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Keeping Confidence In Data Over Time: Testing The Tenor Of Results From Repeat Administrations Of A Question Inventory

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Abstract

The following describes research supported by the Teagle Foundation for the development and testing of an instrument for measuring college student perceptions of institutional mission in the learning environment. Findings from reliability and validity testing of a set of questions called the Mission Perception Inventory (MPI) are discussed. The MPI was first developed in 2004 from qualitative analysis of selected mission statements of postsecondary institutions in the United States. Questions were formulated around the construct of mission perception, operationally defined as an individual's judgment of his or her engagement in the learning environment of an institution as defined by its mission. Testing was performed on data from four consecutive annual administrations of the MPI appended as consortia questions to the National Survey of Student Engagement (NSSE). Data were obtained from a sample of men and women in the first and senior college years (N = 18,671). Results from reliability and factor analysis of the data support the construct validity and reliability of the scale by year in terms of stability, internal consistency, and item-total correlation matrices. This Professional File provides consistent evidence that the MPI is a valid and reliable measure over time in a changing student population. Hence, this instrument can be a useful outcomes measure for activity focused on advancing institutional mission on college campuses.

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Introduction

The mission statement of a college or university assigns purpose and definition to all the activity that supports and engages students in the learning environment. An institution's goals and objectives are suitably derived from its mission statement, and it is important for an institution to have clearly articulated objectives for student learning and development (Chickering, 1993). Crafting effective methods for measuring the relationship between student learning objectives and student learning outcomes is critical to institutional assessment, and this research looks for links in the environment where learning occurs. The assessment tool used is the Mission Perception Inventory (MPI), an instrument designed to measure student perception of institutional mission manifest in the learning environment.

The assumptions of this research are, one, measures of student perception of the learning environment in relation to mission constructs can be devised and, two, scores on these measures are valid indicators of student perception of the institutional mission apparent in the learning environment. The instrument, MPI, is one question set shorter but similar in design to the National Survey of Student Engagement (NSSE) and includes questions on student perceptions of college mission. The NSSE was designed to act as a process indicator to help colleges and universities see connections between programs and activities and student learning outcomes (Pike, Kuh, & Gonyea, 2003). The MPI is also a process indicator, in this case, assessing activity meant to enhance the learning environment and, at the same time, the context where learning occurs. The validity and reliability testing performed here is an investigation of the ability of the MPI to assess and reflect the learning environment.

An instrument developed and tested on one population at one time may not produce comparable results in subsequent trials on changing populations. Reliability analysis can assure confidence in the question items, and factor analysis can identify fundamental constructs within a set of items. According to Pike (1995), reliability is the degree to which a set of items measures the same thing consistently across respondents. The ability of the MPI to produce consistent results needed to be tested over time to confirm instrument reliability and keep confidence in results from MPI administration.

The intent of this research is to analyze and interpret results from further psychometric testing of a mission perception instrument following its administration to independent samples at different points in time. This Professional File describes tests on data collected from the administrations of the instrument and presents the results. Along with reliability testing, factor analysis assesses construct validity of the MPI scale. Additionally, the hypothesis is tested that comparable results for stability, internal consistency, and item-total correlation matrices will be found following analysis of the successive years' data from administrations of the MPI.

Review of the Literature

Higher education researchers hunger for fresh, reliable ways to gather and report data on student learning outcomes. This is particularly true today as a consequence of escalating stakeholder demands for accountability (Ewell, 2007), and a rise in new and unique assessment challenges that may be unmet by the limits of available tools. Some examples of key goals articulated in college and university mission statements currently are (a) provide professional preparation, (b) develop leadership skills, and (c) foster respect for diversity. These kinds of mission goals are realized in the programs and activities of the student learning environment, and assessing student perceptions of that environment is examined here.

For almost two decades, researchers have explored whether institutional characteristics, apart from mission, have an influence on student

outcomes. Weidman (1989) found that institutional characteristics do matter to student learning, but further research by Pascarella and Terenzini (1991), which controlled for student background, determined the relationship to be weak at best. Toutkoushian and Smart (2001) suggest that although institutional characteristics may not directly correlate with student learning, a student's experiences within the institutional environment do correlate strongly with outcomes. A methodology developed by Pike et al. (2003) has been successful for studying the relation of institutional mission to student engagement and learning, and it is similarly employed here.

