Culture change: defining and measuring student-centered teaching

Torey Hickman

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entitled

Culture Change: Defining and Measuring Student-centered Teaching

by

Torey Hickman

Submitted to the Graduate Faculty as partial fulfillment of the requirements for the

Doctor of Philosophy Degree in Curriculum & Instruction

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August 2010
An Abstract of

Culture Change: Defining and Measuring Student-centered Teaching

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The University of Toledo
August 2010

This paper adds to the literature on student-centered teaching in higher education, answering the question of what is expected of instructors for them to teach in a student-centered manner. Building upon the existing literature regarding student-centered teaching, this paper defines a construct of student-centered teaching. In addition, two versions of a data collection instrument have been developed to measure the student centeredness of higher education instructors’ teaching approaches, utilizing self-reported data. This paper also adds to the discussion on whether student-centered teaching is related to the teaching context or teacher demographic variables. Results indicated that there was no practically significant relationship between student-centered teaching and any of the contextual or demographic variables; course discipline and instructor sex were, however, statistically significant. This study took place within the context of a cultural change initiative at The University of Toledo, in which the university is creating a culture of student-centeredness.
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# Table of Contents

Abstract ................................................................. iii
Acknowledgements ......................................................... iv
Contents ................................................................. v
List of Tables .......................................................... viii
List of Figures ............................................................ x
1 Introduction ............................................................ 1
  1.1 Student Centeredness at The University of Toledo ..................... 1
  1.2 Purpose ................................................................... 4
  1.3 Research Questions .................................................. 5
  1.4 Significance .......................................................... 7
  1.5 Overview of Future Chapters ......................................... 8
  1.6 Operational Definitions ............................................. 9
2 Literature Review ....................................................... 11
  2.1 Student-centered Teaching and Student Learning .................... 11
  2.2 Variation in Teaching Approaches .................................. 13
  2.3 Cultural Change to Student Centeredness and Human Performance
      Technology ................................................................ 16
  2.4 Other Student-centered Universities .................................. 30
2.5 Measuring Student-centered Teaching .................................................. 33
2.6 Creating a Measure of Student-centered Teaching ................................. 38
2.7 The Rasch Model and Student-centered Teaching .................................. 42
2.8 Summary ............................................................................................... 48

3 Methodology ............................................................................................ 49

3.1 Research Questions ................................................................................ 49
3.2 Research Hypotheses ............................................................................ 51
3.3 Participants ........................................................................................... 53
3.4 Data Collection Instrument .................................................................. 56
3.5 Procedure for Contacting Participants .................................................. 58
3.6 Procedure for Participants .................................................................... 59
3.7 Data Handling ....................................................................................... 59
3.8 Data Analysis ........................................................................................ 60
   3.8.1 Rasch Analysis ................................................................................. 60
   3.8.2 Short Form Rasch Analysis ............................................................. 62
   3.8.3 Statistical Tests ............................................................................... 63
   3.8.4 Developmental Path ....................................................................... 64
3.9 Limitations ............................................................................................. 64

4 Results .................................................................................................... 65

4.1 Rasch Analysis ....................................................................................... 65
4.2 Short Form Rasch Analysis ................................................................... 70
4.3 Statistical Tests ..................................................................................... 75
4.4 Developmental Path ............................................................................. 79
5 Discussion

5.1 Defining Student-centered Teaching .......................................................... 81
5.2 Measuring Student-centered Teaching .......................................................... 95
5.3 Performance Analysis .................................................................................... 98
5.4 Relationships Between Contextual and Demographic Variables and
      Student-centered Teaching ............................................................................. 104
      5.4.1 Contextual Variables ........................................................................... 104
      5.4.2 Demographic Variables ....................................................................... 105
      5.4.3 Course Discipline and Instructor Sex .................................................. 107
5.5 Developmental Path....................................................................................... 108
5.6 Conclusion ....................................................................................................... 110
5.7 Future Research ............................................................................................. 111
      5.7.1 Misfitting Items .................................................................................... 111
      5.7.2 Student-centered Teaching from Other Perspectives ......................... 112
      5.7.3 Non Self-reported Data ......................................................................... 112
      5.7.4 Look Outside of Higher Education ...................................................... 113
      5.7.5 Student-centered Teaching in Online Environments .......................... 113

References ............................................................................................................ 114

Appendices

A Original Survey Items ....................................................................................... 122
B 34 Survey Items Fitting the Rasch Model ......................................................... 126
C 15 Short Form Survey Items ............................................................................. 129
List of Tables

3-1 Instructors Per College and the Proportion of the Total Number of Instructors .................................................................................................................................................. 54
3-2 Sample Demographics .................................................................................................................................................................. 57
3-3 Contextual Factors ..................................................................................................................................................................... 58
3-4 Statistical Tests Run to Answer the Third and Fourth Sets of Research Questions ........................................................................................................................................ 63
4-1 Summary Statistics for 47 Items .................................................................................................................................................. 66
4-2 Summary Statistics for 334 Non-extreme Participants .............................................................................................................. 66
4-3 Original Rating Scale Category Structure ....................................................................................................................................... 66
4-4 Collapsed Rating Scale Category Structure ....................................................................................................................................... 67
4-5 Summary Statistics for 34 Retained Items ....................................................................................................................................... 69
4-6 Summary Statistics for 251 retained Participants ............................................................................................................................... 69
4-7 Explained and Unexplained Variance ........................................................................................................................................ 70
4-8 Rank Ordering of Items from Split Sample Analysis ................................................................................................................ 71
4-9 Short Form Rating Scale Category Structure ....................................................................................................................................... 72
4-10 Short Form Summary Statistics for 15 Items ................................................................................................................................. 72
4-11 Short Form Summary Statistics for 247 Non-extreme Participants ................................................................................................ 73
4-12 Short Form Explained and Unexplained Variance ......................................................................................................................... 74
4-13  Comparison of Short Form and Original Item Difficulties and Rank
Orders ........................................................................................................... 74

4-14  Descriptive Statistics for Student-centered Teaching Measures .............. 75

4-15  Descriptive Statistics for Instructor Ranks .............................................. 78

4-16  Descriptive Statistics for Discipline-sex Two-way Analysis of
      Variance .................................................................................................... 78

4-17  Descriptive Statistics for Equal Group Size Discipline-sex Two-way
      Analysis of Variance .............................................................................. 79

4-18  Suggested Item Groupings for a Developmental Path............................ 80

5-1   Fitting Items Arranged by Competency ................................................. 84

5-2   Misfitting Items Arranged by Competency ............................................ 86

5-3   Items Ordered by Difficulty Measure .................................................. 89

5-4   Short Form Items Arranged According to Difficulty .............................. 96
List of Figures

5-1 Item map displaying items along the logit scale according to their Rasch difficulty measures

5-2 Item map displaying the items according to difficulty and grouped into content categories

5-3 Item map displaying participants according to ability and items according to difficulty along the logit scale
Chapter 1

Introduction

1.1 Student Centeredness at The University of Toledo

Between publication of the 2004-2006 Catalog of The University of Toledo and the 2006-08 Catalog of the University of Toledo, the Mission Statement of the university changed from referencing The University of Toledo as “a major comprehensive state university” (2004-2006 Catalog, p. 1) to referring to the university as “a student-centered public metropolitan research university” (2006-08 Catalog, p. 1). The current form of the Mission Statement retains the notion of student-centeredness, reading: “The mission of The University of Toledo is to improve the human condition; to advance knowledge through excellence in learning, discovery and engagement; and to serve as a diverse, student-centered public metropolitan research university” (The University of Toledo, 2006).

The push toward student-centeredness at The University of Toledo has received much attention since its inclusion into the Mission Statement, and it seems to be of particular interest to the president. In fall of 2006, the President's Commission on Student Centeredness was formed; meeting minutes can be found beginning in September 2006 (The University of Toledo, 2007a). The charge of the commission was “to develop an
innovative, aggressive plan to change the culture at the New University of Toledo to be one focused on student centeredness” (The University of Toledo, 2007b). Details of the instructions for developing the plan relevant to this paper include provisions for focusing on academic affairs, building a student-centered workforce, and informing all faculty about student centeredness. Student centeredness has continued to hold a prominent position in the university’s planning as evidenced by the attention it received in the president’s Annual Address (see Jacobs, 2008).

Vincow (1997) provides a definition of the concept of the student-centered research university. Through the definition it is clear the move to student-centeredness represents a change in culture for a university, as the President’s Commission on Student Centeredness was charged to do; specifically, the changing role of the faculty is addressed by the definition. The goal of the student-centered research university is the promotion of learning. All activities conducted by the faculty—teaching, research, and service being explicitly mentioned—should be viewed as they relate to learning, and the success of these activities should be judged by their contributions to learning. Throughout the literature, the focus on learning outcomes in the student-centered approach is common (e.g., Barr & Tagg, 1995; Felder & Brent, 1996; Gilis, Clement, Laga & Pauwels, 2008; Landrum, 1999; Nuckles, 2000; Trigwell & Prosser, 1996, 2004).

Vincow (1997) goes on to explain that becoming a student-centered research university removes the focus from the faculty and its teaching, research, and service. Instead, the “number one priority becomes promoting learning by our students” (p. 167). Two immediate consequences are given. First, the faculty cannot be good teachers—in the sense of transmitting knowledge and skills—apart from learning by the students.
Education is no longer about teaching, rather teaching and learning. Vincow writes that “this change in emphasis … is the single most important transformation to be achieved by the vision of a student-centered research university” (1997, p. 167). The second immediate consequence of focusing on student learning is with regards to the research done by faculty. The impetus behind research will be its positive impact on student learning. Vincow claims the shift in rationale for research is “the most controversial aspect of the new [student-centered] model” (1997, p. 168).

The charge given to the President’s Commission on Student Centeredness to change the culture of the university clearly has implications throughout the university, but the effect on the role of the faculty should be of great concern. After all, if student centeredness has learning as its goal, we should look to those who are charged with promoting the learning of the students: the faculty. As was noted, in an effort to change the culture of The University of Toledo to a culture of student centeredness, the President’s Commission on Student Centeredness was charged with building a student-centered workforce and informing faculty about student centeredness; however, managing the effects of the university’s cultural change on the faculty has not taken place.

From a Human Performance Technology perspective there are flaws in the way in which The University of Toledo has set out to conduct its cultural change to student centeredness. Focusing on how the cultural change affects the faculty, the problems begin with the university’s lack of a definition, or construct, of student-centered teaching. Communication is vital to a change process (Malopinsky & Osman, 2006); however, the lack of a definition of student-centered teaching prevents the university from
communicating to the faculty what it expects in terms of student-centered teaching as well as providing information to guide the faculty in making decisions aligned with the university’s overall mission, objectives, and goals. Additionally, without a construct of student-centered teaching, the university faces another problem: the inability to measure the student centeredness of the faculty. Being unable to measure student-centered teaching prevents conducting a performance analysis to determine the current state of the faculty’s teaching, determining if a gap exists between the current state of teaching and the desired state, and tracking changes in the level of student-centered teaching to determine if the cultural change is taking place and if it is ultimately successful. Without first defining student-centered teaching, The University of Toledo cannot expect to successfully complete its cultural change to student centeredness, and it will have no way to objectively determine whether or not a change in the faculty’s teaching has taken place.

1.2 Purpose

The purpose of this paper is to build upon the literature concerning student-centered teaching in higher education. Specifically, this paper seeks to define a construct of student-centered teaching, describing what is expected of instructors if they are to teach in a student-centered manner. In doing so, this paper develops a data collection instrument for measuring student-centered teaching. Furthermore, this paper seeks to better understand the relationship of classroom contextual variables and teacher demographic variables to student-centered teaching.
In accomplishing these purposes, this paper hopes to facilitate The University of Toledo’s cultural change to student centeredness, focusing on the teaching approach of the faculty as one aspect of the university’s overall culture. Viewing cultural change from a Human Performance Technology perspective, the study will follow the Pershing Performance Improvement Process to review how this cultural change process has been carried out, identifying specific steps in the process that have not been properly managed.

The study will correct two specific areas: the university having no defined concept of student-centered teaching, and the university having no measure of the student centeredness of the faculty’s teaching. In correcting these deficiencies, this study will build upon and further develop the theory of student-centered teaching and develop an instrument to measure student-centered teaching. In addition, the study will make recommendations for a developmental path for increasing student-centered teaching, which could be incorporated into formal training in student-centered teaching or made available to faculty to use for personal development.

