Connecting SAU Experiences to Student Growth -- a Structural Equation Modeling Approach

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07P:249 – Structural Equation Modeling

George Kuh, Director of the Center for Postsecondary Research at Indiana University Bloomington, summarizes more than two decades of research into the impact of college on student development by stating:

> … the time and energy students devote to educationally purposeful activities is the single best predictor of their learning and personal development…. Those institutions that more fully engage their students in the variety of **activities that contribute to valued outcomes of college** can claim to be of higher quality in comparison with similar types of colleges and universities (Kuh, 2003, p.1).

Thus, in order to evaluate its quality, a college or university must first identify its valued outcomes and then measure the extent to which its activities contribute to those outcomes.

This framework can be used to evaluate St. Ambrose University (SAU) as it seeks its 10-year re-accreditation from the Higher Learning Commission. The mission of SAU, "[to] enable its students to develop intellectually, spiritually, ethically, socially, artistically, and physically to enrich their own lives and the lives of others," identifies some of the University's valued outcomes. Stated generally, SAU values both the academic and personal growth of its students. Since SAU is a private university seeking to increase enrollment and alumni contributions, another valued outcome is that students gain a positive opinion of their University experience.

To achieve these valued outcomes, St. Ambrose has implemented a variety of programs and initiatives, including its Retention Office, New Student Seminars, Learning Communities, Academic Advising, the Student Success Center, Academic Themes, Welcome Week, Peer Mentoring, First Year Orientations, the Center for Teaching Excellence, Student Life Committee, and the Campus Ministry (Fr. Bud Grant, email to author, February 6, 2007). These initiatives, many of which have been around for years, have always been *assumed* to contribute to the academic and personal growth of SAU students. It is only recently that SAU has begun thinking about systematically assessing the effectiveness of these initiatives on student growth.

One way in which SAU has begun to assess the effectiveness of its activities is by administering the National Survey of Student Engagement (NSSE) to first-year and graduating students. The NSSE, developed by Indiana University in 1999, is a nationally-normed, 109-item survey designed to, "… assess the extent to which students are engaged in empirically derived good educational practices and what they gain from their college experiences" (Kuh, 2001, p.11). These "good" educational practices measured by the survey items are based on research into the best practices in undergraduate education (Chickering & Gamson, 1987; Pascarella & Terenzini, 1991; Pascarella, 2001). A list of the NSSE items used in this study can be found in Appendix A.

Researchers have used both substantive theory and empirical analyses to gather evidence of the validity of NSSE scores and to determine the number of latent factors measured by the survey items. Initially, the latent factors measured by NSSE items were determined through principal components analyses with oblique rotations (Kuh, 2003). The results of these analyses were combined with theory to group NSSE items into five Benchmarks of Effective Educational Practice: (1) Level of Academic Challenge, (2) Active and Collaborative Learning, (3) Student Interactions with Faculty Members, (4) Enriching Educational Experiences, and (5) Supportive Campus Environment (NSSE, 2006). The validity of grouping items into these benchmarks is supported by the high internal consistency estimates of each benchmark (coefficient alpha ranges from .65 to .77 for the benchmarks) and the correlations between items within each benchmark (NSSE, 2007).

Laird, et. al. (2005) grouped NSSE items into different categories based on theories of deep (higher-order) and surface-level learning. Although the NSSE was not developed to assess deep learning, the researchers identified fifteen items that measure three components of deep learning: (1) higher-order learning, (2) integrative learning, and (3) reflective learning. An exploratory factor

analysis found that these factors accounted for more than 60% of the variance in the items. A confirmatory factor analysis was then conducted on a different data set to compare this 3-factor model to a simpler one-factor model and a 2nd-order factor model of deep learning. The researchers concluded that the 2nd-order factor model of deep learning best represented the underlying structure of the data.

Other principal components analyses have been conducted to identify related groups of NSSE items (Kuh, 2003). The 2006 NSSE Scale Properties guide identifies the following item groupings: (1) satisfaction, (2) quality of campus relationships, (3) environment emphasis, (4) quality of campus relationships, (5) gains in personal and social development, (6) gains in practical competence, (7) gains in general education, (8) active/collaborative learning experiences, (9) course/outside interactions with faculty, (10) varied educational experiences, (11) use of information technology, (12) emphasis on diversity, (13) support for student success, (14) interpersonal environment, and (15) diversity (NSSE, 2007). Based on the facts that seemingly similar factors contain different items and seemingly different factors share common items, it seems reasonable to assume that NSSE items measure a wide variety of college experiences and outcomes.

Purpose of Study

The purpose of this study is to evaluate the effectiveness of SAU activities in contributing to the academic and personal growth of its students. To do this, groups of NSSE items must first be identified to represent the types of activities implemented at SAU (using theory and factor analyses). Next, groups of NSSE items must be identified to represent the valued outcomes of SAU. Finally, a structural model must be constructed and evaluated to determine the relationship between the activities and valued outcomes at SAU.

Data

The data in this study were collected from a 2004 online administration of the NSSE to 694 sophomores, juniors, and seniors at SAU. With such a large sample size (relative to enrollment), the demographics of the respondents were extremely similar to the population of SAU students – 65% of the respondents were female, 90% were Caucasian, and the mean ACT score was 22.4. The only concern is that part-time students are not fully represented in the data (9% of respondents were part-time compared to 14% of all SAU students). The data from two respondents were eliminated due to their lack of responses to the majority of items. Otherwise, the data contained no missing cases.