Chickering (1993) points out the importance for an institution to have clearly articulated objectives for student learning and development. Ideally, the objectives pervade the institution's programs and climate and are widely shared and emphasized in oral and written communication. A strong sense of college mission that unifies the educational experience of students can reduce ambiguity and define purpose for students and others in the institution. For example, some of the constructs embodied in the mission statements of institutions participating in this research include: *education as empowerment; a community of learning; moral character; leadership in service; career preparation;* and *appreciation for diversity.*

In *America's Best Colleges* (2011), the *U.S. News and World Report* annual guide to colleges, institution mission is described according to its Carnegie Classification, but that categorization is not followed here. For this research, "mission" is operationally defined as the overall purpose and activity of an institution as defined by the goals of the mission statement. This allows for flexibility in characterizing the institutions in the consortia and understanding the activities they engage in to fulfill their educational mission.

Research by Pike et al. (2002) on institutional mission concludes that mission constructs can be measured. The methodology NSSE uses to produce benchmarks, or scales, of "effective educational practice" (Kuh, 2001, p. 13) is reflected here in the way factor scales have been produced.

The purpose of the factor analytic method used here is to evaluate score validity once the measure had been developed and direct focus on whether scores are valid and the MPI measures "the correct something" (Thompson, 2004, p. 4). Tests used in this research are meant to clarify operational constructs for an area, in this case, the measurement of student perception of institutional mission. The scores, or outcomes, of those measures can then be a means for evaluating students' perceptions of mission-related curricular and co-curricular programs on campus.

Thompson and Daniel (1996) state that factorial validity of a test is "given by its loadings in meaningful, common, reference factors" (p. 197). The Rotated Factor Matrix produced from initial testing of the instrument (Boylan, 2005) compared favorably against that standard for validity.

Of the two main types of factor analysis, exploratory and confirmatory, the former has been employed in this research. Exploratory factor analysis uncovers the structure of a set of variables by grouping variables that are correlated, particularly in the case when no hypothesis about the nature of the underlying factor structure of their measures has been posited (Goho & Blackman, 2009). To determine the statistical validity of these items, confirmatory factor analysis should be performed once the factor structure and variable loadings can be identified in advance (Coughlin, 2005; Pedhazur & Schmelkin, 1991). This study describes how, over the course of four years, as more institutions participated and the number of respondent cases increased, three of the four factors found in exploratory analysis were confirmed by factor analysis performed on MPI results from successive administrations.

A limitation of this study is reliance on research conducted in closed consortia of Catholic colleges and universities participating in one or more

NSSE administrations from 2004 through 2007. Although the results may not be generalizable to all postsecondary institutions, the methodology may be adapted to explorations of institutional mission at other colleges.

In anticipation of future opportunities for testing the construct validity of the MPI for use by other colleges, it was purposely intended at the question construction stage of this research to develop mission questions that are "institution affiliation-neutral." Despite using the mission statements of the first 14 consortium institutions, all Catholic, in a qualitative analysis to draw out common constructs for MPI questions, the constructs that became questions are not exclusive to Catholic institutions. Constructs like "academic excellence" and "leadership development" are familiar in most postsecondary institutions' mission statements. Further, the opportunity to test the questions on two consortia simultaneously, one Catholic and one private, did arise in 2008, thanks to a Teagle Foundation grant for this research. Preliminary factor analysis suggests that the inventory is equally reliable for both consortia. In fact, the investigation of reliability has been repeated with data from a subsequent year administration of the MPI on two consortia with different affiliations. Additional results are available from the author.

Methodology

The process of developing and validating the instrument used a mixed method qualitative and quantitative research analysis. The content of question items was initially developed from a qualitative analysis of mission statements of colleges registered to participate in a NSSE consortium proposed by the research administrator. To facilitate later opportunities for analysis with NSSE individual items and benchmarks, the same scale-format used for those questions is employed for the mission research questions. Draft mission question items using this format were circulated in advance among consortium participants for feedback, and then revised and checked for face validity with experts in survey research at the NSSE headquarters. The instrument was then given to a pilot group of subjects to check question clarity, and final revisions followed.

Since the research administrator has established relations with personnel at many Catholic colleges, it was most convenient to obtain the participation of a group of Catholic colleges in the mission research project. The willingness of Catholic colleges to participate also stemmed from shared mutual interest in measuring institutional mission effectiveness; however, that interest is not exclusive to Catholic colleges. Providing evidence of mission effectiveness to some degree is a requirement of all regional accreditation bodies for all colleges, whether private or public, religiously affiliated or not. Therefore, when developing the mission questions, it was a deliberate choice to design the questions so they could be employed for assessment purposes by any postsecondary institution of any affiliation.