1.3 Research Questions

1. Is the data collection instrument developed by the author useful for measuring student-centered teaching?
   a. Are the participants able to effectively communicate through the rating scale?
   b. Does the collected data for items sufficiently meet the requirements of the Rasch model?
c. Does the collected data for the participants sufficiently meet the requirements of the Rasch model?

d. Are the items comprising the data collection instrument of varying difficulties, such that they represent a linear continuum from less student-centered teaching to more student-centered teaching?

e. Are the items comprising the data collection instrument able to distinguish between participants of varying degrees of student-centered teaching?

f. Do the items comprising the data collection instrument work together to represent a unidimensional construct?

g. Does the construct remain reliably defined across a split sample?

2. How student-centered is the teaching of the faculty of The University of Toledo, as reported by the faculty?

3. Are there relationships between contextual variables and levels of student centeredness?

a. Is there a relationship between class size and levels of student-centered teaching?

b. Are there differences in the levels of student-centered teaching between courses of differing levels?

c. Are there differences in the levels of student-centered teaching between courses in varying disciplines as categorized by Becher (1989; e.g., pure hard)?
4. Are there relationships between characteristics of teacher demographics and levels of student-centered teaching?
   a. Are there differences in the levels of student-centered teaching between men and women?
   b. Is there a relationship between levels of student-centered teaching and years of teaching experience?
   c. Is there a relationship between levels of student-centered teaching and age?
   d. Is there a difference in the levels of student-centered teaching between instructors of different ranks?

5. Does the construct of student-centered teaching reveal a developmental path, which could be useful for training and development in student-centered teaching?

1.4 Significance

This study will facilitate The University of Toledo’s efforts to complete its cultural change to student centeredness. As improved student learning is the goal of student centeredness, the ultimate effect of this study is not simply to properly conduct a cultural change process, but rather to improve the learning of The University of Toledo’s current and future students. In addition, the study will add to the literature concerning student-centered teaching by developing a student-centered teaching construct that is useful for measurement. This construct could be adopted by other colleges or universities which wish to communicate to its faculty what is expected in regards to student-centered
teaching or which would like to measure the student centeredness of its faculty’s teaching. The construct of student-centered teaching will also provide a possible developmental path that an institution could adopt when designing training programs to increase the student centeredness of its faculty; there is also the potential for individual instructors to use the developmental path in their personal efforts to improve their teaching.

1.5 Overview of Future Chapters

Chapter Two provides a review of relevant literature. The chapter begins by reviewing literature that explains the relationship between approaches to teaching and student learning outcomes to establish why it is important for The University of Toledo’s cultural change to student centeredness to be successful. This is followed by a review of the steps of the Pershing Performance Improvement Process as they relate to the cultural change initiative. This review highlights the need for a definition of student-centered teaching and a measure of the student centeredness of the teaching at the university. Next is a review of the Approaches to Teaching Inventory, a data collection instrument used to measure student-centered teaching, and an explanation of why this instrument is not suited to the needs of The University of Toledo. Chapter Two ends with a discussion of using the Rasch Measurement Model to create a measure of student-centered teaching appropriate for the university’s needs.

Chapter Three provides an explanation of the research methodology used during this study. The chapter details the creation of the data collection instrument used in this study. Following this are discussions of the population, sample, and sampling method;
the data collection procedure; the data coding and entering procedure; the procedure for
the Rasch analysis of the data; and the statistical analysis methods.

Chapter Four shares the results of the analysis. The chapter begins by presenting
the results of the Rasch analysis and the indicators of the quality of the measure of
student-centered teaching. This is followed by a presentation of the data indicating the
university faculty’s overall level of student-centered teaching. The chapter then moves on
to the results of the statistical analysis comparing the student-centered teaching of the
various colleges of The University of Toledo. Chapter Four concludes with an overview
of the item difficulty measures as they relate to developing a developmental pathway for
becoming more student-centered.

Chapter Five provides an interpretation of the results presented in Chapter Four
for each of the study’s research questions. The discussion of each research question
includes the conclusions that are drawn from the results, as well as the implications the
results could have for The University of Toledo’s cultural change initiative. The chapter
ends with recommendations for how the university might proceed to successfully execute
the teaching portion of its cultural change to student centeredness.

1.6 Operational Definitions

In the following chapters, the following terms shall be defined as stated below.

Classroom: The physical or virtual space in which instruction takes place. In
courses where the instructor and learner meet face to face, this is the physical space in
which they meet. In online courses, this would be, for example, a course homepage or
discussion board.
Competency(-ies): Gilis, Clement, Laga, and Pauwels (2008) developed a list of student-centered teaching competences [sic] describing the attitudes, knowledge, and skills which are integrated when teaching in a student-centered manner. These competences are referred to as competencies in this paper (e.g., Competence 1 in Gilis et al. becomes Competency 1 in this paper).

Conception of teaching: What instructors believe about teaching, including the purpose of teaching and what teaching should accomplish.

Human performance technology: “The study and ethical practice of improving productivity in organizations by designing and developing effective interventions that are results-oriented, comprehensive, and systematic” (Pershing, 2006, p. 6).

Rasch measurement model: A mathematical model that describes the type of data necessary for fundamental measurement. The specific model used in the analysis is the Rasch Rating Scale Model (Andrich, 1978).

Student-centered teaching approach: A teaching approach that focuses on the learner—what the learner is doing, experiencing, and learning.

Teacher-centered teaching approach: A teaching approach that focuses on what the instructor is doing to transmit information to the learner.

Teaching approach: A method of instruction that can be represented by a set of characteristic behaviors.
Chapter 2

Literature Review

2.1 Student-centered Teaching and Student Learning

There are two approaches to learning generally identified in the literature: a surface approach to learning and a deep approach (see e.g., Entwistle & Ramsden, 1983; Biggs, 1987). The surface approach to learning involves attempting to memorize the information that is considered to be important; furthermore, the decision as to what is important is often guided by which questions the students expect to encounter in an assessment (e.g., a test or quiz). The deep approach, on the other hand, involves developing an understanding of the content. Gibbs and Coffey (2004) explain that “students who take a deep approach have been shown, in a wide range of studies, to have superior learning outcomes, particularly in terms of understanding and developing new and more sophisticated conceptions of the subject” (p. 89). And Svensson (1977) argues that while students taking a deep approach might fail in developing a deep understanding, students taking a surface approach cannot develop a deep understanding unless they switch approaches.

Just as there are alternative approaches to learning, there are alternative approaches to teaching. Postareff, Lindblom-Ylänne, and Nevgi (2008) provide an
overview of the literature on approaches to teaching. To begin, academic teachers have different conceptions of teaching. Some teachers conceive of teaching as the transmission of knowledge from themselves or the textbook to the learners. Other teachers focus on the learners, viewing their own role as a facilitator of learning or a guide for students. The conception of teaching which teachers adopt has been shown to relate to the teaching approaches that they adopt: a teacher-centered approach or a student-centered approach (see e.g. Prosser, Trigwell, & Taylor, 1994). Teachers with an information-transmission conception of teaching often take a teacher-centered approach to teaching. This approach views students as passive recipients of the teacher’s already-constructed knowledge. Teachers who view themselves as facilitators of learning will often take a student-centered approach to learning, helping students as they construct their own knowledge and understanding. It should be noted that the two approaches are not necessarily independent of each other; for example, teachers taking a student-centered approach might at times attempt to transmit knowledge as part of their overall instructional method.

Trigwell, Prosser, and Waterhouse (1999) first revealed the relationship between student learning approaches and teaching approaches. Previous studies had described the relationship between teaching conceptions and teaching approaches (Trigwell & Prosser, 1996) as well as the relationship between learning conceptions and learning approaches (Prosser & Millar, 1989; van Rossum & Schenk, 1984), but no study had investigated the relationship between teaching approaches and learning approaches. Their results indicate that “an information transmission/teacher-focused approach to teaching is strongly associated with surface and non-deep approaches to learning and that a conceptual
change/student-focused approach is associated, but less strongly, with a non-surface approach to learning” (Trigwell et al., 1999, pp. 65-66).

The research reported in Trigwell et al. (1999) “completes a chain of relations between teacher thinking and student learning outcomes by describing the missing link between approach to teaching and approaches to learning” (p. 67). The Approaches to Teaching Inventory used to gather the data on teaching approaches is discussed later in this paper. Trigwell et al. correctly state that these relationships do not infer causality. It has not been established that student-centered teaching causes students to take deep approaches to learning; however, the implication seems to run throughout the literature. As such, the case for student centeredness is that a move to student-centered teaching should lead to students taking deeper approaches to learning, which leads to better learning outcomes.

2.2 Variation in Teaching Approaches

The literature indicates that teachers are not necessarily consistent in employing a student-centered teaching approach; the same teacher might use different teaching approaches in different contexts (Lindblom-Ylänne, Trigwell, Nevgi, and Ashwin, 2006; Prosser & Trigwell, 1999; Samuelowicz & Bain, 2001; Trigwell & Prosser, 2004). Some of the contextual variables that have been most commonly investigated are the discipline of the course, the number of students in the classroom, and the academic level of the students.

Results on the relationship between teaching approach and discipline have been mixed. Some studies have found no significant differences between disciplines; others
have. Kember and Gow (1994) wrote: “There did not seem to be any obvious relationships [of teaching orientation] to fields of study” (p. 70). Investigation of the relationship between teaching approach and discipline in Stes et al. (2008) was done by first categorizing the subject area into one of four discipline levels using Becher’s (1989) system of categorization: pure hard (e.g., chemistry), applied hard (e.g., medicine), pure soft (e.g., history), and applied soft (e.g., education). Stes et al. (2008) found no relationship between discipline and levels of student-centered teaching.

Singer (1996), however, reported that “some instructional behaviors are at least partly shaped by the disciplinary affiliations of the faculty” (p. 674). Lueddeke (2003), too, wrote “that there was a significant difference between faculty/discipline and the type of teaching concept held” (p. 219-220) with teaching concept measured by the ATI. Lindblom-Ylänenne et al. (2006) also found significant differences in teaching approach between disciplines. Comparing hard disciplines to soft disciplines, the student-centered teaching measures for soft disciplines were significantly higher than those for hard disciplines. When comparing Becher’s (1989) four levels, Lindblom-Ylänenne et al. (2006) found the measures of student-centered teaching from the pure hard disciplines were significantly lower than those for the pure soft and applied soft disciplines. Additionally, measures from the applied hard disciplines were significantly lower than those from the pure soft disciplines. However, there were no significant differences between pure hard and applied hard disciplines or pure soft and applied soft disciplines.

Another contextual detail whose relationship to teaching approach has been investigated is the number of students in a class. Again, the results have been mixed. Singer (1996) writes that class size can necessitate temporary changes in teaching
behavior. The logistical constraints of large classes lead to short-term adaptations in teaching. Trigwell and Prosser (2004) seem to agree, writing that teachers who believe that their class sizes are not too large are more likely to adopt a student-centered teaching approach. However, Stes et al. (2008) found no relationship between class size and teaching approach. Prosser, Ramsden, Trigwell and Martin (2003) included class size in their description of teachers’ perceptions of context, which were found to correlate positively with the student-centered teaching approach when students reported a high-quality learning experience; however, they did not report any specific relationship between class size and teaching approach.

The relationship between teaching approach and student level (i.e., the stage of students’ academic careers) has also been investigated. Singer (1996) claimed that as student level increased, teachers saw their role shift to one of imparting facts. However, Trigwell and Prosser (2004), in describing the characteristics of their descriptions of teaching approaches, flip the relationship. They suggest that teachers of higher-level students might be more inclined toward a student-centered approach than teachers of lower-level students. Neither position was supported by Stes et al. (2008), who found no difference in the level of student-centered teaching between teaching bachelor, master’s, or advanced master’s students; nor was there a difference when the groups were collapsed to simply bachelor and non-bachelor students.

Not only does the literature suggest that there might be relationships between contextual variables and teaching approaches, but the relationship between characteristics of teacher demographics and teaching approach has also been investigated. Some of the
characteristics of teacher demographics that have been investigated are sex, teaching experience, and age.

In investigating the relationship of teachers’ sexes and teaching approach, Singer (1996) wrote that gender was associated with teachers’ behaviors: women were more likely to be involved with promoting “more student-oriented, facilitative, and affectively driven” (p. 674) environments than men. Lacey and Saleh (1998) reported that men preferred to control and structure learning environments themselves; women gave more freedom to their students, allowing students to make decisions about what they needed to learn and how they should learn it. Stes et al. (2008), however, found no difference between men and women in the level of student centeredness of their teaching.