Identifying Factors

Before running any formal analyses, NSSE items were examined in an attempt to identify logical, substantive groupings. First, the NSSE was examined in an attempt to identify items that measure student engagement at SAU, such as in-class work and academic effort. Second, an attempt was made to identify items that measure the quality of experiences (activities/programs) offered by SAU, such as course requirements, extracurricular activities, and quality of instruction. These factors, student engagement and SAU experiences, will be considered to be exogenous latent factors that are associated with the University's valued outcomes.

After identifying the exogenous latent factors, items were examined to identify item groups that represent the outcomes valued by SAU. As discussed earlier, SAU's valued outcomes include the academic/social growth of its students and the development of positive student opinions towards the University. These valued outcomes will be represented in this study as endogenous latent factors.

Several analyses were then conducted on these groups of items to determine if, in fact, they do represent the factors of student engagement, SAU experiences, student growth, and student opinions. The actual items grouped into each factor can be found in Appendix A.

Exogenous Student Engagement Factors

Recent studies into postsecondary educational outcomes have found student engagement to be an important predictor of student success and measure of institutional quality (Kuh, 2001, 2007; Pascarella, 2001). These student engagement theories promote the idea that students who put forth time and energy into worthwhile educational activities will grow academically and socially (Gonyea, 2006). The book *Seven Principles for Good Practice in Undergraduate Education* (Chickering & Gamson, 1987) identifies seven indicators of student engagement: student-faculty contact, cooperation among students, active learning, prompt feedback from faculty members, time on task, high expectations, and respect for diverse talents and ways of learning. It seems as though these indicators of student engagement guide the development and implementation of activities implemented at SAU.

In a NSSE validation study, Kuh (2003) conducted exploratory factor analyses (using principal components extraction with oblique rotations) to group NSSE items into these student engagement factors. Kuh found that 22 NSSE items address four factors of student engagement: student-faculty interaction, student-student interaction, diversity, and classwork. In order to determine if data collected from the SAU administration of the NSSE are somehow unusual, these analyses were replicated using Stata software. Item correlations had patterns similar to those found by Kuh. After moving three items to different factors (based on item content and factor loadings), NSSE data from SAU seem to mirror Kuh's results – the four factors account for 71.2% of the variance in the observed items. The following table displays the rotated factor loadings for the items considered to measure student engagement factors.

	Student Engagement Factor Loadings (Principal Components Extraction; Promax Rotation)				
	Student-Faculty Interaction	Student-Student Interaction	Diversity	Classwork	Total
FACGRADE	.8380				
FACPLANS	.7364				
EMAIL	.7146				
FACIDEAS	.6719				
FACFEED	.5265				
FACOTHER	.4981				
COMMPROJ		.6743			
OCCGRP		.5508			
TUTOR***		.4996			
ITACADEM		.4561			
CLASSGRP		.3827			
CLSPRESEN		.2934			
DIFFSTU			.9155		
DIVRSTUD			.8087		
OOCIDEAS			.4574		
INTEGRAT				.7912	
DIVCLAS				.5500	
WORKHARD		(*** = item changed position		.5250	
REWOPAP		From Kuh study)		.5054	
INTIDEAS***				.3466	
CLQUEST***				.3296	
% variance explained	22.8%	19.3%	16.6%	12.5%	71.2%

Exogenous SAU Experiences Factors

While student engagement measures the time and effort student put into their academic work, student growth also depends upon the quality of experiences and opportunities offered by a university. Based on the research of Laird et. al (2005) into deep learning opportunities and knowledge of the extra-curricular activities offered by SAU, a set of 17 items were identified as possibly measuring the quality of experiences provided by SAU. Another exploratory factor analysis was conducted to determine the dimensionality of this proposed *SAU experiences* factor. This analysis found that four factors account for 64.3% of the observed variance. These factors – deep learning, course workload,

opportunities, and viewpoints – represent the quality of in-class and extra-curricular activities that students have access to at SAU. The following table displays the factor loadings estimated by this analysis:

	SAU Experience Factor Loadings (Principal Components Extraction; Promax Rotation)				
	Deep Learning	Course Workload	Opportunities	Viewpoints	Total
APPLYING	.8434				
EVALUATE	.8394				
ANALYZE	.8227				
SYNTHESIZE	.7869				
WRITEMID		.6729			
READASGN		.6691			
PROBSETA		.5452			
WRITEMOR		.5488			
EXAMS		.3094			
INDSTD			.7260		
SNRX			.6412		
RESRCH			.5968		
FORLNG			.5737		
STDABR			.5711		
OWNVIEW				.8798	
OTHRVIEW				.8546	
CHNGVIEW				.7660	
% variance explained	20.0%	16.5%	14.7%	13.1%	64.3%

Endogenous Student Growth Factors

Kuh (2003) conducted analyses to identify student growth factors in NSSE data. He found that NSSE items measure both the academic and personal-social growth of students. Because these factors represent one of the outcomes valued by SAU, this analysis was replicated to determine if item responses from SAU students can be grouped into these two factors. The following table shows that two factors account for 86.1% of the variance among 14 NSSE items:

	Student Growth Factor Loadings (PC Extraction; Promax Rotation)		
	Personal-Social Growth	Academic Growth	Total
GNETHICS	.8590		
GNSELF	.8469		
GNCOMMUN	.8441		
GNSPIRIT	.7685		
GNDIVERS	.7250		
GNINQ	.6976		
GNPROBSV	.6223		
GNANALYZ		.8688	
GNWRITE		.8267	
GNQUANT		.8189	
GNSPEAK		.7937	
GNCMPTS		.7322	
GNGENLED		.6364	
GNWORK		.4413	
% variance explained	43.9%	42.2%	86.1%

