A Study of Factors that Influence College Academic Achievement: A Structural Equation Modeling Approach

Dr. John K. Rugutt and Caroline C. Chemosit
Illinois State University

Abstract
The authors of this study used the structural equation model (SEM) approach to test a model that hypothesized the influence of student learning strategies, internet and campus technology, quality of instruction and overall college experience, and student-faculty interaction on student academic achievement. Further a SEM model was developed to link all the study variables with a discussion provided to explain their interrelationship. The study used data collected from 537 college seniors that represented a mixture of traditional undergraduate curricula. The results show that, internet and campus technology, quality of instruction and overall college experience, and student-faculty interaction significantly predict academic achievement. From a more practical perspective and considered collectively, the measures used in this study provide much more information about the teaching and learning environments in higher education settings than those that have been traditionally used. The information from the multiple measures used in the study can foster the development of more enriched learning environments than the traditional practice of providing faculty with simple feedback from traditionally used teaching or course characteristics student rating forms. The core findings of the study have a variety of implications for higher education and practice, measurement and theory development, and future research.

Linking Individual and Institutional Factors to Academic Achievement: A Structural Equation Modeling Approach

The study of learning environments from the student perspective in schools has a rich, but rather recent history. Studies of learning environments,

particularly during the past 40 years, have rapidly drawn the interests of educational researchers and theorists. Several educational researchers (Bennett, 1978; Carroll, 1963; Glaser, 1976; Walberg, 1981) have proposed theoretical models to explain linkages existing among learning variables and student's educational outcomes. Specifically, each theoretical model includes characteristics of the learner, the learning environment, and the quality of instruction the learner receives (Haertel, Walberg, & Weinstein, 1983). Wang, Haertel, and Welberg's (1993) review of empirical literature on the correlates and predictors of academic achievement, indicated that student characteristics exhibit the most significant direct influence on achievement. Walberg's (1981) theory of educational productivity was empirically tested as one of very few theories of academic achievement. Walberg's theory of academic achievement posits that psychological characteristics of individual students and their immediate psychological environments influence educational outcomes (cognitive, behavioral, and attitudinal) (Reynolds & Walberg, 1992). Further, Walberg's research identified nine key variables that influence educational outcomes as: student ability/prior achievement, motivation, age/developmental level, quantity of instruction, quality of instruction, classroom climate, home environment, peer group, and exposure to mass media outside of school (Walberg, Fraser, & Welch, 1986).

In recent decades, studies of learning environments have been concerned with conceptualization and theory development. Student ratings have also been traditionally included in faculty and course evaluation in higher education settings. Research on learning environments (Astin, 1993; Fraser, Walberg, Welch, & Hattie, 1987; Fullarton, 2002) show that psychosocial characteristics of classroom learning environments demonstrate incremental validity in predicting student achievement. These psychosocial characteristics (such as self-concept, attitudes, behaviors, intrinsic motivation, and overall student engagement in learning) are useful in curriculum evaluation studies, and can provide teachers with useful information to arrange more optimally functioning classrooms.

Researchers working on the assessment of learning environments have also developed and validated constructivist-based, personal forms of learning environment measures to tap students' individual, rather than collective perspectives of classroom life (Fraser, Fisher, & McRobbie, 1996; Rugutt, Ellett, Culross, 2003). Learning environment has often been studied for the

purposes of ensuring maximum student achievement in his/her education endeavors. Further, learning is a highly individual process which occurs within a larger environment. Learning is thus mediated by an individual's interactions with and perceptions of the external environment (Loup, 1994; Olivier, 2001).

Research has shown that academic environments contribute to gains in student abilities, interests, and attitudes (Feldman, 1988; Feldman, Ethington, & Smart, 2001). Holland (1997) noted that environments foster the development of competencies, motivate people to engage in different activities, and reward people for their display of values and attitudes. Environment therefore influences personal and professional self-perceptions, competencies, attitudes, interests, and values. Holland (1997) further indicated that a college student's experiences include, but are not limited to: (a) a student's search for academic environments that match their patterns of abilities, interests, and personality profiles; (b) effects of academic environments on student's social behavior in an effort to acquire the desired abilities, interests and values; and (c) a student achievement to include a function of personality type and the academic environment.

Most research has focused on student and faculty interactions in the classroom context (Astin, 1993; Kuh & Hu, 2001). Few studies, however, have examined the relation between student-faculty interaction outside of classroom and student involvement in learning (Kuh, 2001). Determining whether faculty or the student have an impact on student overall academic performance is important.

Additionally, it is important to consider students' involvement in learning (e.g., working on independent projects, discussing coursework with other students, studying with other students), as it plays a key role in students' academic achievement. Since faculty provide the student with learning materials, the student has a responsibility of completing the required activities so as to realize an improved understanding of the subject matter.

With the use of technology in the teaching and learning environments, research has highlighted the benefits of web-based learning for students. Research studies indicate that the use of educational technology afford the learners greater anonymity and opportunities to practice a range of generic skills (for instance, management of self, others, task, information) (Howe, 1998; Oliver & McLoughlin, 2001). Further, through online technologies,

learners can profit from an interactive and engaging environment with a range of learning scaffolds and supports thus enabling them to broaden and make sense of their experience (Hammond & Trapp, 2001; Krantz & Eagly, 1996). With computer resources, learners are provided with the opportunity to interface with computers on a regular basis. Indeed, library resources are largely retrievable online and students do not have to be in a physical location like a library facility to be able to access most research articles and technical research reports. With advanced computer technology and library online databases, retrieving research has been made much easier. Further, with computer resources, learners have a chance of improving their computer literacy, which can be considered a "critical filter" for the employment market of the future (Heinssen, Glass, & Knight, 1987; Miura, 1987).

Research indicate that most studies have focused on learning environment of the first year college students, with few focusing on the impact of learning environment for the senior year student and student academic performance (Chemosit, 2004). This study investigates both individual and institutional factors that contribute to academic achievement of senior college students.