The relationships of teaching experience and age to teaching approach have also been investigated. Singer (1996) found no relationship between teaching experience and teachers’ behaviors. This result was supported by Stes et al. (2008), who also found no relationship between teaching experience and levels of student-centered teaching. Stes et al. (2008) also examined the relationship between teachers’ ages and levels of student-centered teaching, finding no relationship.

2.3 Cultural Change to Student Centeredness and Human Performance Technology

The practice of instituting cultural change throughout an organization falls within the domain of Human Performance Technology (HPT). Pershing defines HPT as “the study and ethical practice of improving productivity in organizations by designing and developing effective interventions that are results-oriented, comprehensive, and
systematic” (2006, p. 6). There are numerous alternative definitions of HPT, but the
discussion of which definition is most appropriate is outside the scope of this paper. In
the case of the cultural change toward student centeredness at The University of Toledo,
HPT would, according to Pershing’s definition, seek to improve the university’s
productivity, which can be defined in this case as student learning, which Vincow (1997)
writes is the goal of student centeredness. In order to increase the production of learning,
HPT would carry out systematic interventions, and it would do so comprehensively,
meaning all members and components of the university would be addressed.

In carrying out their interventions, practitioners of HPT follow models that guide
them through the steps necessary for planning and executing their interventions. As with
HPT definitions, there are numerous alternatives. This discussion will utilize the Pershing
Performance Improvement Process (PPIP, Pershing, 2006, pp. 14-26). The model can be
broken down into basic steps: perception analysis; strategic alignment with organizational
mission, goals, and objectives; performance analysis; intervention selection; feasibility
analysis; design, development, and implementation; and evaluation and feedback. By
looking at available documents regarding The University of Toledo’s cultural change, the
relevant information pertaining to many of these steps can be constructed.

In beginning the HPT process, the first step in Pershing’s model is the perception
analysis. This stage is where the perceived need for improvement is identified. Pershing
identifies three root perceptions of people who are interested in improving performance:
“They believe there are performance problems, they believe there is a challenge for
quality improvement, or they believe that new or emerging business opportunities have
arisen” (2006, p. 15). In looking at the university president’s Annual Address from 2008,
Pershing’s root perceptions are apparent. For example, Dr. Jacobs states that the quality of student learning at U.S. institutions is inadequate and that many baccalaureate graduates are not prepared for jobs upon graduation; these statements reflect both performance problems and possibilities for quality improvement. In addressing business opportunities afforded The University of Toledo by implementing student centeredness, President Jacobs states: “Students with unique intellectual accomplishments or gifts will be attracted to The University of Toledo by its commitment to customized programs that allow them to proceed at a pace that is intellectually rewarding to them” (Jacobs, 2008). Clearly, The University of Toledo perceives the need and opportunity to improve its performance in promoting student learning.

Once a perceived need has been established, the next step in the PPIP is to compare the perceived need to the organizational mission, goals, and objectives. Is there alignment between the perceived need and the goals of the organization? In the brief description of the perception analysis, the identified perceived need was to improve student learning for two reasons: (1) the current state of U.S. higher education is inadequate and does not generally prepare graduates for work and (2) improving student learning will attract more and better students in the future. The Mission Statement of The University of Toledo as well as the actions and statements of the university’s president support the notion of student centeredness; there is alignment between the perceived need and the goals of the organization. In other words, accomplishing the goal of meeting the perceived need to improve student learning will not conflict with the mission and goals of The University of Toledo.
Now that it has been established that The University of Toledo has a perceived need to improve student learning and that meeting this need is aligned with the university’s mission and goals, the next step in the HPT model is to conduct a performance analysis. Within the PPIP model, the performance analysis is concerned with four elements: organizational systems, management systems, physical and technical systems, and human and social systems. Recognizing the systemic nature of organizations, a completely thorough performance analysis would investigate all four of these elements. However, the scope of this paper is limited to the implications of the cultural change on the teaching of the faculty and discussion of the performance analysis will be limited to the faculty as an element of the university’s human and social systems.

Rossett (2006) lists six goals of performance analysis. The first goal is to determine the current state of performance. The second goal is to determine what excellent performance is. The remaining four goals of analysis build off of these two in order to continue further in the HPT model. In the case of The University of Toledo, an investigation of the faculty’s teaching would reveal what the state of student-centered teaching is and what ideal student-centered teaching is. Unfortunately, such an analysis never took place; The University of Toledo never analyzed the student-centeredness of its faculty with regards to instruction in the classroom.

The problem with conducting a performance analysis begins with the university having no definition or construct of what student-centered teaching is. Such a construct would serve as a description of what excellent student-centered teaching is, thus meeting Rossett’s (2006) second goal of analysis. From there, such a construct could be used as a measure of student-centered teaching, which when implemented, would determine the
current state of student-centered teaching at the university. Stated differently, having a construct of student-centered teaching would allow the university to answer the question of how student-centered the faculty’s teaching is. Without such a measure, the HPT process cannot, or should not, proceed, as there is no evidence that the faculty’s performance needs to improve.

If the university had such measures of faculty student centeredness, then it would be apparent how large the gap is between current performance and desired performance. If a gap were found, then decisions could be made on how to proceed. The analysis process could continue to “[find] out why that performance is as it is” (Rossett, 2006, p. 211). As Chevalier (2006) states: “Conducting a thorough cause analysis helps define the reasons why a gap in performance exists” (p. 975). Once the reasons for performance problems are known, they can be corrected.

“Once the performance gap and its underlying causes, means, or opportunities are identified, interventions can be selected” (Pershing, 2006, p. 21). It has been stated that The University of Toledo did not carry out a performance analysis of the faculty’s teaching to determine whether or not it met the university’s desired performance. However, should any performance gap have been uncovered and the causes for the gap been identified, the next step in the PPIP is to select interventions to solve the performance problem. In the case of the faculty, what needs to take place for them to become more student-centered in their teaching practice?

Once an intervention has been selected, the feasibility of the intervention has to be analyzed; this is the next step in the PPIP. There are a number of considerations that have to be weighed to determine whether or not the intervention has a chance of success.
Pershing (2006) mentions practical factors (e.g., cost, timing), political factors (e.g., leadership, power structures), and cultural factors (e.g., readiness for change). All of these factors combine to determine whether or not an intervention will succeed or not. By considering them before beginning an intervention, interventions with high probabilities for success can be developed and those with low probabilities of success can be disregarded. Should an intervention be deemed feasible, then the next phase of the PPIP can begin: design, development, and implementation.

There are many different types of interventions to solve many different types of performance problems. In its effort to become more student-centered, The University of Toledo has already begun one type of intervention: cultural change or reshaping. Devane (2001) shares characteristics that cultural reshaping interventions generally include. To paraphrase, these characteristics are:

1. Involving numerous people in the design and implementation.
2. Clearly articulating the organization’s vision.
3. Using participatory planning methods to broaden understanding.
4. Redefining working relationships among members.
5. Incorporating whole-systems thinking to maintain alignment throughout the organization.
6. Increasing the dissemination of critical information.
7. Establishing processes for renewal and improvement.
Following the thinking laid out above, the university’s problem is that it has a need to improve student learning. Becoming more student-centered throughout the organization of the university is the path to improving student learning. Assuming, for the sake of argument, that the faculty is performing unsatisfactorily in regards to student centeredness and the underlying causes have been revealed, the university believes it needs to carry out a cultural change or reshaping intervention to alleviate the need for improved student learning; as was noted in Chapter One, the President’s Commission on Student Centeredness was charged with planning a cultural change to become student centered, with part of that cultural change involving informing faculty about student centeredness (The University of Toledo, 2007b). Apparently, the university deems this intervention feasible, since it has already begun, which also reveals that the cultural change intervention should have been designed and developed.

How does the implementation of the cultural change intervention affect the faculty, whose role, as mentioned in the discussion of the definition of a student-centered research university, is greatly altered by the move to student centeredness? In discussing the performance analysis, it was noted that the university has no definition or construct of student-centered teaching and therefore no way of measuring the student-centered teaching of the faculty. This lack of a definition for student-centered teaching also severely limits the ability of the university to communicate to the faculty what its new expectations are.

As is seen in the list of characteristics typical of a cultural reshaping intervention, communication and the dissemination of information are key, and as Malopinsky and Osman (2006) state: “Communication of information lies at the core of any change
process. Without the diffusion of information … change will not take root in the
organization” (p. 282). They go on to write that the change agent must determine which
information and education various groups within the organization need and propose ways
to get the groups that information. However, as has been stated, without a definition or
construct of student-centered teaching, the university cannot communicate its
expectations to the faculty, despite any recognition of the need to do so.

The communication that the university has presented with regard to student
centeredness can be found in the university’s strategic plan, *Directions: The University of
Toledo* (Directions, 2007). Within this document can be found the university’s Mission
Statement, core values, vision, and strategic directions. As was noted above, the
university’s Mission Statement states that The University of Toledo is “a diverse,
student-centered public metropolitan research university” (The University of Toledo,
2006; Directions, 2007, p. 4). While not mentioning student centeredness explicitly, Core
Value II reads, “Vigorously pursue and widely share new knowledge; expand the
understanding of existing knowledge; develop the knowledge, skills and competences
[sic] of students, faculty, staff and the community while promoting a culture of lifelong
learning” (Directions, 2007, p. 4), and is in alignment with the definition of the student-
centered research university of Vincow (1997). The vision of the university states, “The
University of Toledo will become a thriving student-centered, community-engaged,
comprehensive research university known for its strong liberal arts core and multiple
nationally ranked professional colleges, and distinguished by exceptional strength in
science and technology” (Directions, 2007, p. 4).
The university’s strategic directions are more focused than these previous, more general statements. There are six strategic directions listed in Directions (2007), and three mention student centeredness directly: Directions I, II, and IV. Under each direction are strategies necessary for success. Directions I and II deal with undergraduate and graduate education respectively. Within Direction I is written, “The undergraduate experience will provide exceptional student-centeredness” (Directions, 2007, p. 6), and within Direction II is found, “These [graduate and professional academic] programs will gain prominence for being exceptionally student-centered” (Directions, 2007, p. 8).

Looking through the strategies for each of these directions, there are strategies that refer to student centeredness—some of which also mention the faculty. There are others referring to the faculty or to student learning, but they will not be addressed here, as the purpose of this discussion is to view what has been communicated to the faculty about student-centered teaching. Under Direction I, which is related to undergraduate education, are:

5. Strengthen relationships between students and faculty through an increased commitment to student-centeredness.

7. Engage students across all academic disciplines in student-centered learning and provide meaningful opportunities to work with faculty mentors in conducting, presenting, and publishing scholarly, creative and scientific research. (Directions, 2007, p. 6).
Under Direction II, which is related to graduate education, is:

5. Develop a strong student-centered infrastructure that will attract graduate students of the highest caliber, through such means as graduate research and teaching assistantships, postdoctoral fellowships, scholarships and grants. (Directions, 2007, p. 8).

Direction IV deals specifically with student centeredness and reads: “We will be distinguished for our student-centeredness and for our vibrant programs and environment that enhance the sense of community on our campuses and in the surrounding areas” (Directions, 2007, p. 11). However, there are no strategies which detail how the faculty will be operating. Indeed, the only mention of the faculty is in Strategy 1, and it states that the “educational, recreational, cultural and social needs of all of our … faculty” (Directions, 2007, p. 11) will be met.

It might be argued that all of the strategies under Direction IV are related to student centeredness, and so the faculty, while not being explicitly mentioned, could infer its proper student-centered role. However, little mention is given to the faculty, especially in regards to teaching. Strategy 1 says that students’ educational needs will be met. The faculty could be expected to infer that they have a role to play here, but the faculty would do this independent of its understanding of student centeredness. Strategy 3 relates to the physical classroom spaces that are taught in. Strategy 5 states that academic life and residential life should be integrated. How these two strategies might provide insight into student centeredness from the perspective of the faculty seems ambiguous at best.
Clearly, there is very little guidance provided to the faculty by the university on what it means to teach in a student-centered manner. Direction I, Strategy 5 indicates that the relationship between the faculty and students should be strengthened. Direction I, Strategy 7 states that the undergraduate students should have the opportunity to work alongside faculty in conducting, presenting, and publishing research. Direction II, Strategy 5 deals with student centeredness in relation to graduate students, but it does not deal with the faculty directly. Finally, Direction IV, which specifically deals with student centeredness, offers little guidance in its strategies beyond faculty inferring that they play a role in meeting students’ educational needs.