Endogenous Student Opinion Factors

Kuh (2003) also examined NSSE data to identify those items that measure students' opinions towards their school experiences. He found that 11 items measure three factors of student opinions. After adding one variable to the analysis based on its content, three factors (accounting for 82.8% of the variance) seem to underlie SAU student responses: quality of relationships, social climate, and academic climate. The following table displays the rotated factor loadings:

	Student Opinion Factor Loadings (PC Extraction; Promax Rotation)			
	Relationship Quality	Social Climate	Academic Climate	Total
SAMECOLL	.9041			
ENTIREXP	.9008			
ENVFAC	.7723			
ENVSTU	.5245			
ENVADM	.4101			
ENVSOCAL		.9005		
ENVEVENT		.8433		
ENVNACAD		.7772		
ENVDIVRS		.6996		
ENVSCHOL			.9990	
ADVISE			.6505	
ENVSUPRT			.3370	
% variance explained	33.8%	31.3%	17.7%	82.8%

Based on these exploratory factor analyses, it appears as though NSSE items in this study represent 13 factors. Four of the factors can be classified as measuring *student engagement* and another four factors can be classified as measuring *SAU experiences*. Two factors seem to measure *student growth* and three factors appear to measure *student opinions*. Estimates of reliability also support the conclusion that the items within each factor are unidimensional. Estimated values of Cronbach's alpha for each factor (displayed in Appendix A) were between 0.5562 (for the academic climate factor) and 0.9001 (for the personal-social growth factor).

Measurement & Structural Models

In order to determine the relationship among these factors (and the fit of the items to the factor models), a two-step structural equation modeling analysis will be conducted (Kline, 2005). First, a measurement model will be constructed and its fit to the data will be evaluated. Once an acceptable measurement model has been identified, structural models will be developed, tested, and interpreted.

Looking at the nature of the collected data, it appears as though responses to NSSE items will present some problems for this study. First, since NSSE items are constructed with 4- or 6-point Likert scales, the endogenous variables cannot be assumed to be continuously distributed (and, based on histograms of item responses, should not be assumed to approximate normal distributions). Second, this study analyzes responses from 694 students on 64 NSSE items. In order to obtain more stable parameter estimates, especially with non-normal data, a larger sample-size-to-observed-variables ratio would be preferred. Third, it is difficult to assume linear relationships among 4-point Likert scale items. Because the item responses do not appear to meet the linearity and multivariate normality assumptions, SEM parameters should not be estimated using maximum likelihood estimation.

To address the problems with these Likert scale items, Kline cautiously suggests grouping items into parcels – linear composites of homogeneous items (Kline, 2005, p.197). Based on the factor loadings from the previously conducted exploratory factor analyses, the correlations among items, and content considerations, items in this study were grouped into parcels corresponding to the 13 factors found previously. Appendix A displays the items grouped into each parcel along with estimated values of Cronbach's Alpha for each item parcel. The relatively large internal consistency estimates provide some support for the decision to create these item parcels.

Serendipitously, the item parcels all turned out to have 24-point scales. These item parcels will therefore be assumed to be continuous variables. An examination of the distributions for each item parcel finds that most items approximate a normal distribution. Some parcels (deep learning, academic growth, social climate) had negatively skewed distributions and other parcels (student-student

interaction, social climate) had positively skewed distributions, but no parcels greatly deviated from normality. Appendix B displays the correlations and covariances among item parcels. The low-to-moderate correlations among item parcels indicates that multicollinearity should not be a problem. The scatterplots in Appendix B indicate that although some item parcels have low correlations with others, none of the parcels have obvious nonlinear relationships. The assumption of linearity, therefore, seems to be reasonable with these item parcels.

Measurement Model

The four-factor CFA model displayed in Appendix C was fit to the item parcel data using maximum likelihood estimation in AMOS. A converged-admissible solution was obtained, but the chi-square fit statistic ($\chi^2_{(59)} = 322.245$, $p<.001$) indicates the fit is not great. This large value of this chi-square, at 5.46 times bigger than the model degrees of freedom, might be due to poor model fit, non-normality of the data, or the large sample size. The CFI value of 0.614 indicates that this model is only slightly better than a baseline model assuming uncorrelated factors (Kline, 2005, p.141). The sample-size and parsimony-adjusted RMSEA value of 0.065 with a 90% confidence interval of (.056, .073), on the other hand, indicates that the model fits the data fairly well (Kline, 2005, p.139). This is supported by the Goodness-of-Fit Index value of GFI = 0.922, which represents the proportion of observed covariances explained by the model-implied covariances (Garson, 2007).

An inspection of the model parameter estimates (in Appendix C) identifies some of the problems. First, the loadings of the *workload* and *opportunity* indicators are low (with R^2 values of .19 and .23, respectively). The residual covariances indicate that these indicators do not belong with any other factors; they just do not fit in this model. The large positive residual covariances between *academic climate* and *quality of relationships* and between *student-faculty interaction* and *student-student interaction* indicate that the measurement errors on these indicators are not independent.

