data. *Biometrics* 33 (1): 159–74.

Lau, L. K. 2003. Institutional Factors Affecting Student Retention. *Education* 124 (1): 126–36.

Lei, S. A., and N.-K. Chuang. 2010. Demographic Factors Influencing Selection of an Ideal Graduate Institution: A Literature Review with Recommendations for Implementation. *College Student Journal* 44 (1): 84–96.

Lounsbury, J. W., and D. DeNeui. 1995. Psychological Sense of Community on Campus. *College Student Journal* 29 (3): 270–77.

Naretto, J. A. 1995. Adult Student Retention: The Influence of Internal and External Communities. *NASPA Journal* 32 (2): 90¬–97.

National Center for Education Statistics. 2015. Fast Facts: Graduation Rates. Retrieved May 4, 2016, from the World Wide Web: https://nces.ed.gov/fastfacts/display.asp?id=40.

Quaye, S. J., and S. R. Harper, eds. 2014. *Student Engagement in Higher Education: Theoretical Perspectives and Practical Approaches for Diverse Populations*. 2nd ed. New York: Routledge.

Riginos, C., and J. B. Grace. 2008. Savanna Tree Density, Herbivores, and the Herbaceous Community: Bottom-Up vs. Top-Down Effects. *Ecology* 89 (8): 2228–38.

Roberts, J., and M. N. McNeese. 2010. Student Involvement/Engagement in Higher Education Based on Student Origin. *Research in Higher Education Journal* 7: 1–11.

Roberts, J., and R. Styron, Jr. 2010. Student Satisfaction and Persistence: Factors Vital to Student Retention. *Research in Higher Education Journal* 6: 1–18.

Seidman, A., ed. 2005. *College Student Retention: Formula for Student Success*. Westport, CT: Praeger.

Thompson, J., V. Samiratedu, and J. Rafter. 1993. The Effects of On-Campus Residence on First-Time College Students. *NASPA Journa*l 31 (1): 41–47.

Toor, W., and S. W. Havlick. 2004. *Transportation and Sustainable Campus Communities: Issues, Examples, Solutions*. Washington, DC: Island Press.

AUTHOR BIOGRAPHIES

AMIR H. HAJRASOULIHA, PH.D., is an assistant professor at the Department of City and Regional Planning, Cal Poly State University, San Luis Obispo. He holds a bachelor's of architecture from Beheshti University, master's degrees in city planning and urban design from the University of Tehran and the University of Michigan, and a Ph.D. in urban planning and design from the University of Utah. His main research interest concerns campus planning and urban morphology, using qualitative and quantitative methods together.

REID EWING, PH.D., is a professor of city and metropolitan planning at the University of Utah, associate editor of the *Journal of the American Planning Association*, and columnist for *Planning* magazine, writing the bi-monthly column "Research You Can Use." He holds master's degrees in engineering and city planning from Harvard University and a Ph.D. in urban planning and transportation systems from the Massachusetts Institute of Technology. A recent citation analysis by Virginia Tech found that his work is the sixth-most highly cited among more than 850 planning academics in the United States.

Planning for Higher Education

Society for College and University Planning
www.scup.org

ISSN 0736-0983

Indexed in the Current Index to Journals in Education (ERIC), Higher Education Abstracts, and Contents Pages in Education.
Also available from ProQuest Information and Learning, 789 E. Eisenhower Parkway, P.O. Box 1346, Ann Arbor, Michigan

ABOUT PLANNING FOR HIGHER EDUCATION JOURNAL

Planning for Higher Education is a publication of the Society for College and University Planning, an association of professionals devoted to planning at academic institutions. This journal seeks to transmit the knowledge, ideas, research, and experience most likely to advance the practice of higher education planning and policy making. SCUP members receive a complimentary subscription. The society offers both individual and institutional group memberships.

For contributor guidelines, subscription information, or permission to share from the journal, visit **www.scup.org/phe** or contact **managing.editor@scup.org**. Correspondence about membership should be sent to **membership@scup.org**.

ADVERTISING IN THE JOURNAL

Thank you to the organizations that have chosen to advertise with SCUP in this publication. Please remember to consider these organizations when you are looking for additional planning services.

Interested in advertising with SCUP? Please visit **www.scup.org/advertise** or contact **advertise@scup.org**.

ABOUT THE SOCIETY FOR COLLEGE AND UNIVERSITY PLANNING (SCUP)

The Society for College and University Planning is a community of higher education planning professionals that provides its members with the knowledge and resources to establish and achieve institutional planning goals within the context of best practices and emerging trends. For more information, visit **www.scup.org**.

WHAT IS INTEGRATED PLANNING?

Integrated planning is the linking of vision, priorities, people, and the physical institution in a flexible system of evaluation, decision-making and action. It shapes and guides the entire organization as it evolves over time and within its community.