The direction provided to the faculty on student centeredness by The University of Toledo is inadequate for the purposes of successfully changing the culture of the university to one of student-centeredness. The problem with the university’s mission statement, vision, strategic directions, and so forth is not unique to the university. According to Watkins (2006), most organizations develop strategic plans which outline what they hope to accomplish but which are often ignored by employees as they make their daily decisions.

Watkins (2006) continues, stating that strategic plans should be written as to provide, at all levels of an organization, the guidance needed to make daily decisions. The purpose of providing decision-making guidance is to ensure that all members of the organization are strategically aligned, meaning the actions of members of the organization are aligned with and producing results aligned with the mission and strategic direction of the organization. Bradford (2002) explains, “Aligning everyone in your
organization with your strategy is one of the most important things you can do beyond formulating and implementing great strategies” (¶ 2).

Kaufman, Oakley-Brown, Watkins, and Leigh (2003) describe the process of developing effective strategic plans. Their process begins with considerations of societal results, which they call Mega-level results. From the Mega-level, planning moves down to the Macro-level, which is concerned with the outcomes of the organization. Watkins (2006) notes that the product of this stage is often a mission statement, which should “provide unambiguous objectives by which all decisions … can be aligned” (pp. 194-195). As has been noted, in accordance with The University of Toledo’s Mission Statement, all decisions should be student-centered, as being student-centered is an objective of the university.

From this Macro-level, planning moves down to the Micro-level. At this level, the results of smaller elements within the organization (e.g., individuals, teams, divisions) are aligned with the overall organization. At this stage, the strategic plan should provide guidance to all organizational members in their decision making. It is important to note, however, that the strategic plan should not micromanage or dictate exactly how any individual, team, or group should meet its objectives. “Instead, they [strategic plans] provide clear statements about what results are expected, how success in accomplishing those results will be measured, and how the results are aligned with the organizational objectives” (Watkins, 2006, p. 196).

From the initial Mega-level, the strategic plan has to work its way down to all members of the organization. The University of Toledo could be said to be facing the Mega-level, or societal, issues of graduates who are underprepared to join the workforce
and an inadequate U.S. higher education system (Jacobs, 2008). The university wants to improve student-learning to meet the challenges of producing better-prepared graduates and improving U.S. higher education. In meeting these Mega-level objectives, the university will be student-centered. At this point, the university needs to address the Micro-level. The faculty teaching in a student-centered manner is one Micro-level objective, since this is clearly expected if teaching practice is to be aligned with the university’s Macro-level goal of being student-centered. The university needs to develop its strategic plan to the point where it can serve as a guide to the faculty in how to teach in a student-centered manner. How meeting the goal of improved student centeredness in teaching will be measured and how improved student centeredness in teaching is aligned with the goals of the university also need to be communicated through the strategic plan.

“Measuring progress and the status of change implementation is critical, as it allows organizations to objectively assess whether the change actually takes place. We cannot improve what we cannot measure” (Malopinsky & Osman, 2006, p. 281). The notion of measuring a change within an organization introduces the final stage of the Pershing Performance Improvement Process: evaluation and feedback. Evaluation should be taking place throughout the intervention. At all stages of the PPIP, evaluation should be taking place to ensure, as much as possible, the success of the intervention. Evaluation also takes place at the end of the intervention; the purpose of this evaluation is to determine the impact the intervention had on the organization (Brinkerhoff, 2006).

With regard to the cultural change to student centeredness at The University of Toledo, there needs to be continuous assessment of that change throughout the organization. Evaluation must take place in order to determine whether or not the change
to student centeredness has been successful. Of particular relevance to this paper is the assessment of the change to student-centered teaching by the faculty. Organizations should be developing metrics that allow them to collect and analyze data on the change status (Brinkerhoff, 2006).

“The measures or indicators for change progress should be selected to best represent the factors that lead to improved performance at various levels of an organization” (Malopinsky & Osman, 2006, p. 282). The University of Toledo should have a method for measuring the effectiveness of the change to student centeredness for all aspects of the university—student-centered teaching among them. Without these measures, the university cannot determine whether or not it has become student-centered. More specifically, the teaching must be measured to determine if it has changed to become student-centered, and this measure should be focused on those factors of student centeredness which will most lead to improved student learning, which is the ultimate goal of the cultural change.

However, the university is currently unable to determine whether or not the teaching has become student-centered because it has no measure of student-centered teaching. As was mentioned in the discussion of the earlier stages of the PPIP, the university has no definition of student-centered teaching and no construct of student-centered teaching that can be measured. Therefore, the university could not establish the student centeredness of the teaching at the beginning of the cultural change intervention. And now, it cannot measure any change in the student centeredness of the teaching to determine whether or not the cultural change has been successful with regard to the faculty’s teaching.
Having no measure of student-centered teaching prevents The University of Toledo from appropriately carrying out the cultural change intervention that it has begun. Without a definition of student-centered teaching, the performance analysis of the faculty cannot take place. There is no measure of how student-centered the faculty is and, therefore, no way to diagnose a performance problem. In regard to the cultural change intervention already taking place, the lack of a definition of student-centered teaching prevents the university from effectively communicating its expectations for the faculty. Since the faculty does not know what the university expects in student-centered teaching, it will most likely not change. Finally, having no measure of student-centered teaching allows the university no way to measure any changes in teaching; therefore, the university is unable to determine the success of the cultural change to student centeredness as it pertains to teaching.

2.4 Other Student-centered Universities

The University of Toledo is not alone in promoting itself as a student-centered university. It is also not alone in lacking a clear definition of student-centered teaching and clear expectations for the faculty. Kansas State University (KSU) refers to itself as “a student-centered university” and states that the university has an “identity and reputation as a student-centered, land-grant, and research university” (2008-2012 Strategic Plan, 2008). However, the university president stated in October 2009 that “as an institution we [KSU] have not clearly articulated what we mean when we say that Kansas State is a student-centered research university” (Schultz, 2009). A number of programs at KSU stress student learning and improved teaching, but “there is no single statement or web page …
to clarify Kansas State’s expectations for faculty teaching with respect to student centeredness” (V. Clegg, personal correspondence, May 27, 2010).

Florida International University (FIU) has a vision to be “a leading student-centered urban public research university that is locally and globally engaged” (Florida International University, 2010b). FIU is currently developing a strategic plan to achieve this vision (Florida International University, 2010a). Part of the plan will focus on enhancing learning through student-centered academic excellence; as of yet, no guidelines or have been developed for student-centered teaching at FIU (D. Robertson, personal correspondence, May 7, 2010).

The Pennsylvania State University (PSU) strategic plan states that the university will become a more student-centered university (Priorities for Excellence, 2009). The plan was finalized in 2009 and implemented beginning with the 2009-2010 academic year. Becoming more student-centered does not represent a change for the university, as it already emphasized student centeredness. The university president gave a speech in 2001 titled Creating a Student-Centered Learning Community (Spanier, 2001). After the president articulated his vision of a student-centered university, PSU worked toward that goal (Spanier, 2006). In 2007, the president referred to PSU as “the nation’s most student-centered research university” and again as “the most comprehensive student-centered research university in the nation” (Spanier, 2007).

However, as with other universities, PSU has no university-wide guidelines for faculty that define student-centered teaching (A. Linse, personal correspondence, May 6, 2010). The university’s Schreyer Institute for Teaching Excellence, which supports the university’s teaching and learning community, has a web page that defines teaching
excellence. This description contains one section pertaining to student-centered mentoring, which lists eight attributes of student-centered mentoring. In the same way that faculty could look to various publications on student-centered teaching, PSU faculty could reference this description as a guide for student-centered teaching—it is not the same as an organization-wide definition of student-centered teaching to which faculty are expected to look when making decisions related to their teaching.

The University of Alabama (UA) promotes itself as “the South’s premier student-centered research university” (Witt, 2007). No documentation could be found regarding UA policy toward student-centered teaching. The UA provost was contacted by the author, asking for documentation that might clarify UA’s expectations for the faculty’s teaching with respect to student centeredness, but no reply was received. Similarly, West Virginia University’s (WVU) vision articulates that the university “is a student-centered learning community” (2010 Plan, 2005). No documentation of a student-centered teaching policy could be found beyond a brief statement in the Electronic Faculty Handbook (2005). In a section titled Best Practices for Faculty in a Student-Centered Learning Environment, the university encourages faculty to respond to student requests in a timely fashion throughout the year. As with UA, the WVU provost was contacted, but no reply was received.

While this survey of other universities that promote themselves as being student-centered is not exhaustive, it illustrates that The University of Toledo is not unique in how it has handled defining student-centered teaching. Other universities with a mission or vision of being student-centered have also not defined student-centered teaching for their faculty.
2.5 Measuring Student-centered Teaching

In the literature, the only instrument found to be relatively widely used to measure the student centeredness of higher education teaching is the *Approaches to Teaching Inventory* (ATI; e.g., Postareff, Lindblom-Ylänne, and Nevgi, 2007, 2008; Stes, Gijbels, and Petegem, 2008). The ATI was developed primarily by Trigwell and Prosser (1996, 2004; Prosser, Trigwell & Taylor, 1994). Trigwell et al. (1994) began developing the ATI by qualitatively examining the various approaches to teaching used by university science teachers. The results of the qualitative analysis revealed five approaches to teaching, ranging from a teacher-focused strategy of transmitting information to a student-focused strategy of changing students’ conceptions; development of the ATI is ultimately concerned with these two extreme approaches to teaching.

The qualitative descriptions used to identify the teaching approaches were then used to write the items of the ATI. This was done by extracting statements and phrases from the transcripts that were recorded during the qualitative study. Through an iterative process, the items were refined to a trial version of 39 items on five subscales: Information Transfer (IT), Conceptual Change (CC), Teacher-focused (TF), Student-Teacher Interaction (ST), and Student-focused (SF). Data analysis of item reliability reduced the scale to 22 items. Pearson correlation coefficients and a principal components analysis of the sub-scales demonstrated the relationship between the IT and TF sub-scales and the relationship between the CC, ST, and SF sub-scales. As a result of loading heavily on the SF sub-scale, the ST sub-scale was dropped.

In 1999, the ATI was modified into a more general form for application outside of the sciences. During this process four items from each of the IT and TF sub-scales were
selected and combined to form the Information Transmission/Teacher-focused (ITTF) scale. Four items from each of the CC and SF sub-scales were selected and combined to form the Conceptual Change/Student-focused (CCSF) scale. All item responses are on a five-point Likert scale. This resulted in an instrument containing two sets of eight items. It is noteworthy that “the CCSF approach and the ITTF approach to teaching are two separate variables and a linear relationship between these variables is not expected (Postareff et al., 2007, p. 568). The ATI is designed to obtain teaching approach measures on these two scales: the ITTF scale and the CCSF scale. These two teaching approach measures have been used to establish relationships with conceptions of teaching (Trigwell & Prosser, 1996), establish relationships with learning approaches (Trigwell et al., 1999), and track changes in teaching approaches over time (Gibbs & Coffey, 2004; Postareff et al., 2007, 2008).

In its latest form, the Approaches to Teaching Inventory-Revised (ATI-R; see Trigwell et al., 2005) contains 22 items—11 items for each teaching approach scale, with subjects responding to each item on a five-point Likert-type scale. Measures for each subject for both teaching approaches are obtained by taking the mean of the responses to the items comprising each respective scale; however, rather than using the mean as the measure as intended, Gibbs and Coffey (2004) used each subject’s total score. Statistical procedures (e.g., ANOVA in Gibbs & Coffey, 2004; Postareff et al., 2007, 2008) are then conducted using these mean/total scores. The statistical validity of the two-factor structure of the ATI (ITTF and CCSF scales) was established through a principal components factor analysis (Trigwell & Prosser, 2004) and was confirmed by Prosser and Trigwell (2006); these factor analyses were conducted using a 16-item ATI. Trigwell et
al. (2005) performed a factor analysis based on the 22-item ATI-R, which resulted in the retention of the two scales, each with eleven items.