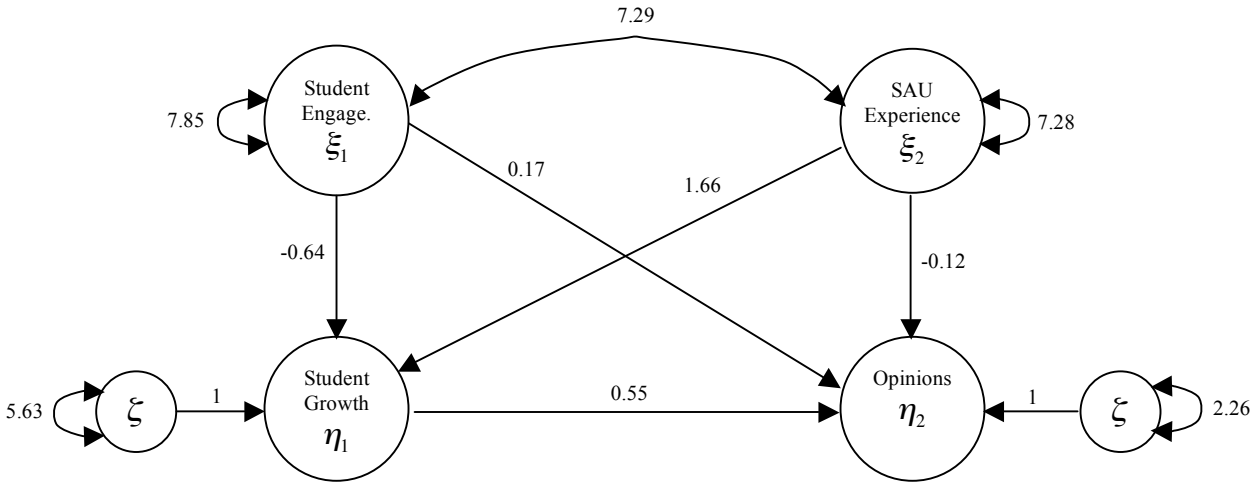
Based on these results, the *workload* and *opportunity* indicators were removed from the analysis. Also, measurement error variances between the pairs of indicators mentioned above were allowed to covary. Parameters for this respecified measurement model, found in Appendix D, were then estimated using AMOS.

The respecified model does fit the observed covariance matrix a bit better. The chi-square fit statistic ($\chi^2_{(36)} = 132.79$), at 3.7 times the degrees of freedom, is still bit large. The increased value of the CFI = 0.812 and the smaller value of the RMSEA = .051 (with 90% confidence interval of .042, .073) indicate that this model fits the data reasonably well. Reassuringly, the parameter estimates did not significantly change in this respecified model, although the R^2 values for *student-student interaction*, *student-student interaction*, *academic climate*, and *social climate* did decline from the original measurement model.

One more measurement model was specified as an alternate explanation of the data. This model had only two factors: one representing the combination of exogenous factors and the other representing the combination of endogenous factors. The fit of this measurement model was bad enough to eliminate it as a possible model for the data.

Structural Model

Settling on the (imperfect) respecified measurement model, the next step is to estimate the structural model. The structural model (displayed below) was specified to model the theoretical relationship among the exogenous and endogenous factors in this study. Using maximum likelihood estimation, AMOS calculated parameter estimates for the model. Since the structural part of this model is just-identified, it is an equivalent model to the respecified measurement model. Therefore, this model fits equally well to the data as the measurement model.



A competing structural model was then specified in order to determine the relative fit of the previous model. In this respecified model, the direct path between endogenous variables (from *student growth* to *opinions*) was eliminated. This elimination was based on the theoretical question of whether the amount of student growth at SAU influences a student's opinions about the University.

This (overidentified) respecified model is nested within the previous structural model, so a chi-square difference test can be used to test its relative fit. The respecified model yielded a chi-square value of $\chi^2_{(37)} = 178.71$, so the chi-square difference test of $\chi^2_{(37)} - \chi^2_{(36)} = 178.71 - 132.79 = \chi^2_{(1)} = 45.92$ indicates that this nested model has significantly worse fit than the original structural model. It also indicates that the path between endogenous variables is significantly different from zero.

Based on these results, the just-identified structural model displayed above is selected as a potentially useful, yet admittedly imperfect, model for evaluating SAU based on NSSE data.

Interpretation

AMOS reports R^2 values of 0.661 for the *opinions* factor and 0.578 for the *student growth* factor. These magnitudes of these values appear to be moderate, especially considering the variety of factors that could influence student growth and opinions. An interpretation of the total effects of this structural model would be:

(a) A one-point increase in student engagement is associated with a 0.642-point *decrease* in student growth and a 0.182-point *decrease* in student opinions (holding SAU experiences constant).
(b) A one-point increase in SAU experiences is associated with a 1.657 point increase in student growth and a 0.789-point increase in student opinions (holding student engagement constant)
(c) A one-point increase in student growth is associated with a 0.550-point increase in student opinions (holding student engagement and SAU experiences constant)

In attempting to explain the unusual conclusion that increasing student engagement actually decreases student growth and opinions, one could point out that the survey only measures student *perceptions* of engagement and growth. A much more simple explanation exists, however. The

following table displays the parameter estimates, standard errors, and significance of the model path coefficients (as estimated by AMOS):

Direct Effect	Estimate	Std. Error	Estimate / S.E.	P-value
Student Engagement → Student Growth	-0.642	1.183	-0.542	.587
Student Engagement → Opinions	0.171	0.428	0.401	.689
SAU Experiences → Student Growth	1.657	1.263	1.312	.190
SAU Experiences → Opinions	-0.122	0.507	-0.241	.810
Student Growth → Opinions	0.550	0.071	7.793	< 0.001

Whereas all factor loadings, variance estimates, and covariance estimates were statistically significant at the .001 level, the direct effects from the exogenous factors to the endogenous factors do not significantly differ from zero. Therefore, no interpretations should be made from these path coefficients. The only statistically significant direct effect is that student growth is positively associated with student opinions about SAU.