In the 2004 inaugural year of this study, the mission research instrument was appended to the NSSE main survey and administered by 14 Catholic colleges in a consortium. The 2004 data (N = 3,605) were released by participating institutions and obtained to begin this research. This process of survey administration and obtaining data was repeated in each of the following three years, 2005 (N = 2,448), 2006 (N = 4,897), and 2007 (N = 7,721).

Table 1 displays the MPI question items used by year. In any given year, a consortium can append a total of 20 question items to the NSSE. Questions are static or may vary. In addition to the demographic question on "current religious preference," 14 items have been the same every year 2004 through 2007. The five questions that varied did so because of changes in consortia coordinators by year. Note that in 2004 and 2007, however, the items are the same, allowing the opportunity to explore confidently the strength of that joint MPI dataset. Also, in successive years 2005, 2006, and 2007, 16 items are the same, and that is explored, too.

Table 1
MPI Scale Items and Reliability by Year

	2004	2005	2006	2007
Current religious preference: (Mark one) *(Not included in MPI)*	x	x	x	x
The mission of this institution is widely understood by students.	x	x	x	x
Ethical and spiritual development of students is an important part of the mission at this institution.	x	x	x	x
This institution offers opportunities for volunteering and community service.	x	x	x	x
Social and personal development of students is an important part of the mission at this institution.	x	x	x	x
This institution offers opportunities for developing leadership skills.	x	x	x	x
The heritage of the founding religious community of this institution is evident here.	x	x	x	x
The faculty, staff, and students here are respectful of people of different religions.	x	x	x	x
The faculty, staff, and students here are respectful of people of different races and cultures.	x	x	x	x
People of different sexual orientations are accepted socially here.	x	x	x	x
Students feel free to express their individual spirituality here.	x	x	x	x
The environment here encourages students to develop an appreciation of diversity.	x	x	x	x
The professors at this institution discuss the ethical implications of what is being studied.	x	x	x	x
Within the past week, have you spent time in private prayer or meditation?	x	x	x	x
Within the past week, have you participated in a religious service?	x	x	x	x
The mission of this institution is reflected in its course offerings.		x	x	x
As a result of your experience here, you are more aware of your own personal values.		x	x	x
At this institution, there are opportunities for students to strengthen their religious commitment.	x			x
*How important is it to you that you accomplish the following objectives? Raising a family.				
*How important is it to you that you accomplish the following objectives? Becoming an authority in your field.				
How important is it to you that you accomplish the following objectives? Volunteering in community service.	x			x
How important is it to you that you accomplish the following objectives? Influencing social values.	x			x
Since you have been here, has your religious commitment become: *stronger*		x	x	
Frequency on campus: Discussion about moral and ethical issues		x	x	
Number of MPI scale items	**17**	**18**	**18**	**19**
Total Scale α =	**0.880**	**0.894**	**0.902**	**0.907**
***N*=**	**3,605**	**2,448**	**4,897**	**7,721**

Note: *Item deleted 2004

To assess the construct validity of the MPI, the items of the instrument used by year were subjected to exploratory factor analysis to yield a factor structure containing the best performing subset of items (Chesney, Neilands, Chambers, Taylor, & Folkman, 2006). Reliability of the overall MPI was measured via internal consistency coefficient alpha (Cronbach, 1951). A complete description of the statistical analysis approach is described previously (Boylan, 2005).

In addition to listing the question items, Table 1 shows by year the results of internal consistency analysis (Cronbach's alpha) for the total MPI scale, not accounting for the presence of any internal

factors. The strongest Cronbach alpha score by year is indicated for the MPI 2007 (^{a} = .907), but scores for every year exceed .80. Therefore, all MPI scales are reliable by year. However, are all scales equally valid for measuring mission perception? Which set of items should comprise the MPI to produce the most consistent and reliable measure in future testing?

Results

The research is based on data from first-year and senior students at 54 institutions participating over four years in the NSSE 2004–2007 Catholic College Consortia. Each year, the NSSE main survey was administered to the consortium sample with an added 20-item set of consortium questions. There were 18,671 valid cases obtained over four administration years. Respondents were classified by schools as either first-year students or seniors, and in truth, there was a roughly 50/50 division each year. Of total respondents for the four years, about 27% are male and 73% female.