There are a few reasons why the ATI or the ATI-R will not be used to measure student-centered teaching in this paper. First, there are measurement concerns with respect to the method of validating the ITTF and CCSF scales and with the quality of the measures obtained through the ATI. The data obtained through the ATI are collected using a five-point Likert-type scale representing ordered categories. This scoring system produces ordinal level data, and as Wright (1996) states: “ordinal data are seldom in practice, and never in principle, sufficiently interval to justify the arithmetical calculations employed by means, variances, regressions, and factor analyses” (p. 4). The calculations involved with linear statistics, such as factor analysis and ANOVA, will produce distorted results when conducted with non-linear data (e.g., mean scores obtained through the ATI), and these distortions cause the inferences which can be made based on the results unclear (Wright, 1999). Therefore, the mean/total score measures obtained through the ATI and the results and interpretation of the linear statistical analyses of these measures (e.g., ANOVA) are questionable. To obtain more appropriate measures on which to run linear statistical analyses which would provide clear interpretations, it would be better to follow Wright’s (1999) advice: “An obvious first law of measurement is: Before applying linear statistical methods, use a measurement model to construct linear measures from your observed raw data” (p. 71).

In comparing the results of factor analyses for two data sets to the results of Rasch analyses for the same data sets, Waugh and Chapman (2005) showed clear differences in the results of the analyses. The factor analyses conducted on the two data sets indicated
that, in both cases, “a good scale [i.e., a scale representing the theoretical construct and useful for measuring the construct] has been created and that the scores are reliable” (Waugh & Chapman, 2005, p. 93). The Rasch analyses, however, demonstrated that neither set of items was useful for creating linear measures—not as a single construct nor as multiple constructs as suggested by the factor analyses. The difference in results from a factor analysis and a Rasch analysis can perhaps be boiled down to one statement: “factor analysis does not construct measures” (Wright, 1999, p. 91). Factor analysis looks for sets of intercorrelating items. These sets of intercorrelating items are viewed as possible variables being measured. However, as Waugh and Chapman (2005) write: “just because scores on items correlate doesn’t mean that one has a conceptual scale of items” (p. 81); sets of intercorrelating items are not necessarily useful for measurement. Rasch measurement takes a different perspective. A conceptual scale (i.e., a set of items) that is useful for producing measures on a variable must consist of items that represent “a hierarchical ‘more than/less than’ line of inquiry” (Bond & Fox, 2007, p. 41; see Thurstone & Chapman, 1929) rather than simply intercorrelating items. Because of the inability of factor analysis to construct measures, the two-factor structure of the ATI—the ITTF and CCSF scales—should not be accepted without further investigation. Both scales should be analyzed with regard to the extent that they measure their respective teaching approaches.

Even if it were demonstrated that the data gathered through the ATI’s CCSF scale did constitute a measure of student-centered teaching, there is another issue that makes it less than optimal for use by The University of Toledo. Trigwell and Prosser (2004) write that in developing the ATI, two of their key issues were measuring the variation between
the ITTF approach and the CCSF approach and keeping the length of the data collection instrument short enough that it would be completed. In other words, the design goal was to keep the number of ATI items to a minimum but retain its measurement capabilities.

It is possible to create an accurate measure with few items, and in many situations it would be advantageous to do so. Therefore, in spite of its minimal number of items, were the ATI shown to be an actual measure of student-centered teaching, it would be useful for accomplishing its developers’ main purpose: analyzing “relations between approaches to teaching [e.g., the student-centered approach] and other elements of the teaching-learning environment perceived by the same teacher in the same context” (Trigwell & Prosser, 2004, p. 421); the ATI would provide a CCSF measure to be correlated with another measure. Furthermore, in regard to The University of Toledo, the ATI’s CCSF scale would then also be useful for analyzing the performance of the university’s faculty.

However, for the purposes of this study, there is a downside to using only the minimum number of items necessary for effective measurement. One of the problems The University of Toledo has in affecting its cultural change is communicating to faculty what it means to be student-centered. The university needs to define student-centered teaching and communicate to the faculty its expectations regarding student centeredness. Also, in encouraging strategic alignment, the university needs to provide the faculty with a guide for decision making. Because of these concerns, a more exhaustive sample of items representing student-centered teaching (i.e., more than the eight or eleven included in the CCSF scales of the ATI and ATI-R) would prove more beneficial in encouraging the university’s cultural change to student centeredness.
2.6 Creating a Measure of Student-centered Teaching

One purpose of this study is the creation of a measure of student-centered teaching. Such a measure is necessary for The University of Toledo to properly conduct its HPT cultural change intervention. To that end, this study will utilize the Rasch measurement model. The Rasch model offers the possibility to construct invariant, unidimensional, interval-level measures from ordinal level data. However, this possibility is only realized when the data fit the Rasch model, which is an ideal, theoretical description of how data must interrelate, if they are to be considered a measure. As the Rasch model is a mathematical ideal, real-world data will not match the model perfectly; however, data that sufficiently match the model meet the requirements for measurement.

The Rasch measurement model possess characteristics useful for completing the university’s change to student-centered teaching. First, employing the Rasch model will determine if the theoretical concept of student-centered teaching expressed in the literature, when developed into a data collection instrument, yields data that fit the properties necessary for fundamental measurement. If this is the case, then a measure of student-centered teaching has been constructed. Such a measure of student-centered teaching would allow The University of Toledo to conduct a performance analysis to determine the level of the faculty’s student-centered teaching. Second, because the Rasch model provides estimates of the difficulty of the items comprising the data collection instrument, a useful developmental path for training and development in student centeredness would be available. Third, by anchoring item difficulties during future analyses, it would be possible to measure the growth of student-centered teaching.
In discussing the PPIP model, the first problem with regard to student-centered teaching appeared during the performance analysis stage. In discussing this stage of the model, it was noted that The University of Toledo has no definition of student-centered teaching. Therefore, the university has no way of measuring the current level of student centeredness displayed in the faculty’s teaching. Within the Rasch model, the items comprising a data collection instrument become the operational definition of the variable being measured (Wright & Stone, 1979). When creating an instrument to measure the variable of student-centered teaching, writing items based on the substantive theory of student-centered teaching constructs a definition of student-centered teaching. Provided the items produce data consistent with the requirements of the Rasch measurement model, there is evidence that the items represent one underlying concept—in this instance, student-centered teaching. And, as the items will be written based on the theory of student-centered teaching, there would be evidence that the theory itself is one unified concept (Bond & Fox, 2007).

As was alluded to, the items comprising the data collection instrument need to be based on the theory of student-centered teaching. The literature on student-centered teaching will provide the theoretical foundation for the items. In particular, the items will be derived from the work of Gilis et al. (2008), whose description of student-centered teaching will be compared to the work of Trigwell and Prosser (1996, 2004; Prosser, Trigwell & Taylor, 1994) and Vincow (1997) to ensure that it is aligned with the description of other authors.

The work of Gilis et al. (2008) was selected primarily for two reasons. First, its purpose was to answer the same questions that this study needs to answer before writing
items to measure student-centered teaching: “What does student-centered teaching exactly require from teachers’ actual teaching practice? [and] What is expected from them in order to teach in a student-centered way?” (p. 534). Second, Gilis et al. provided the most comprehensive list of competencies and indicators for student-centered teaching that could be found in the literature.

To answer their research questions, Gilis et al. (2008) set out to create a competency profile which described the knowledge, attitudes, and skills which teachers found essential for a student-centered teaching approach. Their approach to creating the competency profile was similar to that described in Prosser, Trigwell, and Taylor (1994), which provided the foundation for development of the Approaches to Teaching Inventory. In creating the profile, Gilis et al. formulated guidelines for themselves, which are conducive to the needs of the cultural change initiative at The University of Toledo. First, rather than rely on experts to describe the student-centered teaching approach, their profile is based on interviews of higher education teachers. Their thinking was that this should induce more acceptance from educators to whom the profile is presented; this advantage would hopefully carry over to any use of the competency profile for measuring student-centered teaching. Second, the profile describes student-centered teaching, not teaching in general. Third, the profile is written at a level of detail that allows faculty to use it as a guide to being student-centered while not being so detailed that it controls exactly how teachers behave; these are important characteristics of the expectations presented to members of an organization during a change process (Devane, 2001; Watkins, 2006).
The study of Gilis et al. (2008) took place within the K. U. Leuven Association (KULA), which is composed of 13 higher education institutes in Belgium. Participants in the study—all teachers within the KULA—were selected by the KULA educational development task force on the basis of being known for their student-centered teaching. Each participant was interviewed, with “the conversation centered as much as possible on the concrete teaching practice of the teacher” (p. 540). The participants were then asked what was necessary to teach in that way.

Once the interviews were completed, the first step in analyzing the transcripts was to uncover general competency domains. After this, specific behaviors identified by the participants were grouped under the domains. The next step was to generalize the specific behaviors into a limited set of competencies. Gilis et al. (2008) attempted to validate their competency list by having the KULA educational development task force recreate the third step and by soliciting feedback from the participants. This validation process resulted in the inclusion of performance indicators for each competency to make the competency more concrete; the indicators were written based on quotes taken from the interviews. This process resulted in a competency profile representing “what practicing [higher education] teachers themselves see as important competences [sic] for a student-centered approach” (Gillis et al., 2007, p. 539).

The competency profile consists of fifteen competencies, each of which is represented by performance indicators. In total there are 46 indicators. These indicators can be used to construct a measure of student-centered teaching; however, it should be noted that the intended purpose of the competency profile was to stimulate professionalism, not evaluation (A. Gilis, personal correspondence, October 29, 2008).
This approach to developing a set of items for measuring student-centered teaching would mimic the process used in developing the ATI. However, the empirical data collected by the instrument would have to match the Rasch model in order to be considered as a measure of student-centeredness. Should the obtained data meet the requirements of the Rasch model it can be said that the set of items comprising the data collection instrument expresses the theory of student-centered teaching. Furthermore, the theory of student-centered teaching itself can be said to be of a singular construct, which is being measured; no other construct is being measured, which would confound our interpretations drawn from the data.

2.7 The Rasch Model and Student-centered Teaching

The Rasch model is based on the assumptions that each person has an ability, each item has a difficulty, which can both be expressed by numbers on one line, and that the probability of a response to any item by any person can be computed based on the difference in the numbers alone (Bond & Fox, 2007, p. 26). Order is central to the Rasch model. As noted, the Rasch model assumes that every person has an ability. In terms of student-centered teaching, it might be said that each faculty member is student-centered to some degree. Some will be more student-centered, and some will be less student-centered. Based on ability, persons can be ordered from less able to more able. Persons with more ability (i.e., persons who are more student-centered) would be more likely to endorse each item of a data collection instrument than a person with less ability.

Similarly, each item within a data collection instrument has a degree of difficulty required to endorse the item. In regard to a data collection instrument based on the Gilis
et al. (2008) student centeredness indicators, difficulty could be considered the amount of student centeredness required to endorse an item. Some items would be less difficult to endorse, requiring less student centeredness. Other items would be more difficult to endorse, requiring more student centeredness. As with persons, the items can be ordered from less difficult to more difficult. Also similar to the description of persons, less difficult items are more likely to be endorsed by all persons than a more difficult item.

The next assumption is that person ability estimations and item difficulty estimations can be expressed by numbers along one line. The Rasch model accomplishes this by estimating person ability and item difficulty along the same log odds unit, or logit, scale; “The logit scale is an interval scale in which the unit intervals … have a consistent value or meaning” (Bond & Fox, 2007, p. 38). Person ability estimates are calculated from the number of items endorsed by calculating each individual’s endorsed to unendorsed odds. In the same way, item difficulty estimates are calculated by the number of endorsements by calculating each individual item’s endorsed to unendorsed odds.

The final assumption is the probability of a response to any item by any person can be computed based on the difference in the numbers alone. Because both person ability estimates and item difficulty estimates are on the same logit scale, comparison of any person’s ability estimate with any item’s difficulty estimate reveals the probability of any person endorsing any item. According to the Rasch model, a person has a 50% chance of endorsing an item whose difficulty estimate matches the ability estimate of the person. The probability (e.g., 50%) that any person endorses any item is a function of the difference between the person’s ability and the item’s difficulty. As any person’s ability estimate increases in comparison to an item’s difficulty estimate, the probability that this
person endorses the item increases. Conversely, when any person’s ability estimate is lower in comparison to any item’s difficulty estimate, the probability of endorsing the item decreases.

When the person ability measures and the item difficulty measures are compared to each other, the relation between the two can be determined. As was already stated, probabilities for endorsement for any person on any item can be calculated using the person’s ability estimate and the item’s difficulty estimate. Visual representations of all person ability measures and all item difficulty measures, such as an item-person map, allow for making quick comparisons between the ability of the sample of persons and the difficulty of the items.