Perhaps the lack of significant associations can prove to be useful. Since positive relationships were expected among all the latent factors, it might be problematic that SAU students do not perceive direct relationships among their engagement, experiences, growth, and opinions. Perhaps SAU should explicitly tell students how their time, effort (engagement), and participation in activities (experiences) influence their academic and social growth. If students are made aware of the potential benefits of these activities, perhaps their opinions of SAU will also improve.

Limitations

This study had several notable limitations. First, the lack of direct measures of student academic and social growth may have contributed to the lack of significant relationships among latent factors. Even if student engagement and SAU experiences had significant effects on student growth, they might not have a significant impact on student perceptions of growth (as was measured in this study). Second, the use of item parcels may have led to the lack of significance. By combining items into parcels, some of the variability among items (and information about the latent factors) was lost. Finally, this study used data from a single survey to test a limited range of structural and measurement models. Perhaps the tested models, the assumed names of the latent factors, or the data from the NSSE led to the lack of statistical significance.

Further Research

This study could be improved by integrating more direct measures of student growth (GPAs, standardized test scores, General Education assessment data) into the model. The study could also be improved by including student ability as another exogenous factor that influences student growth and opinions. This ability factor could be estimated through student ACT scores and reported parental levels of education (both reported by students on the NSSE). Finally, the study could be improved by testing other, perhaps more sophisticated, models of postsecondary institutional effectiveness.

Sources:

Chickering, A.W., & Gamson, Z.F. (1987). Seven principles for good practice in undergraduate education. *AAHE Bulletin*, 39(7), 3-7.

Garson, G.D. (2007). Structural equation modeling. Course website for PA 765: Structural Equation Modeling. College of Humanities and Social Sciences, North Carolina State University. Site: http://www2.chass.ncsu.edu/garson/pa765/structur.htm accessed 04/09/2007.

Gonyea, R.M. (2006). The relationship between student engagement and selected desirable outcomes in the first year of college. Indiana University Center for Postsecondary Research. Paper presented at the 46th Annual Association for Institution Research Forum, May 2006, Chicago, IL.

Kuh, G.D. (2001). Assessing what really matters to student learning: inside the National Survey of Student Engagement. *Change*, 33(3), 10-17, 66.

Kuh, G.D. (2003). *The National Survey of Student Engagement: conceptual framework and overview of psychometric properties*. National Survey of Student Engagement, Indiana University Center for Postsecondary Research and Planning. Site: http://nsse.iub.edu/pdf/conceptual_framework_2003.pdf accessed 3/24/2007.

Kuh, G.D. et al. (2007). Connecting the dots: multi-faceted analyses of the relationships between student engagement results from the NSSE, and the institutional practices and conditions that foster student success. Revised final report prepared for Lumina Foundation for Education Grant #2518, Center for Postsecondary Research, January 2007, Indiana University Bloomington.

Laird, T.F.N., Shoup, R. & Kuh, G.D. (2005). *Measuring deep approaches to learning using the National Survey of Student Engagement*. Paper presented at the Annual Meeting for the Association for Institutional Research, May 2005, Chicago, IL.

(NSSE) National Survey of Student Engagement (2006). *The College Student Report 2006 Codebook*. Indiana University Center for Postsecondary Research and Planning

(NSSE) National Survey of Student Engagement (2007). Psychometric Portfolio. Indiana University Center for Postsecondary Research and Planning. Site: http://nsse.iub.edu/html/researchers.cfm accessed 3/30/2007.

Pascarell, E.T. (2001). Identifying excellence in undergraduate education: Are we even close? Change, 33(1), 18-23.

Pascarella, E.T., & Terenzini, P.T. (1991). *How college affects students: Findings and insights from twenty years of research*. San Francisco: Jossey-Bass.

Radford University (2001). *Radford University's Participation in the National Survey of Student Engagement: background, observations, and results*. Radford University Division of Planning and Research, 4/5/2001. Site: http://www.radford.edu/~planning/SACS/NSSEInformation040501.pdf accessed 3/24/2007.

Appendix A: NSSE Item codes (ordered by factors and item parcels)

Source: National Survey of Student Engagement (2006). The College Student Report 2006 Codebook. Indiana University Center for Postsecondary Research and Planning

Factor #1: Student Engagement (α= 0.7864)

Parcel: Student-Faculty Interaction (α= 0.7771)

1m. email	Used e-mail to communicate with an instructor
1n. facgrade	Discussed grades or assignments with an instructor
1o. facplans	Talked about career plans with a faculty member or advisor
1p. facideas	Discussed ideas from your readings or classes with faculty members outside of class
1q. facfeed	Received prompt written or oral feedback from faculty on your academic performance
1s. facother	Worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc.)