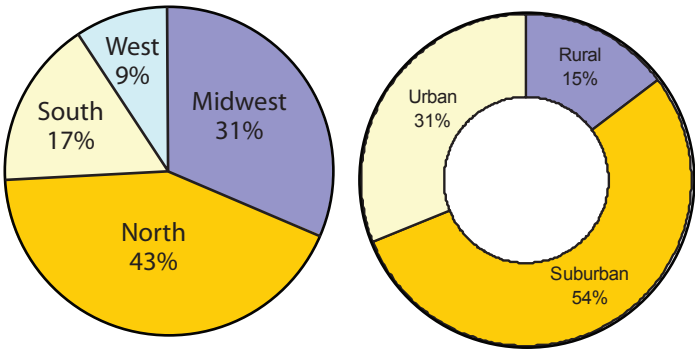

Figure 1. Percent distribution institutions by regions 2004–2007.

Figure 2. Consortia institutions by urbanicity 2004–2007.

Institutional characteristics by regional location and urbanicity are shown in Figures 1 and 2. Figure 1 shows the percent distribution of participating consortia colleges by region of the United States, with most from the North (43%), and in descending order from the Midwest (31%), South (17%), and West (9%), a fair reflection of overall institutional distribution nationwide. As indicated in Figure 2, 54% of institutions participating in consortia data sharing were from suburban areas, 31% from urban, and 15% from rural.

Factorial validity

The sample met the subject to variable ratio of 5:1 (Tabachnick & Fidell, 1996). To address the research question about validity and reliability of the MPI, a Cronbach's alpha test was conducted on the total set of mission question data from administration years 2004, 2005, 2006, and 2007, individually. For each year, question items with low inter-item correlation, or lower than .30 (p. 641), such as "becoming an authority in my field" and "raising a family" from the first administration in 2004, and others about drinking and cheating behavior from 2005 and 2006, were removed due to low factor loading in exploratory factor analysis. Repeating the steps of analysis and removing items that appear in the pattern matrix as having low item-total correlations, or below .32 (p. 677) produced the most reliable set of items for MPI scales for each year of data.

The next object of analysis was to develop the most reliable MPI scale using the greatest number of question items shared over four years. Results are shown in Table 2. The text of questions and their item factor loadings by aggregated dataset are indicated. Data were aggregated in sets: two-year (2004/2007), three-year (2005-06-07), and four-year (2004-05-06-07). Sets were created by combining results from question inventories that shared the largest number of questions in common. In each dataset, about 6% to 8% of cases are classified as missing, an acceptable level.

Exploratory factor analysis was conducted on each aggregate dataset, and low-loading items were dropped. The factor analysis produced three factors from the combined MPI 2004/2007 data,

Table 2
Results of Factor Analysis of MPI by Combined Data Years

	2-Year			3-Year					4-Year		
	2004 and 2007			2005-06-07			2005-06-07		2004-2005-2006-2007		
Factors	**1**	**2**	**3**	**1**	**2**	**3**			**1**	**2**	**3**
Current religious preference: (Mark one) (Not included in MPI)											
The mission of this institution is widely understood by students.	.518			.555					.542		
Ethical and spiritual development of students is an important part of the mission at this institution.	.693			.681					.684		
This institution offers opportunities for volunteering and community service.	.687			.584					.653		
Social and personal development of students is an important part of the mission at this institution.	.638			.677					.733		
This institution offers opportunities for developing leadership skills.	.633			.617					.679		
The heritage of the founding religious community of this institution is evident here.	.635			.593					.613		
The faculty, staff, and students here are respectful of people of different religions.		.703			.442	.698				.675	
The faculty, staff, and students here are respectful of people of different races and cultures.		.698			.478	.648				.683	
People of different sexual orientations are accepted socially here.		.680			.688					.694	
Students feel free to express their individual spirituality here.		.692			.722					.694	
The environment here encourages students to develop an appreciation of diversity.		0.664			0.709					0.677	
The professors at this institution discuss the ethical implications of what is being studied.	.505			.534					.489		
Within the past week, have you spent time in private prayer or meditation?			.340			<.32					.696
Within the past week, have you participated in a religious service?			.308			<.32					.642
The mission of this institution is reflected in its course offerings.	.518			.624						n/a	
As a result of your experience here, you are more aware of your own personal values.	n/a			.565						n/a	
At this institution, there are opportunities for students to strengthen their religious commitment.	n/a				n/a					n/a	
*How important is it to you that you accomplish the following ? Raising a family.	n/a				n/a					n/a	
*How important is it to you that you accomplish the following? Becoming an authority in your field.	n/a				n/a					n/a	
How important is it to you that you accomplish the following objectives? Volunteering in community service.				.726	n/a					n/a	
How important is it to you that you accomplish the following objectives? Influencing social values.				.720	n/a					n/a	
Since you have been here, has your religious commitment become: stronger (2005-06 only)	n/a				n/a					n/a	
Frequency on campus: Discussion about moral and ethical issues (2005-06 only)	n/a				n/a					n/a	
Scale items	**17**			**16**			**14**		**14**		
Total Scale α =	**.887**			**.903**			**.911**		**.883**		
N=	**11,326**			**15,066**			**15,066**		**18,671**		
variance explained	**46.71**			**48.45**			**50.93**		**50.55**		