An item-person map displays the logit scale running vertically. At the top of the scale are the higher logit values, representing greater person ability estimates and greater item difficulty estimates. At the bottom of the scale are the lower logit values, representing lesser person ability estimates and lesser item difficulty estimates. Along one side of the scale are mapped the ability estimates for all persons. Along the other side are mapped the difficulty estimates of all items. Looking at the location and dispersion of the person ability estimates compared to those of the items, it is possible to draw conclusions about the persons and item. (Bond & Fox, 2007)

With a measure of student-centered teaching, an item-person map would display the difficulty estimates of the items along one side of the logit scale. Items requiring less student-centeredness would be placed nearer to the bottom, while items requiring more student-centeredness would be placed nearer to the top. Then, on the other side, the
persons would be mapped. The less student-centered persons would be located nearer the bottom, while the more student-centered persons would be located nearer the top.

Should the dispersion of person ability estimates be located largely below that of the item difficulty estimates, then it would appear that the faculty’s teaching is lacking in student centeredness, and a performance gap exists. If the person ability estimate dispersion should be above the dispersion of the item difficulty, then it would appear that the faculty’s teaching is already quite student-centered, and no performance gap would be identified. Should the two of the two estimates be located equally along the logit scale, then the faculty’s student-centered teaching as a whole would match the expectations of the theory expressed through the data collection instrument. Whether this would represent a performance gap or represent acceptable performance is a decision that the university would need to address.

Should a performance analysis of the faculty’s teaching reveal a performance gap between the current state of student-centered teaching and the university’s expected performance, the Rasch analysis would provide a development path for increasing student-centered teaching. As was noted above, the Rasch model is based on ordering and produces item difficulty estimates ranging from less difficult to more difficult. From the perspective of the persons, the item difficulty estimates indicate how much ability is needed to endorse each item, in probabilistic terms. Those items with a lower difficulty estimate require less ability to endorse than those with a higher. As the item difficulties increase, so too does the amount of ability necessary for endorsement. Any person wishing to develop (i.e., become more able) or any HPT practitioner developing a training program could use the item difficulties as a route for development, looking first
to develop the ability necessary to endorse the item or set of items immediately more difficult than the person’s current ability level and then proceeding to more and more difficult items.

This use of the item difficulty estimates provided by the Rasch model seems particularly applicable to the development of student-centered teaching. The claim that student-centered teaching can be improved through an intervention (e.g., training) is substantiated by Gibbs and Coffey (2004) and Postareff, Lindblom-Ylänn, and Nevgi (2007). However, while Felder and Brent (1996) also indicate that student-centered teaching can be learned, they report that faculty may experience a steep learning curve while attempting to become more student-centered. Perhaps the grade of the learning curve could be reduced if faculty knew which developmental step would be easiest to start with or easiest to next attain. Furthermore, Felder and Brent indicate that “professors who move into student-centered instruction gradually rather than trying to do it all at once … will reap their rewards in having students who learn more deeply” (Felder & Brent, 1996). It can be inferred from this statement, once again, that becoming student-centered is a developmental process. The Rasch model can reveal a possible developmental path for teachers who wish to become more student-centered.

As was previously discussed, in order to determine the success of any HPT intervention, an evaluation must take place to measure the intervention’s effect on the organization. Creating a measure of student-centered teaching not only allows The University of Toledo to conduct a proper performance analysis, but the measure could then be used to track the progress in becoming more student-centered—assuming that the performance analysis would indicate a performance gap.
When the initial analysis is conducted to determine whether or not the data conform to the requirements of the Rasch model, both person ability estimates and item difficulty estimates are produced. One of the characteristics of the Rasch model logit scale is invariance. Subsequent use of the created measure with a new sample or the same sample at a later date would produce item difficulty estimates which preserve the ordering of items from less to more difficult, within error. However, when measuring change in the relationship of persons to items over time, it might be beneficial to preserve the original item difficulty estimates. The Rasch model allows for the anchoring of item difficulty estimates with known values. By holding the item difficulty estimates constant, changes in the person ability estimates are readily apparent (Bond & Fox, 2007).

Should the data collected from a data collection instrument based on the competencies list of Gilis et al. (2008) meet the requirements of the Rasch model—meaning that a measure of student-centered teaching had been developed—The University of Toledo would be supplied with information useful for determining whether or not a performance gap exists between the current level of student-centered teaching and the expected performance. Assuming that a performance gap is found, the university would need to constantly evaluate the progress toward student-centered teaching if it is to determine whether or not the cultural change initiative is successful. Even after the faculty’s student centeredness reaches an acceptable level, evaluation would be necessary to be sure that the faculty performance remained aligned with the strategic direction of the university.

By anchoring the item difficulty values, the positioning of the item difficulty values on the logit scale remains constant. When person ability measures are then placed
on this scale during the second, third, and additional subsequent analyses, the movement of the person ability measures along the logit scale relative to the items becomes apparent. If the person ability estimates increase, moving higher up the logit scale, then there has been improvement toward student-centered teaching. Such an increase in ability estimates would occur without anchoring the item difficulty estimates, but the exact relationship between person ability estimates and item difficulty estimates would be lost.

2.8 Summary

To summarize this literature review, the basic argument is the cultural change intervention conducted by The University of Toledo was not properly conducted with regard to the teaching approach of the faculty. The basic problems are that the university has no defined concept of student-centered teaching. Therefore, the university cannot communicate its expectation for student-centered teaching to the faculty. Additionally, the university cannot measure student-centered teaching—neither the current state of student-centered teaching among the faculty as part of a performance analysis nor future levels as part of an evaluation of the effectiveness of the intervention. This paper, then, seeks to correct these shortcomings through the development of a construct of student-centered teaching, utilizing the Rasch measurement model, whose properties are particularly conducive to this process. Then, utilizing the measures of student-centered teaching, this paper will investigate the levels of student-centered teaching found at The University of Toledo.
Chapter 3

Methodology

3.1 Research Questions

1. Is the data collection instrument developed by the author useful for measuring student-centered teaching?
   a. Are the participants able to effectively communicate through the rating scale?
   b. Does the collected data for items sufficiently meet the requirements of the Rasch model?
   c. Does the collected data for the participants sufficiently meet the requirements of the Rasch model?
   d. Are the items comprising the data collection instrument of varying difficulties, such that they represent a linear continuum from less student-centered teaching to more student-centered teaching?
   e. Are the items comprising the data collection instrument able to distinguish between participants of varying degrees of student-centered teaching?
f. Do the items comprising the data collection instrument work together to represent a unidimensional construct?

g. Does the construct remain reliably defined across a split sample?

2. How student-centered is the teaching of the faculty of The University of Toledo, as reported by the faculty?

3. Are there relationships between contextual variables and levels of student centeredness?
   a. Is there a relationship between class size and levels of student-centered teaching?
   b. Are there differences in the levels of student-centered teaching between courses of differing levels?
   c. Are there differences in the levels of student-centered teaching between courses in varying disciplines as categorized by Becher (1989; e.g., pure hard)?

4. Are there relationships between characteristics of teacher demographics and levels of student-centered teaching?
   a. Are there differences in the levels of student-centered teaching between men and women?
   b. Is there a relationship between levels of student-centered teaching and years of teaching experience?
   c. Is there a relationship between levels of student-centered teaching and age?
d. Is there a difference in the levels of student-centered teaching between instructors of different ranks?

5. Does the construct of student-centered teaching reveal a developmental path, which could be useful for training and development in student-centered teaching?

3.2 Research Hypotheses

1. A Rasch analysis of data collected through the data collection instrument developed by the author will demonstrate that the instrument is useful for measuring student-centered teaching.
   a. An analysis of the rating scale following the guidelines of Linacre (2002) will demonstrate that the participants were able to effectively communicate through the rating scale.
   b. Fit statistics for the items will fall within the guidelines of Smith (1996) and Wright and Linacre (1994).
   c. Fit statistics for the participants will fall within the guidelines of Smith (1996) and Wright and Linacre (1994).
   d. Rasch model separation statistics for the items will be equal to or greater than 2.0 with an acceptable Rasch reliability.
   e. Rasch model separation statistics for the participants will be equal to or greater than 2.0 with an acceptable Rasch reliability.
f. A Rasch principle contrast analysis will demonstrate that the primary linear measure accounts for 60% or more of the variance found in the data (Linacre, 2006a).

g. Item difficulty measures will—within error—remain stable across split samples.

2. Comparison of the participant ability measures to the item difficulty measures will demonstrate that the participant ability measures are—within error—greater than the item difficulty measures.

3. There are relationships between contextual variables and levels of student-centered teaching.
   a. There is a relationship between class size and levels of student-centered teaching.
   b. There are differences in the levels of student-centered teaching between courses of differing levels.
   c. There are differences in the levels of student-centered teaching between courses in varying disciplines.

4. There are relationships between characteristics of teacher demographics and levels of student-centered teaching.
   a. There are differences in the levels of student-centered teaching between men and women.
   b. There is a relationship between levels of student-centered teaching and years of teaching experience.
c. There is a relationship between levels of student-centered teaching and age.

d. There are differences in the levels of student-centered teaching between instructors of different ranks.

5. Considering the model separation statistics for the items, the item map will reveal a developmental path from items requiring less student centeredness to items requiring more student centeredness.

### 3.3 Participants

The population being considered in this paper was any individual instructing a course section which met at least partially face-to-face during the Spring 2010 semester at The University of Toledo. The population was identified through the university’s online *Look Up Classes* page, accessed through the myUT portal. For each subject offered at the university during the Spring 2010 semester (e.g., History), the instructors for each section of each course were identified. Their names and e-mail addresses were copied into a Microsoft Excel spreadsheet. In instances where multiple individuals were listed as instructors, only the first instructor was recorded.

Also recorded in the Excel file were the subject of the course and the college under which the subject is offered. Eleven colleges offered courses: the College of Arts and Sciences (ARS), the College of Business Administration (BUS), the College of Engineering (ENG), the College of Graduate Studies (XGR), the College of Health Science and Human Service (HHS), the College of Law (LAW), the College of Medicine
(MED), the College of Nursing (NUR), the College of Pharmacy (PHA), the Judith Herb College of Education (EDU), and University College (UNI).

As some instructors were teaching courses in multiple subjects in multiple colleges, it was necessary to remove duplicate entries from the Microsoft Excel file. To do this, all cases were sorted, in order of priority, by first name, then last name, and then by college in ascending order. These were then filtered by first name and last name to only show unique cases (i.e., the second and subsequent cases of identical cases were hidden).

This meant that each instructor was listed as only teaching for one college. Determination of which college was made by the sorting strategy. Namely, the colleges were listed alphabetically according to the author’s coding scheme (e.g., ARS for the College of Arts and Sciences). Therefore an instructor for both ARS and any other college, would only be listed as teaching in ARS. BUS came next, followed by EDU, ENG, HHS, and so forth. The data were then copied and pasted into a new spreadsheet where it was sorted by college.

This process identified 1,489 individuals instructing courses—with each of the eleven colleges having some instructors unique to itself. The number of instructors for each college can be seen in Table 3.1.

Table 3.1

<table>
<thead>
<tr>
<th></th>
<th>ARS</th>
<th>BUS</th>
<th>EDU</th>
<th>ENG</th>
<th>HHS</th>
<th>LAW</th>
<th>MED</th>
<th>NUR</th>
<th>PHA</th>
<th>UNI</th>
<th>XGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>671</td>
<td>142</td>
<td>118</td>
<td>120</td>
<td>197</td>
<td>49</td>
<td>54</td>
<td>39</td>
<td>46</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td>%</td>
<td>45</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>13</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
There were situations that led to identified instructors being removed from consideration as participants. First, the members of this Dissertation Committee were removed from the lists of instructors. Second, instructors for whom no e-mail address was available were removed. These instructors were not assigned random numbers, rather each received a 9, which ensured that they would be sorted to the bottom of the colleges’ respective contact lists. Removal of these instructors resulted in invitations to participate being sent to 1,464 instructors. Generally, the removed instructors were isolated individuals within any one subject area. Only within one subject was there a noticeable portion of instructor e-mail addresses unavailable: Law (Special Topics) (LAWT). For only one of the 10 instructors in this subject area was an e-mail address available.

Replies were received from 15 instructors, who reported that despite being listed as an instructor for Spring 2010 semester, they were not teaching a course during the semester. Fourteen e-mails were returned as undeliverable; the e-mail listed for the faculty member by the university was no longer valid. This meant that only 1,435 eligible instructors had been invited to participate.