Parcel: Student-Student Interaction (α= 0.6465)

1g. classgrp	Worked with other students on projects during
1h. occgrp	Worked with classmates outside of class to prepare class assignments
1b. clpresen	Made a class presentation
1l. itacadem	Used an electronic medium (listserv, chat group, Internet, instant messaging, etc.) to discuss or complete an assignment
1j. tutor	Tutored or taught other students (paid or voluntary)
1k. commproj	Participated in a community-based project (e.g., service learning) as part of a regular course

Parcel: Diversity (α= 0.7237)

1u. divrstud	Had serious conversations with students of a different race or ethnicity than your own
1v. diffstu2	Had serious conversations with students who are very different from you in terms of religious beliefs, political opinions, and values
1t. oocideas	Discussed ideas from your readings or classes with others outside of class (students, family members, co-workers, etc.)

Parcel: Effort (α= 0.7090)

1a. clquest	Asked questions in class or contributed to class discussions
1c. rewropap	Prepared two or more drafts of a paper or assignment before turning it in
1d. integrat	Worked on a paper or project that required integrating ideas or information from various sources
1e. divclass	Included diverse perspectives (different races, religions, genders, political beliefs, etc.) in class discussions or writing assignments
1i. intideas	Put together ideas or concepts from different courses when completing assignments or during class discussions
1r. workhard	Worked harder than you thought you could to meet an instructor's standards or expectations

Factor #2: SAU Experiences (α= 0.6724)

Parcel: Deep Learning (α= 0.8486)

2b. analyze	Analyzing basic elements of an idea/experience/theory, such as examining a particular case in-depth and considering its components
2c. synthesz	Synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships
2d. evaluate	Judging the value of info/arguments/methods; examining how others gather/interpret data and assess soundness of conclusions
2e. applying	Applying theories or concepts to practical problems or in new situations

Parcel: Course Workload (α= 0.5777)

3a. readasgn	Number of assigned textbooks, books, or book-length packs of course readings during the current school year
3c. writemor	Number of written papers or reports of 20 pages or more during the current school year
3d. writemid	Number of written papers or reports between 5 and 19 pages during the current school year
4a. probseta	Number of problem sets that take you more than an hour to complete
5. exams	The extent to which your examinations during the current school year challenged you to do your best work

Parcel: Opportunities (α= 0.6335)

7d. resrch04	Work on a research project with a faculty member outside of course or program requirements
7e. forlng04	Foreign language coursework
7f. stdabr04	Study abroad
7g. indstd04	Independent study or self-designed major
7h. snrx04	Culminating senior experience (capstone course, senior project or thesis, comprehensive exam, etc.)

Parcel: Viewpoints (α= 0.8080)

6d. ownview	Examined the strengths and weaknesses of your own views on a topic or issue
6e. othrview	Tried to better understand someone else's views by imagining how an issue looks from his or her perspective
6f. chngview	Learned something that changed the way you understand an issue or concept

Factor #3: Student Growth (α= 0.7893)

Parcel: Personal-Social Growth (α= 0.9001)

11j. gninq	Learning effectively on your own
11k. gnself	Understanding yourself
11l. gndivers	Understanding people of other racial and ethnic backgrounds
11m. gnprobsv	Solving complex real-world problems
11n. gnethics	Developing a personal code of values and ethics
11o. gncommun	Contributing to the welfare of your community
11p. gnspirit	Developing a deepened sense of spirituality

Parcel: Academic Growth (α= 0.8870)

11a. gngenled	Acquiring a broad general education
11b. gnwork	Acquiring job or work-related knowledge and skills
11c. gnwrite	Writing clearly and effectively
11d. gnspeak	Speaking clearly and effectively
11e. gnanaly	Thinking critically and analytically
11f. gnquant	Analyzing quantitative problems
11g. gncmpts	Using computing and information technology

Factor #4: Student Opinions (α= 0.7663)

Parcel: Quality of Relationships (α= 0.7608)

13. entirexp	How would you evaluate your entire educational experience at this institution?
14. samecoll	If you could start over again, would you go to the same institution you are now attending?
8a. envstu	Quality of relationships with other students
8b. envfac	Quality of relationships with faculty members
8c. envadm	Quality of relationships with administrative personnel and offices

Parcel: Social Climate (α= 0.7979)

10c. envdivrs	The extent to which your institution encourages contact among students from different economic/social/racial/ethnic backgrounds
10d. envnacad	The extent to which your institution emphasizes providing the support you need to help you succeed academically
10e. envsocal	The extent to which your institution emphasizes providing the support you need to thrive socially
10f. envevent	The extent to which your institution emphasizes attending campus events & activities (speakers, performances, athletics, etc.)

Parcel: Academic Climate (α= 0.5562)

10a. envschol	The extent to which your institution emphasizes spending significant amounts of time studying and on academic work
10b. envsuprt	The extent to which your institution emphasizes helping you cope with your non-academic responsibilities (work, family, etc.)
12. advise	Overall, how would you evaluate the quality of academic advising you have received at your institution?