Rationale

This research is important since it integrates individual and institutional variables that can impact academic achievement. While numerous studies have focused on student-faculty interaction, and the impact it has on student academic performance, no study has investigated the linkages existed in the following set of variables: student-faculty interaction, student involvement in learning through active learning strategies, quality of instruction and institutional learning and support infrastructure in terms of library and computer resources and student academic outcome. Further, this study is important since factors in-and-outside the classroom learning environment are studied to determine if they play a role in student's academic achievement. The findings will give rise to further hypotheses, thereby increasing the probability of adding to existing knowledge in this field.

The purpose of this study was to explore the degree of influence learning environment factors, both institutional and individual, have on academic achievement. Specifically, the primary focus was twofold: a) to investigate whether internet and campus technology, student-faculty interaction, student

active learning strategies, and quality of instruction and overall college experience were significantly related to academic achievement; and b) to develop a structural equation model to explain interrelationship among the study variables (internet and campus technology, student-faculty interaction, student active learning strategies, and quality of instruction and overall college experience, and students' academic achievement).

Rationale for Structural Equation Modeling (SEM) Approach

Latent SEM is an appropriate procedure for use with non-experimental data (Keith, 1998; Quirk, Keith & Quirk, 2001). In this study, developing a SEM to best represent the data required two key steps: first, measurement models for each of the four latent variables was specified and tested using confirmatory factor analysis (CFA) and a structural model that provided linkages among the four latent variables and student academic achievement (GPA) as an endogenous variable. In evaluating CFA models, several criteria can be used. This study focused on four: a) model convergence and an "acceptable range" of parameter estimates, b) fit indices, c) significance of parameter estimates and related diagnostics, and d) standardized residuals and modification indices.

Methodology

Research Design

This study is both cross-sectional and survey in nature. It is cross-sectional in that it focuses on major variables of higher education teaching and learning environment at a specific period. It is also a survey research design because the students were surveyed on key variables of college teaching and learning. Further, a post hoc correlation design was used as a framework for data analysis in the study. Thus relationships among the variables were explored (rather than manipulated) in an attempt to develop a model for examining linkages among key variables of the study.

Instrumentation

This study utilized the National Survey of Student Engagement (NSSE) questionnaire (Kuh, 2001) [with permission]. The NSSE survey is administered

at colleges and universities nationwide. The purpose of the survey is to obtain information from colleges and universities nationwide about student participation in programs and activities that institutions provide for learning and personal development. The development of the survey was completed with a view of addressing the national benchmarks of effective educational practice of the undergraduate experience.

Reliability

NSSE survey benchmarks and norms accurately and consistently measure the student behaviors and perceptions represented on the survey (Kuh, 2001). Further, the results from NSSE report are relatively stable from year to year, indicating that the instrument produces reliable measurements from one year to the next. That is, students with similar characteristics are responding approximately the same way from year to year. This study completed factor analysis and Cronbach's alpha reliability coefficients for the survey subscales to further bolster the psychometric properties of the instrument subscales used in the study (see Table 1).

Table 1: *Cronbach Alpha Reliability Coefficients*

Variable	Variable Description	Alpha Reliabilities
ALS (6)*	Active Learning Strategies	.60
QICE (6)	Quality of Instruction and Overall College Experience	.80
ICT (6)	Internet and Campus Technology	.75
SFI (6)	Student-faculty Interaction	.86

Note: * Number of items comprising measure.

Validity

The NSSE instrument developers devoted considerable time to make certain that the items on the survey were clearly worded, well-defined, and had high levels of face and content validity (Kuh, 2001). Further, logical relationships between items were assessed to insure that they were consistent with the results of objective measures and other research.

Variables

The following section provides a description of each variable used in the study. Sample items for each latent variable are included in Appendix A.

Student-faculty Interaction (SFI). Because of the findings from past studies documenting the important relationship between student-faculty interaction and student college outcomes (Astin, 1993; Lamport, 1993; Pascarella, & Terenzini, 1991; Tinto 1993; Woodside 1999), SFI was included as one of the predictors of academic achievement in this study. The SFI response format required participants to use a three-point, forced choice rating scale to respond to how often they participated in various activities (1 = frequently, 2 = occasionally, 3 = not at all).

Active Learning Strategies. The importance of student involvement or engagement and quality of effort as a significant determinant of students' educational outcomes is a key factor in predicting student academic achievement (Astin, 1984; Pace, 1984). "Active learning invites students to bring their life experiences into the learning process, reflect on their own and others' perspectives as they expand their viewpoints, and apply new understanding to their own lives" (ACPA and NASPA, 1997, p. 3). Students tend to learn more when they are actively involved in their education in different settings (Institution Benchmark Report, 2002). The ALS is a latent variable with six observed measures such as (a) studied with other students; (b) worked on independent study projects; and (c) discussed course content with other students. The ALS response format required participants to use a three-point, forced choice rating scale to respond to how often they participated in various activities (1 = frequently, 2 = occasionally, 3 = not at all).

Quality of Instruction and Overall College Experience (QICE). Previous research findings (Walberg, Fraser, & Welch, 1986) have documented the importance of quantity and quality of instruction and the impact this has on student academic outcomes. For this study, QICE is a latent variable with six observed measures such as (a) satisfaction with relevance of coursework to everyday life; (b) overall quality of instruction; and (c) satisfaction with overall college experience. Students rate their satisfaction with current or most recent aspect of campus life on a five-point scale. The responses option is as follows: 1 = very satisfied, 2 = satisfied, 3 = neutral, 4 = dissatisfied, 5 = cannot rate/no experience.

Grade Point Average. In this study, we examined the senior year

cumulative grades. We chose grades as the measure of college academic performance because they are more closely tied to each student's curriculum, a more sensitive measure of learning, and therefore more likely to show change as a result of learning (Pascarella, Terenzini,& Hibel, 1978; Quirk, Keith, & Quirk, 2001. The outcome variable was student college senior year Cumulative Grade Point Average (CGPA) measured on a scale of 0.00 to 4.00.