In addition, in order to control for potential differences in student-centered teaching between online distance learning courses and courses which meet face-to-face, it was determined that only instructors who taught a course which met at least partially face-to-face would be eligible. It is unclear exactly how many of the identified instructors taught only courses which met solely online because at The University of Toledo a course listed as a distance learning course may have up to 30% of course content delivered and course interaction occur outside of the distance learning environment (i.e., face-to-face). Therefore, instructors were asked to self-select out of participating if they did not teach a
course which met at least partially face-to-face. Twenty-four instructors sent e-mail replies indicating that they were strictly teaching via distance learning during the Spring 2010 semester. This brought the number of possibly eligible, invited participants down to 1,411.

The number of participants who ultimately fully completed the survey was 336. Fully completed meant that participants clicked on the submit button at the end of the survey and had responded to items about their teaching behaviors. Not all items needed a response. Participants who responded to demographic and contextual items but did not respond to any teaching behavior items were not included in the total number of participants. Based on the 1,411 invitations that were sent to possibly eligible instructors, the response rate was 23.8%. Because it is unlikely that all invitees who were erroneously listed as instructors during the Spring 2010 semester and all instructors of strictly distance learning courses alerted the author that they were ineligible to participate, it is possible that the actual response rate from instructors eligible to participate was slightly higher. The demographic make up of the sample can be found in Table 3.2.

### 3.4 Data Collection Instrument

The data collection instrument used in this paper was created by the author. The survey was hosted and completed online, using LimeSurvey software (www.limesurvey.org). The items comprising the data collection instrument, which were used for measuring levels of student centeredness, were written by the author based on the 46 student-centered indicators in Gilis et al. (2008). The indicators were rewritten from the
Table 3.2

Sample Demographics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>47.27</td>
<td>12.57</td>
<td>22</td>
<td>80</td>
<td>58</td>
</tr>
<tr>
<td>Teaching Experience</td>
<td>13.73</td>
<td>11.146</td>
<td>0</td>
<td>52</td>
<td>52</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>170</td>
<td>50.3</td>
</tr>
<tr>
<td>Men</td>
<td>156</td>
<td>46.2</td>
</tr>
<tr>
<td>No Response</td>
<td>12</td>
<td>3.5</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Rank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professor</td>
<td>66</td>
<td>19.5</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>55</td>
<td>16.3</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>54</td>
<td>16.0</td>
</tr>
<tr>
<td>Lecturer</td>
<td>36</td>
<td>10.7</td>
</tr>
<tr>
<td>Instructor/Visiting (Ed.D./Ph.D.)</td>
<td>11</td>
<td>3.3</td>
</tr>
<tr>
<td>Instructor/Visiting (M.A.)</td>
<td>17</td>
<td>5.0</td>
</tr>
<tr>
<td>Part-time Faculty</td>
<td>52</td>
<td>15.4</td>
</tr>
<tr>
<td>Graduate Assistant/Teaching Assistant</td>
<td>40</td>
<td>11.8</td>
</tr>
<tr>
<td>No Response</td>
<td>7</td>
<td>2.0</td>
</tr>
</tbody>
</table>

perspective of a teacher considering their own teaching practice. For example, indicator 10. 1. reads, “Ensure a variation in teaching methods.” The indicator was rewritten to read: “I use a variety of teaching methods.” The list of items was reviewed by the first author of Gilis et al. (2008) to ensure that they accurately reflect the indicators.

Before responding to these items, each participant identified one section of one course that they were teaching during the Spring 2010 semester (e.g., ETPT 5010). The participants were directed to respond to the items in relation to this one, specific section of a course. This attempted to control for participants who might utilize varying levels of student centeredness in different contexts. Participants were asked to provide contextual
Table 3.3  
*Contextual Factors*

<table>
<thead>
<tr>
<th>Class Size</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38.86</td>
<td>40.08</td>
<td>1</td>
<td>280</td>
<td>279</td>
</tr>
</tbody>
</table>

n  
<table>
<thead>
<tr>
<th>Discipline</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Soft</td>
<td>60</td>
<td>17.8</td>
</tr>
<tr>
<td>Pure Hard</td>
<td>53</td>
<td>15.7</td>
</tr>
<tr>
<td>Applied Soft</td>
<td>139</td>
<td>41.1</td>
</tr>
<tr>
<td>Applied Hard</td>
<td>77</td>
<td>22.8</td>
</tr>
<tr>
<td>No Response</td>
<td>9</td>
<td>2.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Undergraduate/Graduate Course</th>
<th>Undergraduate</th>
<th>267</th>
<th>79.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate</td>
<td>59</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>No Response</td>
<td>12</td>
<td>3.5</td>
<td></td>
</tr>
</tbody>
</table>

details related to the course whose relationships with teaching approaches have been previously investigated: course level (e.g., 1000-level), class size, and the subject under which the course is taught (e.g. History). Data regarding the contextual factors can be found in Table 3.3.

After then responding to the items based on the indicators in Gilis et al. (2008), the participants responded to some demographic items. As was the case for the contextual details, the demographic items solicited data on characteristics whose relationships to teaching approaches have been previously investigated: sex, years of previous higher education teaching experience, and age; these data were presented in Table 3.2.

### 3.5 Procedure for Contacting Participants

Participants were contacted via e-mail. The author wrote the body of an invitation to participate e-mail in Microsoft Word. Through the use of a mail merge, the first name
and last name of each instructor invited to participate was inserted into the Microsoft Word document and then sent to Microsoft Entourage as a personalized e-mail to be delivered to each respective instructor’s e-mail address.

The invitation to participate informed the instructors of the study and the general purpose of the study. The instructors were asked to participate and were directed to a link within the e-mail that took them to the online survey where they received further instruction.

3.6 Procedure for Participants

Instructors received an e-mail notifying them of this study and inviting them to participate. If instructors elected to participate, they clicked on a link to the survey within the e-mail. The link directed the instructors to the online survey. The first webpage served as an informed consent page, informing the instructors of their rights as participants and requiring them to click a button to proceed to the survey. Instructors then took the survey and submit their responses.

3.7 Data Handling

The instructors completed the survey online. All answers were recorded and stored in an online database by the LimeSurvey software. Data remained confidential and accessible by only the author. When new responses stopped arriving, the data were exported from LimeSurvey into a Microsoft Excel spreadsheet accessible to the author and stored on the
author’s personal computer. The survey was then deactivated and the online data were deleted.

3.8 Data Analysis

3.8.1 Rasch Analysis

The analysis for this paper began with a Rasch analysis using the Rasch Rating Scale Model (Andrich, 1978). The analysis was carried out through the use of the WINSTEPS (Linacre, 2006b) software package. The analysis began by obtaining WINSTEPS-produced summary statistics output to provide an overall sense for how the instrument functioned with regard to the spread of items along the less-to-more continuum and the ability of the items to discriminate between participants of differing abilities (i.e., differing levels of student centeredness).

Next, the rating scale, on which the items were answered, was investigated to determine whether or not the participants were able to effectively communicate through the rating scale. The rating scale provided participants with four response categories: strongly disagree, disagree, agree, and strongly agree. Participants were instructed to endorse the category which best represented their engagement in the behaviors represented in the items. This investigation of the rating scale followed the guidelines of Linacre (2002), who writes: “Since the analyst is always uncertain of the exact manner in which a particular scale will be used by a particular sample, investigation of the functioning of the rating scale is always merited” (p. 86).
The investigation involved analyzing the number of responses per category, the average measures for each response category, and the Rasch-Andrich thresholds. In addition, the probability curves were investigated to visually confirm that each response category is the most likely category to be endorsed at some point along the continuum and that each response category has a 50% probability of being endorsed at some point along the continuum.

After the analysis of the rating scale, the data were analyzed to determine whether or not the data for items and the data reported by participants matched the Rasch model’s description of data necessary for measurement. This determination was made by analyzing the items’ and participants’ fit indicators. The first indicator examined was point-measure correlations. According to Linacre (1995), “negative (or very low) rpbs [point-biserial correlations] probably contradict our definition of the variable” (p. 422). Next, the INFIT and OUTFIT statistics were investigated following the guidelines of Smith (1996) and Wright and Linacre (1994). OUTFIT was investigated before INFIT, standardized statistics before mean-squares, and high values before low or negative values.

As misfitting items or participants confound the interpretation of the variable, any items or participants with low or negative point-measure correlations or INFIT or OUTFIT statistics outside of the acceptable range were candidates for removal from the analysis. The removal process was iterative, removing and reintroducing items and participants to maximize the item and person separation and Rasch reliability statistics as well as the amount of variance explained by the primary linear measure. It was also investigated whether or not there were any underlying patterns to the misfitting items and participants.
Once this iterative process was completed, the rating scale was reinvestigated to ensure that it still functioned properly. Final summary statistics of item and participant separation and reliability were then output, and a principal contrast analysis was then conducted for the items to determine the amount variance explained by the primary linear measure to address the dimensionality of the construct.

The final stage of the Rasch analysis was to test the invariance of the construct across different samples. In order to do this, the participants who were retained in the analysis were randomly sorted into two groups. Separate Rasch analyses were conducted for the two groups. The item difficulty measures were obtained from each analysis and compared to each other. A Pearson correlation ($\alpha = .05$) was conducted to determine the relationship between the item measures from the two analyses. To determine that the rank order of the items remained consistent between the two analyses, the item measures were ranked and Spearman’s rho was calculated ($\alpha = .05$).

### 3.8.2 Short Form Rasch Analysis

After the initial analysis was completed, a second shortened form of the data collection instrument was developed based on the data of the 34 fitting items and 251 fitting participants. Pairs and groups of items with similar difficulty measures were examined, and psychometrically redundant items were removed from the analysis. This resulted in a shortened version of the data collection instrument comprised of 15 items.

A Rasch analysis was conducted using the data from these 15 items. The same criteria were used for this analysis as were used for the first analysis using all items. The same procedures were carried out to determine if the rating scale functioned properly, if
the data fit the specifications of the Rasch model, if there was adequate separation for items and participants, and if the primary linear measure accounts for enough variance in the data to be considered a unidimensional construct. The item difficulties from the two analyses were compared to determine if they remained stable. In addition, the participants’ ability measures from the two analyses were compared to determine whether the full instrument and the short form produced the same ability measures.

3.8.3 Statistical Tests

Once the Rasch analysis was completed, each participant had a Rasch-calibrated ability estimate (i.e., a measure of the student centeredness of their teaching approach). These measures were used in statistical tests to answer the third and fourth sets of research questions. The statistical tests were calculated using SPSS ($\alpha = .05$). The specific tests that were run on these measures can be found in Table 3.4.

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Grouping/Correlating Variables</th>
<th>Statistical Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. a.</td>
<td>Class size</td>
<td>Pearson correlation</td>
</tr>
<tr>
<td>3. b.</td>
<td>Course level</td>
<td>Independent samples $t$ test; one-way analysis of variance</td>
</tr>
<tr>
<td>3. c.</td>
<td>Discipline</td>
<td>One-way analysis of variance</td>
</tr>
<tr>
<td>4. a.</td>
<td>Sex</td>
<td>Point-biserial correlation</td>
</tr>
<tr>
<td>4. b.</td>
<td>Teaching experience</td>
<td>Pearson correlation</td>
</tr>
<tr>
<td>4. c.</td>
<td>Age</td>
<td>Pearson correlation</td>
</tr>
<tr>
<td>4. d</td>
<td>Instructor Rank</td>
<td>One-way analysis of variance</td>
</tr>
<tr>
<td></td>
<td>Discipline/Sex</td>
<td>Two-way analysis of variance</td>
</tr>
</tbody>
</table>
3.8.4 Developmental Path

The fifth research question was investigated by analyzing the item map, the item difficulties, and the item separation statistics to group the items according to their difficulties. The separation statistics were used to determine the appropriate number of groups into which the items should be organized. The item map and item difficulties were used to divide the items into the groups, which could then be presented as developmental stages. For training and development, the group of the easiest items would be the first step in beginning to become student-centered. Once this group of items would be incorporated into the teaching practice, then the next group of items could be incorporated until a teacher had reached an acceptable level of student centeredness.

3.9 Limitations

The limitations of this study were those associated with self-reporting instruments. With self-reporting instruments there is the threat that participants will answer in a way that is thought to be socially acceptable or in-line with the expectations of the researcher. In regard to this paper, there was the possibility that instructors might have responded to items based on what they believe their teaching should be, rather than what their actual teaching behaviors are. To minimize this, the author stressed that survey responses would be kept anonymous and would not identify that a specific teaching approach, the student-centered teaching approach, was being investigated.
Chapter 4

Results

This chapter presents the results of the analyses conducted for this paper. It begins by presenting the results of the Rasch analysis of the data. This is followed by a presentation of the results of statistical tests that investigated the relationship between levels of student-centered teaching and various teaching context and instructor demographic variables. The chapter ends with a presentation of item groupings for a developmental path.