Note: Asterisk indicates low loading of item in Exploratory Factor Analysis; therefore, item removed.

three from the MPI 2005-06-07 data, and three from the 2004-05-06-07 data. In the three-year analysis for years 2005-06-07, evidence suggests that two low-loading items were possibly confounding the alignment of two others that previously aligned strongly with the diversity factor. So, low-loading items were removed and factor analysis was conducted an additional time on the three-year dataset. As a result, two strong factors, or subscales, with very good to excellent loadings of all 14 items were produced. These scales are consistent with ones previously identified as Sense of Mission (9 items) and Respect for Diversity (5 items).

To interpret the results of factor analysis shown in Table 3, the rule of thumb is followed wherein only variables with loadings of .32 and above are interpreted (Tabachnick & Fidell, 1996). The greater the loading, the more the variable is a pure measure of the factor. Comrey and Lee (1992) suggest that loadings in excess of .71 are considered *excellent,* .63 *very good,* .55 *good,* .45 *fair,* and .32 *poor.*

With regard to subscales shown in Table 3, the most reliable in every administration year are Sense of Mission and Respect for Diversity. Other scales previously identified, Individual Actions in 2004 and Religious Practice in 2004, 2005, 2006, and 2007 (Boylan, 2005), are also shown in Table 3. These subscales have few variables, just two or three by year. The Religious Practice factor was consistent over four years. Therefore, that scale could be employed by consortia in the future, along with the Sense of Mission and Respect for Diversity scales, if that is of interest to participating institutions. However, caution is advised when interpreting factors, like Religious Practice, that consist of just two items (Tabachnick & Fidell, 1996).

Table 3

Cronbach's Reliability Analysis of the Mission Perception Inventory (MPI) and Subscales 2004–2007

Subscales	2004	2005	2006	2007
Sense of Mission	.87	.88	.88	.90
Respect for Diversity	.85	.84	.87	.86
Individual Actions	.67	n/a	n/a	n/a
Religious Practice	.62	.55	.54	.62
MPI scale	**.88**	**.89**	**.90**	**.91**

Discussion

Findings from testing of the MPI suggest that the overall scale and subscales are reliable over time, are supported by factor analysis, and are of relevance to postsecondary institutions interested in gathering evidence of student perception of mission.

To summarize, the MPI was administered annually for four consecutive years by a consortia of varying college participants, and the data were collected. Testing of the instrument, with poorly correlated items by year removed, was conducted, and the instrument was found overall to be a reliable and valid measure of student perception of institutional mission. As shown in Table 3, additional testing via factor analysis produced up to four reliable subscales from the MPI called Sense of Mission, Respect for Diversity, Individual Actions, and Religious Practice. Because the Individual Actions and Religious Practice scales have so few items each, only Sense of Mission and Respect for Diversity, with more items and higher reliability, would be most useful to subsequent survey administrations that might be conducted to explore student perception of mission.

It is important to consider the replicability, utility, and complexity of factors when interpreting output. Here, by selecting the fewest factors to comprise the MPI, the utility of the inventory can be increased. The high internal consistency of items and strong correlations within factors lends confidence to the results of future administration of the MPI.

Conclusions and Implications

The subscales produced from analysis by administration year indicate the presence of those concepts in students' perceptions of their educational experiences at consortium colleges. The reliability of the overall MPI scale indicates that it can be employed with confidence as a measure of student mission perception in subsequent studies. Also, the high reliability of the Sense of Mission and Respect for Diversity subscales indicates that these scales can be used alone or in concert with other instruments to measure those constructs.

Another appropriate research exploration using the MPI and subscales of Sense of Mission and Respect for Diversity is to administer them to different consortia of institutions with different input characteristics, and compare results. Indeed, that analysis has been performed on results from the NSSE 2008 and 2009 administrations, in which two consortia of institutions, one Catholic and one private, administered the same MPI questions to their first- and senior-year students. See results at http://www.marywood.edu/instresearch/professional-publications-activities.html

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The AIR *Professional File*—1978-2011

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