Internet and Campus Technology (ICT). This study included ICT as one of its predictor variables because research indicate that the use of technology to augment the traditional teaching techniques has been increasing, and as such may be considered inevitable as the trend shifts to a system of mass higher education (Maye, 1998). For instance, web-enhanced learning is certainly an option that offers instructors a range of advantages, such as providing feedback with relative ease and thus providing more flexible pace of learning while reaching a wider and diverse audience (Collis, De-Boer, & Slotman, 2001; Hoskins, & Van Hooff, 2005; Hoskins, Newstead, & Dennis, 1997; Plous, 2000; Ward & Newlands, 1998). For this study, ICT is a latent variable with six observed measures such as (a) communicate via e-mail with faculty; (b) communicate via e-mail with students at this college; and (c) participate in class discussions via e-mail/internet. Students indicated how often in the past one year did they participate in using a five-point scale. The response option is as follows: 1 = daily, 2 = 2 or 3 times/week, 3 = once a week, 4 = 1 or 2 times/month, 5 = never.

Participants

The target population of the study consisted of undergraduate seniors in a Midwestern doctoral university. The sample of this study consisted of 537 students drawn from a random sample of senior students during the spring of 2000. The classes represented a mixture of traditional undergraduate curricula (i.e., mathematics, social sciences, humanities, etc.). Twenty-seven percent (27%) of these students were male; seventy-three percent (73%) were female.

Procedures

The study participants were recruited through the university's student records. All undergraduate students who were enrolled in fall 1999 and were within 12 semester hours of graduation (hours earned plus hours enrolled =

at least 108 semester hours). The administration of the survey was done by the University Assessment Office (UAO). A random sample of 1,000 senior students was selected for the study. Each graduating senior student was given the survey instrument and participation was voluntary. Selected students received an initial letter of announcement to participate in the project, signed by the president of the university. The second mailing consisted of the actual invitation letter with instructions and informed consent statements, and the copy of the survey instrument. This letter also included instructions that allowed the participant to complete the survey over the internet. A follow-up mailing was sent to encourage the participants to complete the survey if they had not already done so. Further, the participants received a description of the research in written form; no deception of any kind was involved. Participants were informed that participation was voluntary. Further, instructions on request-to-participate letter accompanied the student survey and described the purpose of the survey (to acquire data that the college will use to provide a quality educational experience for students). The letter also assured the students that all responses would be confidential and guaranteed the right to refuse to participate or choose not to answer a question. When all the participating students had completed the surveys, the survey administrators collected the materials and made sure they were securely stored.

Data Analyses

This study used secondary data from the University Assessment Office (with permission). Upon the completion of construction of various data files, a variety of analyses were completed that included: descriptive statistics for the sample, a series of exploratory Principal Components Analyses (PCAs) to identify empirically derived dimensions of the study factors, reliability analyses for each measurement dimension, Confirmatory Factor Analysis (CFA) to operationalize the latent variables, goodness of fit indices for the measurement model, and for structural equation modeling (SEM) using LISREL (Jöreskog & Sörbom, 1996). Indicators of the latent variables were selected from the larger NSSE survey of the college senior students in a Midwestern doctoral university. The correlations and covariance matrices calculated using SPSS (SPSS, Inc., 1990) were used as input into LISREL to develop the Structural Equation Model (SEM). Individuals comprising the undergraduate college senior year students were used as the units of analysis.

SEM was used as the primary method for analyzing data. SEM allows a researcher to specify a priori a relationship among variables included in the model. This specification is necessary for testing the model of academic achievement developed from literature review. Further, SEM allows a researcher to establish direct and indirect effects of each variable included in the model on the outcome variable. LISREL 8.54 (Jöreskog & Sörbom, 2003) was used to test the achievement model proposed in this study. The correlations and covariance matrices calculated using SPSS (SPSS, Inc., 1990) were submitted for analysis, and model parameters were generated via maximum likelihood estimation. Several fit indices were used to assess the fit of the proposed model based on recommendations of Kline (1998) and Hu and Bentler (1995) as well as a review of the fit indices commonly reported across the SEM studies included in the literature review. These indices included the generalized likelihood ratio chi-square values (x^2) with associated degrees of freedom (*df*), root mean square error of approximation (RMSEA), normed fit index (NFI), comparative fit index (CFI), root mean residual (RMR), and goodness of fit (GFI) index values for each variable in the measurement model. The results for the model = *s* goodness of fit indices were within acceptable limits (Bentler, 1990, 1993; Browne & Cudeck, 1993; Byrne, 1989,1996, 1998; Diamantopoulus & Siguaw, 2000; Kline, 1998; Keith, 1997; Schumacker & Lomax, 1996). The allowable fit values for the NFI, CFI and GFI indices are those close to 1.00. For RMSEA values less than 0.08 are considered acceptable, and RMR values as close to zero as possible are preferred (Browne, & Cudeck, 1995; Kline, 1998).

Results

Descriptive Statistics

For the Active Learning Strategies (ALS) latent variable, item means ranged from a low of 1.82 ("Have been a guest in professor's home") to a high of 2.71 ("Discussed course content with other students") on a scale of 1 to 3. For the Quality of Instruction and Overall College Experience (QICE) latent variable, item means ranged from a low of 3.64 ("Relevance of coursework to everyday life") to a high of 4.38 ("Course in major field") on a scale of 1 to 5. For the Internet and Campus Technology (ICT) latent variable, item means ranged from a low of 1.58 ("In Class Discussions via E-mail/Internet") to a

high of 3.88 ("Use Internet for non-Academic Reasons") on a scale of 1 to 5. For the Student-faculty interaction (SFI) latent variable, item means ranged from a low of 1.82 ("Letter of recommendation") to a high of 2.49 ("Respect") on a scale of 1 to 3. For the student cumulative GPA, the overall mean was 3.19 and ranged from a low of 1.97 to a high of 4 on a 0-4 scale.