Factor #5: Student Ability

Parcel: Parental Education

27a. fathredu	Father's educational attainment
27b. mothredu	Mother's educational attainment

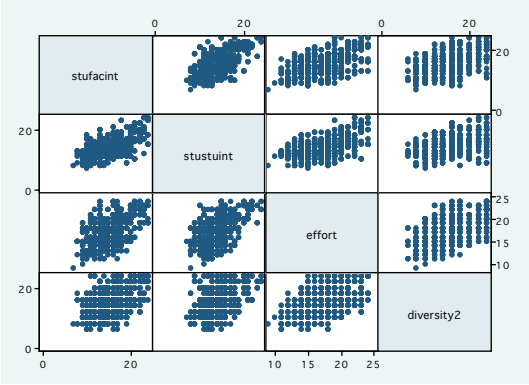
28. ACTT	ACT composite score

Demographic Data

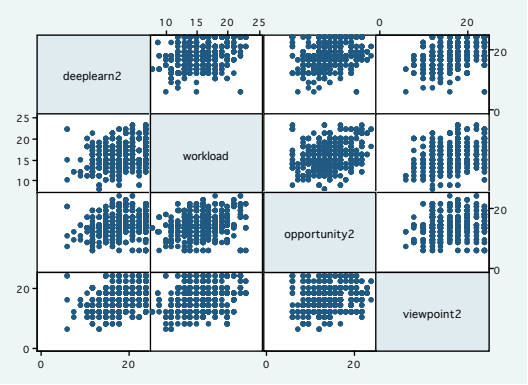
16. sex	Your sex
19. class	Freshmen, Sophomore, Junior, or Senior
23. enroll	Full-time or part-time enrollment
24. athlete	Are you a student-athlete?
25. grades	What have most of your grades been up to now at this institution?

Appendix B: Item Parcel Correlations & Covariances

	Variances (diagonal), covariances (upper-diagonal), and correlations (lower-diagonal) among item parcels												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Student-Faculty Int.	**12.40**	6.38	6.54	5.90	6.28	2.48	5.13	5.96	7.89	5.44	4.33	6.03	4.49
2 Student-Student Int.	.57	**10.08**	5.45	5.41	4.91	2.48	4.24	3.81	5.15	4.17	1.79	2.89	2.12
3 Diversity	.43	.40	**18.52**	6.77	7.62	4.01	4.54	8.31	6.99	5.54	2.99	3.67	3.29
4 Classwork	.54	.55	.50	**9.73**	6.54	3.22	3.72	6.61	5.76	5.69	2.63	2.64	3.85
5 Deep Learn	.45	.39	.45	.53	**15.74**	3.36	3.34	6.73	6.51	7.37	2.96	4.18	4.42
6 Workload	.24	.27	.32	.35	.29	**8.50**	2.51	3.27	3.37	3.55	1.83	0.43	2.29
7 Opportunities	.38	.35	.28	.32	.22	.23	**14.32**	2.41	1.96	3.02	.10	.88	.40
8 Viewpoints	.41	.29	.47	.51	.41	.27	.15	**17.20**	7.63	5.44	3.12	4.40	4.47
9 Personal Growth	.49	.35	.35	.40	.36	.25	.11	.40	**21.05**	11.45	7.62	11.06	7.27
10 Academic Growth	.41	.35	.34	.49	.50	.32	.21	.35	.67	**14.08**	6.61	6.77	6.62
11 Relationship Quality	.36	.17	.21	.25	.22	.19	.01	.22	.49	.52	**11.46**	7.10	6.86
12 Social Climate	.40	.21	.20	.20	.24	.03	.05	.25	.56	.42	.49	**18.58**	7.20
13 Academic Climate	.38	.20	.22	.36	.33	.23	.03	.32	.47	.52	.60	.49	**11.57**