A summary of the SEM results are presented in Table 2. The results for the model = *s* goodness of fit indices were within acceptable limits (Bentler, 1993; Brown & Cudek, 1993, Byrne, 1989, 1996, 1998; Diamantopoulus & Siguaw, 2000; Schumacker & Lomax, 1996). The allowable fit values for the NFI, CFI and GFI indices are those close to 1.00. For RMSEA values less than 0.08 are considered acceptable, and RMR values as close to zero as possible are preferred. The results shown in Table 2 support a good fit of the variables to the measurement model.

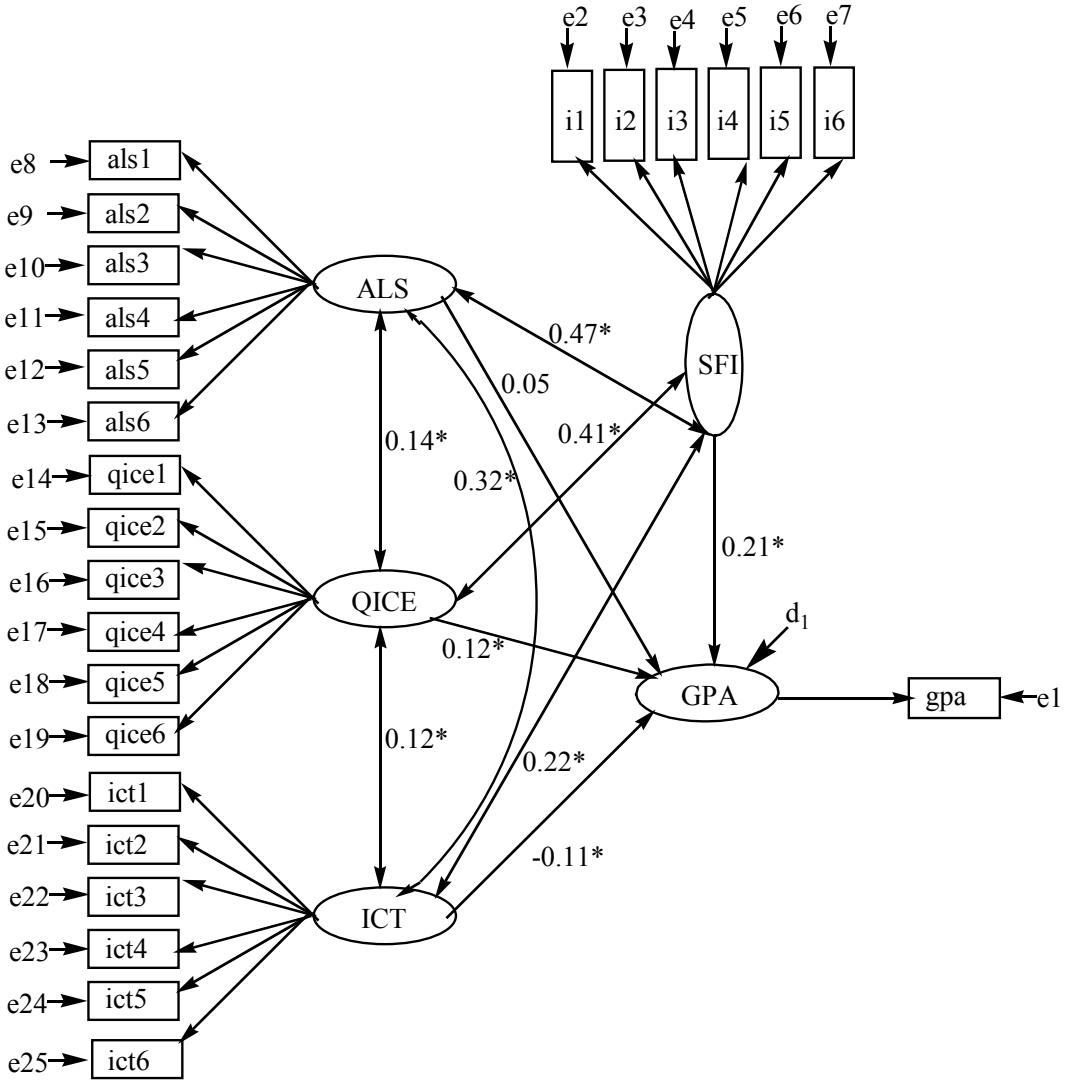
Table 2: *Summary of Hypothesized Measurement Model Fit Statistics for Each Study Variable*

Measurement Model	χ^2	df	GFI	CFI	NFI	RMR	RMSEA
ALS*	40.25	9	0.98	0.85	0.82	0.019	0.08
QICE	7.86	5	0.99	1.00	0.99	0.010	0.03
ICT	26.34	9	0.98	0.98	0.97	0.049	0.06
SFI	19.90	9	0.91	0.99	0.99	0.011	0.05

Note: * Study Variable; SFI: Student-Faculty Interaction; ALS: Active Learning Strategies; QICE: Quality of Instruction and Overall College Experience; ICT: Internet and Campus Technology.

Figure 1 (see following page) shows the correlation coefficients among the SEM exogenous latent variables and path coefficients between each exogenous latent variable and the endogenous latent variable (GPA). The conceptual focus guiding the development of the SEM was to develop a SEM model to examine the influence of the ALS, QICE, ICT, and SFI variables on the GPA and to investigate the nature and degree of relationship among the exogenous latent variables. The latent variables (ovals) are constructs inferred from the measured variables (indicators shown in rectangles) previously developed using CFA procedures. The paths from the latent variables (ovals) to the measured variables (rectangles) show the weighting (not included

Figure 1: *Structural Equation Model (SEM) for Study Variables Using the Student GPA as the Dependent Variable*



Note: * $p < 0.05$; ALS: Active Learning Strategies; QICE: Quality of Instruction and Overall College Experience; ICT: Internet and Campus Technology; SFI: Student Faculty Interaction; GPA: Cumulative Grade Point Average.

---

in the schematic due to its large number) of the measured variables as they operationalize the latent variables. All the measurement weights (loadings) were significantly different from zero. Paths from the latent variable (ALS, QICE, ICT, SFI) to the GPA are standardized regression coefficients that suggest the extent to which each independent variable affects the dependent variable (GPA). The curved lines and the double-headed arrow lines indicate bivariate correlations between the various latent variables (ALS, QICE, ICT and SFI). Disturbance (d_1) is included in the model to represent influence on

the latent variable (GPA) other than those already contained in the model (ALS, QICE, ICT, SFI). The exogenous latent variables also take into account any error or other influences not shown (e.g., e_1, e_2, e_3…) that may be influencing the variables beyond the latent variables. Separating error from the model enhances the interpretation of the constructs of interest and their effects on each other (Keith, 1998; Quirk, Keith, & Quirk, 2001). The results of the final SEM model indicated that the structural model fit the data reasonably well for the study sample (χ^2 (243) = 541.83, p = .00, GFI = 0.92, CFI = 0.94, NFI = 0.90, RMR = 0.033, and RMSEA = 0.048).

Given an adequate fit of the model to the data, the next step was to interpret the paths. Of interest was the path from internet and campus technology (ICT) to student academic achievement (GPA) (-0.11). This path suggests that for each standard deviation increase in internet and campus technology, student academic achievement decreased by 0.11 of a standard deviation. In other words, internet and campus technology appears to have had a significant *negative effect* on student academic achievement. The path from active learning strategies (ALS) to student academic achievement (GPA) (0.05) suggests that for each standard deviation increase in active learning strategies, student academic achievement increased by 0.05 of a standard deviation. This standardized regression coefficient was not statistically significant. There was a 0.21 standard deviation increase in student academic achievement (GPA) for each standard deviation increase in student-faculty interaction (SFI). This result shows a positive and statistically significant relationship between SFI and student academic achievement. The path from quality of instruction and overall college experience (QICE) to student academic achievement (GPA) (0.12) suggests that for each standard deviation increase in QICE, student academic achievement increased by 0.12 of a standard deviation. This standardized regression coefficient was statistically significant.

Active learning strategies, quality of instruction and overall college experience, internet and campus technology and student-faculty interaction demonstrated low to moderate, positive relationships to each other (ALS on QICE = 0.14; QICE on ICT = 0.12; ALS on ICT = 0.32; SFI on ICT = 0.22; ALS on SFI = 0.47; QICE on SFI = 0.41). The six coefficients were statistically significant at .05 significance level. Of all the bivariate correlations computed, internet and campus technology and quality of instruction and overall college experience demonstrated a weak significant positive relationship to each other

(ICT on QICE = 0.12).

The results of this study established that student quality of instruction and overall college experience (QICE) and student-faculty interaction (SFI) would significantly and positively influence student GPA. Internet and campus technology (ICT), however, would significantly but negatively influence student GPA. The Active learning strategies (ALS) variable was not significantly related to senior year cumulated grade point average. Standardized regression coefficients (path coefficients) are included in Figure 1.

Discussion and Implications

The purpose of this study was to explore the degree of influence learning environment, both in terms of institutional and individual factors, has on student academic achievement. Specifically, the primary focus was two-fold: a) to investigate whether Internet and campus technology, student-faculty interaction, student active learning strategies, and quality of instruction and overall college experience were significantly related to academic achievement; and b) to develop a structural equation model to explain interrelationship among the study variables (internet and campus technology, student-faculty interaction, student active learning strategies, and quality of instruction and overall college experience, and student's academic achievement).

The results show that student active learning strategies, quality of instruction and overall college experience, student-faculty interaction significantly predict student academic achievement. Further, a significant negative relationship exists between Internet and campus technology and student achievement. The path coefficient between any pair of the following variables (ALS, QICE, SFI, ICT) was positive and statistically significant. Further, SFI and QICE were positively and statistically related to student academic achievement (GPA) while ICT was significantly but negatively related to student's GPA.

The findings of this study suggest that student-faculty interaction and quality of instruction and overall college experience promote student academic achievement. Researchers of characteristics of the learner, the learning environment, and the quality of instruction the learner receives (Haertel, Walberg, & Weinstein, 1983; Wang, Haertel, & Welberg, 1993) reached the same conclusion. The findings of this study, therefore, lend support to the

theory of academic achievement. An examination of the overall contributions to student academic achievement by the four predictor variables included in the model indicate that these predictors have varying levels of impact on achievement as presented in Figure 1. Student-faculty interaction had a higher and significant standardized regression coefficient with student achievement (0.21), followed by quality of instruction and overall college experience. This was followed by internet campus technology (-0.11) and active learning strategies (0.05) which was not significantly related to student achievement.

Limitations of the Study

There are two limitations that must be considered before drawing conclusions from the results of this study. The first limitation is that the findings require replication to demonstrate that they are not unique to the current study sample. A second limitation is that associated with using secondary data. The bulk of the data was self-reported by college seniors and it was assumed that their responses reflected their honest views of what they were being asked by the survey. Further, the researchers were limited by the variables included in the survey.

Implications for Higher Education and Practice

Although the stated limitations must be addressed before making strong recommendations for practice, there are several potential implications for practice based on the results of the current study. First, it is important to understand the contributions of the individual and organizational correlate and predictors of student academic achievement since these are professional issues. Second, when helping students who are experiencing academic difficulty, school professionals must make decisions about skills, quality of instructions, instructional strategies, attitudes, and/or behaviors to target for assessment, and ultimately for intervention. The results of this study suggest that student-faculty interaction, quality of instruction and overall college experience, and internet and campus technology were significantly related to student academic achievement. Thus for students who could be experiencing academic difficulty, college administrators and other school professionals may investigate if there have been changes in the level of student-faculty interaction, quality of instruction and overall college experience and the availability and

use of internet and campus technology services.