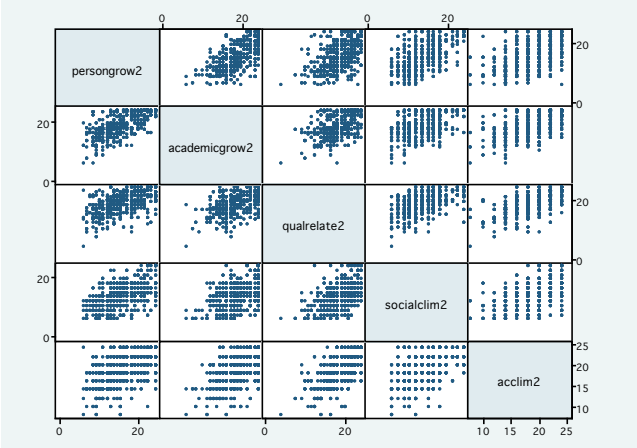


Student Engagement Item Parcel Scatterplot

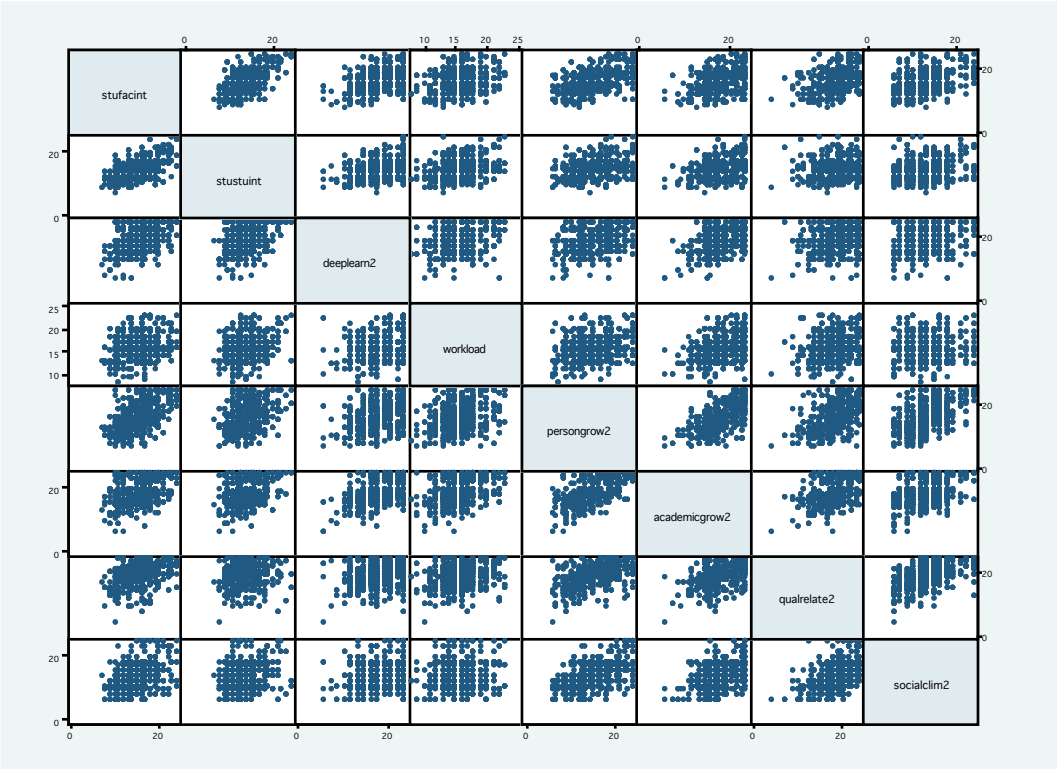


SAU Activities Item Parcel Scatterplot

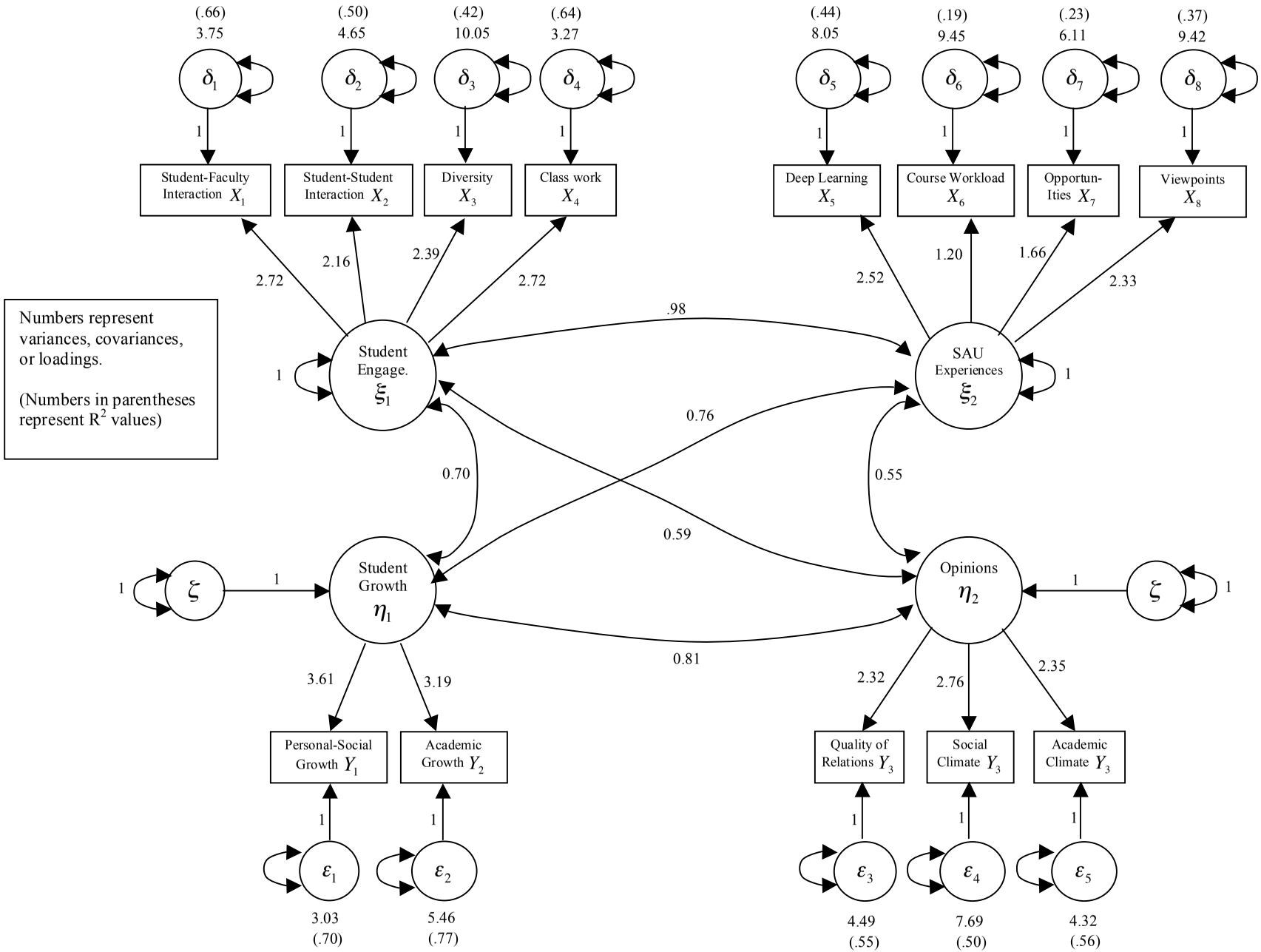
Endogenous Item Parcels (Growth & Opinions) Scatterplot



Scatterplot among selected item parcels (2 parcels within each factor)



Appendix C: Measurement Model



Appendix D: Respecified Measurement Model