Further, there is a need for professionals in colleges and universities to be cognizant of the elements of students' active learning strategies, teacher student relations, and quality of teaching and learning so that they are fully involved in providing the kinds of educational experiences that can enhance the development of achievement predictors, some of which have been shown by this study to be directly related to student academic achievement. This strategy may lead to increase quality of instruction and overall college experience, elevated active learning strategies and student-faculty interaction and thus student academic success. Strengthening these individual and institutional characteristics seems particularly important for learners and institutions of learning. Further, use of computer technology, for instance, Web-enhanced learning is certainly an option that offers instructors a range of advantages, such as, providing feedback with relative ease and thus providing more flexible pace of learning while reaching a wider and diverse audience (Collis et al.,2001; Hoskins & Van Hooff, 2005; Hoskins et al.,1997; Plous, 2000; Ward & Newlands, 1998). With computer technology becoming prevalent in our teaching and learning institutions, an expanded market of learners is harnessed given that the benefits of web-based learning for students are well documented. It is important to note that use of educational technology afford the learners greater anonymity and opportunities to practice a range of generic skills (for instance, management of self, others, task, information) (Howe, 1998; Oliver & McLoughlin, 2001).

Of considerable interest was the finding that internet and campus technology, comprised of statements such as "Communicate via e-mail with faculty, Communicate via e-mail with students at this college, Communicate via e-mail with students at other colleges, Communicate via e-mail with your family, Participate in class discussions via e-mail/Internet, and Use the Internet for nonacademic reasons," had a negative relationship with senior year cumulative grade point average and significant relationships with all other model variables (SFI, ALS, QICE). This finding suggests that undergraduate students who attached importance to internet and campus technology are more likely to be engaged in active learning strategies, student faculty interaction and have a positive view of quality of instruction and overall college experience. Such students, however, are also less likely to positively influence their cumulative GPA whether they are actively engaged

in all other activities stated above or not. This interpretation makes intuitive sense as well given the extant literature on task orientation, engaged time and learning productivity and that various research on the impact use of technology have found inconclusive findings. This view is supported by the work of Hancock, Bray, and Nason (2002) which concluded that "all students in a computer technology course demonstrated higher motivation when exposed to student-centered instruction offers an important consideration for teachers of technology courses --professors of these courses may want to consider greater use of student-centered instruction when designing and implementing their courses." (p. 371).

From a more practical perspective and considered collectively, the measures used in this study provide much more information about the teaching and learning environments in higher education settings than those that have been traditionally used. From the formative evaluation perspective, the information from these multiple measures can foster the development of more enriched learning environments than the traditional practice of providing faculty with simple feedback from traditionally used teaching or course characteristics student rating forms.

Information about how students perceive the quality of teaching and learning, the quality of instruction and overall college experience, student learning resources, the effectiveness/enhancement of their own learning, and important elements of the learning environment can provide a rich base for enhancing the quality of teaching and learning in higher education settings. Current plans are to actively use this data base within the University Assessment Office to enhance the quality of teaching and learning, and to provide better learning experiences for students through workshops and training sessions organized for students, staff and teachers through the University's teaching and learning center.

Implications for Future Research

This study was a cross-sectional in nature, completed at only one point in time with one large, institution sample of traditional and non-traditional students. Replications of the study, with the refined study measures resulting from the confirmatory factor analyses, and the addition of other important measures as well, are needed. For the most part, the measures used in this study yielded reliable data, though some of the measurement dimensions

may need to be refined with revisions of items. The researchers believe these measures are adequate to do replication studies in other large university contexts, and with other research designs. The findings of this study suggest that these variables may be quite potent and yield rich information for theory development. As well, the continued use of mixed methodologies in future studies can strengthen the nomological network (Cronbach & Meehl, 1955) of a theory of measurement and learning and add to the utility and explanatory power of the quantitative results presented in this study.

Through student faculty interaction, the teacher gets to know students' preconceptions and misconceptions on subject matter, student's active learning strategies such as student-to-student relations and how such relationships could further the learning process, students' areas of interests, and student weak points. With this knowledge, the teacher can devise strategies to foster motivation and provide the necessary college experience for learners to succeed in their pursuits of excellence.

Further, on the basis of the results of this study, faculty who wish to increase student academic achievement in their classes may do a number of things, such as focusing on improving the overall quality of their teaching through the integration of elements of active learning strategies and teacher student relations, and to create a classroom environment that encourages relationships with other students. Such changes in teaching methods are likely to increase student academic achievement. Similarly, information about students' ratings about their satisfaction with courses in major field, relevance of coursework to life, overall quality of instruction, amount of contact with faculty, class size, and overall college experience can provide a rich base for enhancing the quality of teaching and learning in higher education settings.

Implications for Research Methodology

This study utilized a structural equation modeling technique which has tremendous advantages over traditional regression analyses such as: (a) SEM being a multivariate approach and structural/causal relationships are estimated at the level of latent variables or theoretical constructs rather than on the basis of the observed variables; (b) SEM procedures differentiate between a measurement model (describing relationships among observed variables and latent factors) and a structural model (describing interrelationship among theoretical constructs) thus allowing for a separate estimation of

measurement errors in the observable specification of errors in the structural part of the model; and (c) SEM also provides an assessment of the degree of fit between the causal model and the data set to which it is applied (Koerkel & Schneider,1991; Kurtz-Costes & Schneider, 1994).

Further, the results of this study provide continuing support for the usefulness of NSSE survey as a measure of multiple dimensions of college/ university teaching and learning environments. Also, the results of the study clearly identify student-faculty interaction and quality of instruction and overall college experience as more potent in predicting student academic achievement.

References

American College Personnel Association and Nation Association of Student Personnel Administrators. (1997). *Principles of good practice for student affairs*. Washington DC: Author.

Astin, A. W. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Personnel, 25,* 297-308.

Astin, A. W. (1993). *What matters in college? Four critical years revisited*. San Francisco Jossey-Bass.

Bennett, S. N. (1978). Recent research on teaching: A dream, a belief, and a model. *British Journal of Educational Psychology, 48*, 127-147.

Bentler, P.M. (1990). Comparative fit indices in structural models. *Psychological Bulletin, 107*, 238-246.

Bentler, P. M. (1993). *EQS structural equations program manual*. Los Angeles: BMDP Statistical Software.

Browne, M. W., & Cudeck, R. (1993). Alternatives ways to of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136-162). Newbury Park, CA: Sage.

Browne. M.W., & Cudeck, R. (1995). Single sample cross-validation indices for covariance structures. *Multivariate Behavioral Research, 24*, 445-455.

Byrne, B. M. (1989). *A primer of LISREL: Basic applications and programming for confirmatory factor analytical models*. New York, NY: Srpinger-Verlag.

Byrne, B. M. (1996). *Measuring Self-concept across life span: Issues and instrumentation*. Washington, DC: American Psychological Asso ciation.

Byrne, B. M. (1998). *Structural Equation Modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming*. Mah wah, New Jersey: L. Erlbaum Associates.

Carroll, J. B. (1963). A model of school learning. *Teachers College Record, 64*, 723-733.

Chemosit, C. C. (2004). *Predictors and correlates of student academic achievement: Student-faculty interaction, active learning strategies, and academic rigor*. Unpublished master's thesis, Illinois State University, Normal.

Collis, B., De-Boer, W. & Slotman, K. (2001). Feedback for Web-based assignments. *Journal- of-Computer-Assisted-Learning 17,* 306-313.

Cronbach,. L.J., & Meehl, (1955). Construct validity in psychological tests. *Psychological Bulletin, 53*, 281-302.

Diamantopoulos, A., & Siguaw, J.A. (2000). *Introducing LISREL: A guide for the uninitiated*. Thousand Oaks, CA: Sage.

Feldman, K.A. (1988). Effective college teaching from the students' and faculty view: Matched or mismatched priorities? *Research in Higher Education, 28*, 291-344.

Feldman, K. A., Ethington, C. A., & Smart, J. C. (2001, Nov./Dec.). A further investigation of major field and person-environment fit: sociological versus psychological interpretations of Holland's theory. *The Journal of Higher Education (Columbus, Ohio) 72*(6), 670-698.

Fraser, B., Fisher, D.L., & McRobbie, C.J. (1996). *Development, validation and use of personal and class forms of a new classroom learning environment instrument*. Paper presented at the annual meeting of the American Educational Research Association, New York, N.Y.

Fraser, B.J., Walberg, H.J., Welch, W.W., & Hattie, I.A. (1987). Syntheses of educational productivity research. *International Journal of Educational Research*, *11*, 145-252.

Fullarton, S. (2002). *Student engagement with school: Individual and school-level influences longitudinal surveys of Australian youth*. Research Report No. LSAY-27. (ERIC Document Reproduction

Service No. ED 470 798).
Glaser, R. (1976). Components of a psychological instruction: Toward a science of design. *Review of Educational Research, 46*, 1-24.
Good, T. L., & Brophy, J. E. (1987). *Looking in classrooms*. New York: Harper & Row.
Hammond, N. V., & Trapp, A. L. (2001). How can the web support the learning of Psychology? In C. R. Wolfe (Ed.), *Learning and Teaching on the World Wide Web* (pp. 153-169). New York: Academic Press.
Hancock, D. R., Bray, M., & Nason (2002). Influencing University Students' Achievement and Motivation in a Technology Course. *The Journal of Educational Research, 95*(6), 365-372.
Haertel, G. D., Walberg, H. J., & Weinstein, T. (1983). Psychological models of educational performance: A theoretical synthesis of constructs. *Review of Educational Research, 53*, 75-91.
Heinssen, R. K., Glass, C. R., & Knight, L. A. (1987). Assessing computer anxiety: development and validation of the Computer Anxiety Rating Scale. *Computers in Human Behavior, 3*, 49-59.
Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd ed.). Odessa, FL: Psychological Assessment Resources.
Hoskins, S. L., & Van Hooff, J. C. (2005). Motivation and ability: Which students use online learning and what influence does it have on their achievement? *British Journal of Educational Technology 36*(2) 177-192.
Hoskins, S. L., Newstead, S. E., & Dennis, I. (1997). Degree performance as a function of age, sex, prior qualifications and discipline studied. *Assessment and Evaluation in Higher Education 22,* 317-328.
Howe, C. (1998). Psychology teaching in the 21st Century. *The Psychologist, 11*, 371-373.
Institutional Benchmark Report. (2002). *National survey of student engagement*. Illinois State University.
Hu, L. T., & Bentler, P. M. (1995). Evaluating model fit. In R. H. Hoyle (Ed.), *Structural Equation Modeling: Concepts, Issues, and Applications* (pp. 76-99). Thousand Oaks, CA: Sage.
Institutional Benchmark Report. (2002). *National survey of student engagement*. Illinois State University.

Jöreskog, K. G., & Sörbom, D. (1996*). LISREL 8 User's Reference Guide*. Chicago, IL: Scientific Software International.

Jöreskog, K. G., & Sörbom, D. (2003). *LISREL 8.54*. Chicago, IL: Scientific Software International, Inc.

Keith, T. Z. (1997). Using confirmatory factor analysis to aid in understanding the constructs measured by intelligence tests. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.). *Contemporary Intellectual Assessment: Issues in Clinical Child Psychology* (pp. 317-329). New York: Plenum.

Keith, T. Z. (1998). Structural equation modeling in school psychology. In C. R. Reynolds & T. B. Gutkin (Eds.), *The Handbook of School Psychology* (3rd ed., pp. 78-107). New York. Wiley.

Kline, R. B. (1998). *Principles and practice of structural equation modeling*. New York: The Guilford Press.

Koerkel, J., & Schneider, W. (1991). Domain-specific versus metacognitive knowledge effects on text recall and comprehension. In M. Carretero, M. Rope, R. J. Simmons, & J. I. Pozo (Eds.), *Learning and Induction* (pp. 311-323). Oxford: Pergamon Press.

Krantz, J. H. & Eagly, B. M. (1996). Creating psychological tutorials on the world-wide web. *Behavior Research Methods, Instruments, and Computers, 28*, 156-160.

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., & Hu, S. (2001). The effects of student-faculty interaction in the 1990s. *The Review of Higher Education, 24*, 309–332.

Kurtz-Costes, B. E., & Schneider, W. (1994). Self-concept, attributional beliefs, and school achievement: A longitudinal analysis. *Contemporary Educational Psychology, 19,* 199-216.

Lamport, M. A. (1993). Student-faculty informal interactions and the effect on college student outcomes: A review of the literature. *Adolescence, 28*(112), 971-990.

Loup, K.S. (1994). *Measuring and linking school professional learning environment characteristics, teacher self and organizational efficacy, receptivity to change, and multiple indices of school effectiveness*. Unpublished Doctoral Dissertation, Louisiana State University, Baton Rouge, Louisiana.

Maye, T. (1998). Teaching, technology and talk. *The Psychologist, 11*, 375-377.

Miura, I. T. (1987). The relationship of computer self efficacy expectations to computer interest and course enrolment in college. *Sex Roles, 16*, 303-311.

Olivier, D. F. (2001). *Teacher personal and school culture characteristics in effective schools: Toward a model of a professional learning community*. Unpublished doctoral dissertation. Louisiana State University, Baton Rouge, Louisiana.

Oliver, R., & McLoughlin, C. (2001). Exploring the practice and development of generic skills through web-based learning. *Journal of Educational Multimedia and Hypermedia, 10*, 207-225.

Pascarella, E., & Terenzini, P. (1991). *How college affects students*. San Francisco: Jossey-Bass.

Pascarella, E. T., Terenzini, P. T., & Hibel, J. (1978). Student-faculty interactional settings and their relationship to predicted academic performance. *Journal of Higher Education, 49* (5), 450-463.

Plous, S. (2000). Tips on creating and maintaining an educational World Wide Web site. *Teaching of Psychology, 27*, 63-70.

Quirk, K. J., Keith, T. Z., & Quirk, J. T. (2001). Employment during high school and student achievement: Longitudinal analysis of national data. *The Journal of Educational Research, 95*, 4-9.

Reynolds, A. R., & Walberg, H. J. (1992). A process model of mathematics achievement and attitude. *Journal of Research in Mathematics, 23*, 306-328.

Rugutt, J. K., Ellett, C. D., & Culross, R. (2003). Discriminating student learning and efficacy levels in higher education: Contributions of classroom environment and teaching and learning effectiveness. *Planning and Changing*, *34*(3 & 4), 229-249.

Schumacker, R. E., & Lomax, R. G. (1996). *A beginner's guide to structural equation modeling*. Mahwah, New Jersey: L. Erlbaum Associates.

SPSS Inc. (1990). *SPSS User=s Guide*. Chicago: SPSS Inc.

Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition*. Chicago: The University of Chicago Press.

Walberg, H. J. (1981). A psychological theory of educational productivity. In F. H. Farley & N. Gordon (Eds.), *Psychological and Education* (pp. 81-110). Chicago: National Society for the Study of Education.

Walberg, H. J., Fraser, B. J., & Welch, W. W. (1986). A test of a model of educational productivity among senior high school students. *Journal of Educational Research, 79*, 133-139.

Wang, M. C., Haertel, G. D., & Walberg, H. J. (1993). Toward a knowledge base for school learning. *Review of Educational Research, 63*, 249-294.

Ward, M., & Newlands, D. (1998). Use of the Web in undergraduate teaching. *Computers and Education, 31,* 171-184.

Woodside, B. M. (1999). The effects of student academic achievements and self concept. *Education (Chula Vista, California), 119,* 4, 730-3.

APPENDIX

Factors and Sample Items Operationalizing Each Latent Variable Used in the Study

Active Learning Strategies (ALS)

1. als1: Worked on Independent Study Project
2. als2: Took Interdisciplinary Courses
3. als3: Discussed Course Content with other Students
4. als4: Have Been a Guest in a Professor's Home
5. als5: Did Extra (unassigned) Work for a Course
6. als6: Studied with Other Students

Student-Faculty Interaction (SFI)

1. i1: Encouragement for Grad School
2. i2: Advice about Educational Program
3. i3: Respect
4. i4: Emotional Support & Encouragement
5. i5: Letter of Recommendation
6. i6: Help in Achieving Professional Goals

Quality of Instruction and Overall College Experience (QICE)

1. qice1: Satisfaction with courses in your major field
2. qice2: Satisfaction with relevance of coursework to everyday life
3. qice3: Overall quality of instruction
4. qice4: Satisfaction with amount of contact with faculty
5. qice5: Class size
6. qice6: Satisfaction with overall college experience

Internet and Campus Technology (ICT)

1. ict1: Communicate via e-mail with faculty
2. ict2: Communicate via e-mail with students at this college
3. ict3: Communicate via e-mail with students at other colleges
4. ict4: Communicate via e-mail with your family
5. ict5: Participate in class discussions via e-mail/Internet
6. ict6: Use the Internet for nonacademic reasons

Grade Point Average (GPA)

1. gpa: Student College Senior Year Cumulative Grade Point Average

Survey Items Adapted from Chemosit, (2004) (With Permission).