4.1 Rasch Analysis

The Rasch analysis began by obtaining baseline statistics for the item and participant separation and reliability; see Table 4.1 and Table 4.2.

The next step in the analysis was to analyze the functioning of the rating scale. The initial analysis of the rating scale indicated that it functioned properly; see Table 4.3. However, as the Rasch analysis progressed and items and persons were removed from the analysis, the rating scale did not sufficiently meet the guidelines of Linacre (2002); the strongly disagree category was endorsed too few times. As a result, the strongly disagree and disagree categories were collapsed together into one disagree category. The new,
### Table 4.1

**Summary Statistics for 47 Items**

<table>
<thead>
<tr>
<th>Raw Score</th>
<th>Count</th>
<th>Measure</th>
<th>Model Error</th>
<th>Infit MNSQ</th>
<th>ZSTD</th>
<th>Outfit MNSQ</th>
<th>ZSTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>732.3</td>
<td>328.8</td>
<td>0.00</td>
<td>0.10</td>
<td>1.00</td>
<td>-0.2</td>
<td>1.02</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>92.1</td>
<td>4.3</td>
<td>0.90</td>
<td>0.01</td>
<td>0.25</td>
<td>3.0</td>
<td>0.42</td>
</tr>
<tr>
<td>Max.</td>
<td>888.0</td>
<td>333.0</td>
<td>1.97</td>
<td>0.12</td>
<td>2.05</td>
<td>9.9</td>
<td>3.53</td>
</tr>
<tr>
<td>Min.</td>
<td>511.0</td>
<td>310.0</td>
<td>-1.70</td>
<td>0.09</td>
<td>0.59</td>
<td>-6.3</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Model: Separation: 8.76  Reliability: .99

### Table 4.2

**Summary Statistics for 334 Non-extreme Participants**

<table>
<thead>
<tr>
<th>Raw Score</th>
<th>Count</th>
<th>Measure</th>
<th>Model Error</th>
<th>Infit MNSQ</th>
<th>ZSTD</th>
<th>Outfit MNSQ</th>
<th>ZSTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>103.0</td>
<td>46.3</td>
<td>1.91</td>
<td>0.28</td>
<td>1.03</td>
<td>-0.1</td>
<td>1.02</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>17.5</td>
<td>2.7</td>
<td>1.22</td>
<td>0.06</td>
<td>0.49</td>
<td>2.1</td>
<td>0.64</td>
</tr>
<tr>
<td>Max.</td>
<td>137.0</td>
<td>47.0</td>
<td>6.00</td>
<td>0.73</td>
<td>4.11</td>
<td>9.8</td>
<td>8.97</td>
</tr>
<tr>
<td>Min.</td>
<td>2.0</td>
<td>10.0</td>
<td>-5.49</td>
<td>0.22</td>
<td>0.27</td>
<td>-4.8</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Real: Separation: 3.73  Reliability: .93
Model: Separation: 4.15  Reliability: .95

### Table 4.3

**Original Rating Scale Category Structure**

<table>
<thead>
<tr>
<th>Category</th>
<th>Observed Count</th>
<th>Observed Average</th>
<th>INFIT MNSQ</th>
<th>OUTFIT MNSQ</th>
<th>Structure Calibration</th>
<th>Category Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>280</td>
<td>-1.00</td>
<td>1.29</td>
<td>1.53</td>
<td>(-3.25)</td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td>1650</td>
<td>0.41</td>
<td>0.96</td>
<td>0.97</td>
<td>-2.00</td>
<td>-1.29</td>
</tr>
<tr>
<td>Agree</td>
<td>7798</td>
<td>1.55</td>
<td>0.95</td>
<td>0.98</td>
<td>-0.55</td>
<td>1.05</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>5724</td>
<td>3.00</td>
<td>0.99</td>
<td>0.99</td>
<td>2.55</td>
<td>(3.68)</td>
</tr>
<tr>
<td>Missing</td>
<td>246</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
collapsed rating scale met the guidelines of Linacre (2002); see Table 4.4 for the statistics related to the performance of the collapsed rating scale at the end of the analysis.

With the rating scale functioning properly, the investigation of the item and participant fit statistics took place. Misfitting items and persons whose data degraded the measurement system were removed from the analysis through an iterative process, seeking to maximize item and participant separation and reliability statistics and the amount of variance explained by the primary linear measure. Before the final decision on removing participants or items was made, the misfitting participants and items were examined for underlying patterns of misfit. Examination of the participants removed from the analysis found no underlying patterns of misfit. The first step in making this determination was to reintroduce the misfitting participants into the data analysis and then run a principal contrast analysis of the persons. This analysis provided evidence that the participants as a whole were not formed out of disparate groups, but rather one group.

The second step in determining that there were no patterns of misfit was to determine the relationship between misfit status and other demographic and contextual variables. A series of chi-square tests of homogeneity and point-biserial correlations were run (α = .05); no significant relationships were found. There was no significant

<table>
<thead>
<tr>
<th></th>
<th>Observed Count</th>
<th>Observed Average</th>
<th>INFIT MNSQ</th>
<th>OUTFIT MNSQ</th>
<th>Structure Calibration</th>
<th>Category Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disagree</td>
<td>880</td>
<td>-1.63</td>
<td>1.01</td>
<td>1.00</td>
<td>None</td>
<td>(-3.36)</td>
</tr>
<tr>
<td>Agree</td>
<td>4625</td>
<td>0.51</td>
<td>0.97</td>
<td>0.93</td>
<td>-2.25</td>
<td>0</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>2889</td>
<td>3.19</td>
<td>1.01</td>
<td>1.01</td>
<td>2.25</td>
<td>(3.36)</td>
</tr>
<tr>
<td>Missing</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
relationship between misfit status and the number of students in a course, $r_{pb}(334) = -.09$, $p = .074$; between misfit status and subject discipline, $x^2(3, N = 329) = .85, p = .836$; between misfit status and instructing an undergraduate or graduate course, $x^2(1, N = 326) = 2.70, p = .10$; between misfit status and instructor rank, $x^2(7, N = 331) = 5.65, p = .58$; between misfit status and instructor sex, $x^2(1, N = 326) = 2.97, p = .085$; or between misfit status and instructor age, $r_{pb}(318) = .02, p = .686$.

Investigating the misfitting items was done somewhat differently than was done for the participants. The 47 items were written by Gilis et al. (2008) to describe 15 competencies. If there was no pattern of misfit, the dispersion of misfitting items should be spread among the fifteen competencies. Thirteen of 47 items misfit (27%); therefore, it would be expected that 27% of the items for each competency would misfit. A chi-square goodness of fit test was run ($\alpha = .05$). The results were not significant, indicating that the dispersion of misfitting items did not differ from expectations, $x^2(14, N = 47) = 15.60, p = .338$.

However, while the general dispersion of misfitting items did not differ from expectations, all of the items representing two of the competencies misfit: Competencies 3 and 5. Competency 3 was represented by a single behavioral indicator, which misfit. Competency 5 was represented by three behavioral indicators, all of which misfit. This indicated that these two competencies might not be a part of the student-centered teaching construct as suggested in the literature; this will be discussed further in Chapter 5.

The iterative process of removing and reinserting potentially misfitting items and persons continued until separation and reliability statistics and the amount of variance...
explained by the primary linear measure were maximized. Thirteen items were removed from the analysis. Eighty-seven participants were removed from the analysis. Table 4.5 presents final item summary statistics, and Table 4.6 presents final participant summary statistics.

A principal contrast analysis was then conducted to address the dimensionality of the construct. Results of the principal contrast analysis revealed that the primary linear measure explains 79.4% of variance in the data. No residual contrasts explained more than 1.9% of the unexplained variance; see Table 4.7. Therefore, following the guidelines of Linacre (2006a), the measure was considered unidimensional with no secondary dimensions.

<table>
<thead>
<tr>
<th>Table 4.5</th>
<th>Summary Statistics for 34 Retained Items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Raw Score</td>
</tr>
<tr>
<td>Mean</td>
<td>552.9</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>72.0</td>
</tr>
<tr>
<td>Max.</td>
<td>683.0</td>
</tr>
<tr>
<td>Min.</td>
<td>403.0</td>
</tr>
</tbody>
</table>

Real: Separation: 9.43 Reliability: .99

<table>
<thead>
<tr>
<th>Table 4.6</th>
<th>Summary Statistics for 251 Retained Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Raw Score</td>
</tr>
<tr>
<td>Mean</td>
<td>74.9</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>12.4</td>
</tr>
<tr>
<td>Max.</td>
<td>101.0</td>
</tr>
<tr>
<td>Min.</td>
<td>11.0</td>
</tr>
</tbody>
</table>

Real: Separation: 3.88 Reliability: .94
Model: Separation: 4.13 Reliability: .94
Table 4.7
*Explained and Unexplained Variance*

<table>
<thead>
<tr>
<th></th>
<th>Eigenvalue</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance explained by the primary linear measure</td>
<td>130.9</td>
<td>79.4</td>
</tr>
<tr>
<td>Total unexplained variance</td>
<td>34.0</td>
<td>20.6</td>
</tr>
<tr>
<td>Unexplained variance in 1st contrast</td>
<td>3.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Unexplained variance in 2nd contrast</td>
<td>2.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Unexplained variance in 3rd contrast</td>
<td>2.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Unexplained variance in 4th contrast</td>
<td>1.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Unexplained variance in 5th contrast</td>
<td>1.4</td>
<td>0.9</td>
</tr>
</tbody>
</table>

The final stage of the Rasch analysis was to test the invariance of the construct across samples. The participants were randomly assigned to two groups. Separate Rasch analyses were conducted and the item measures from each of the analyses obtained. A Pearson correlation was run to determine the relationship between the item measures from the two analyses. The test was significant, \( r(32) = .98, p < .001 \). Then the item measures were converted into ranks, ordered from highest to lowest. Spearman’s rank correlation coefficient was calculated to determine the relationship between the ordering of items within the two groups. The test was significant, \( \rho(32) = .978, p < .001 \). See Table 4.8 for a comparison of the rank ordering of items from the two groups.

### 4.2 Short Form Rasch Analysis

The Rasch analysis of the short form version of the data collection instrument was generally conducted in the same manner as the analysis of the full version. The analysis began by investigating the functioning of the rating scale. Statistics regarding the rating scale structure indicated that the scale functioned properly; see Table 4.9.

The item and participant fit statistics were then examined to determine whether the data matched the specifications of the Rasch model. Item fit statistics were all within
Table 4.8
*Rank Ordering of Items from Split Sample Analyses*

<table>
<thead>
<tr>
<th>Rank</th>
<th>Item</th>
<th>Measure</th>
<th>Rank</th>
<th>Item</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>2.97</td>
<td>1</td>
<td>11</td>
<td>2.85</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>2.37</td>
<td>2</td>
<td>35</td>
<td>2.44</td>
</tr>
<tr>
<td>3</td>
<td>44</td>
<td>2.35</td>
<td>3</td>
<td>27</td>
<td>2.05</td>
</tr>
<tr>
<td>4</td>
<td>27</td>
<td>2.32</td>
<td>4</td>
<td>44</td>
<td>1.92</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
<td>1.46</td>
<td>5</td>
<td>24</td>
<td>1.48</td>
</tr>
<tr>
<td>6</td>
<td>42</td>
<td>1.34</td>
<td>6</td>
<td>40</td>
<td>1.22</td>
</tr>
<tr>
<td>7</td>
<td>40</td>
<td>1.05</td>
<td>7</td>
<td>34</td>
<td>1.09</td>
</tr>
<tr>
<td>8.5</td>
<td>8</td>
<td>0.99</td>
<td>8</td>
<td>29</td>
<td>0.97</td>
</tr>
<tr>
<td>8.5</td>
<td>24</td>
<td>0.99</td>
<td>9</td>
<td>25</td>
<td>0.94</td>
</tr>
<tr>
<td>10</td>
<td>29</td>
<td>0.91</td>
<td>10</td>
<td>8</td>
<td>0.83</td>
</tr>
<tr>
<td>11</td>
<td>25</td>
<td>0.71</td>
<td>11</td>
<td>42</td>
<td>0.74</td>
</tr>
<tr>
<td>12.5</td>
<td>18</td>
<td>0.63</td>
<td>12</td>
<td>18</td>
<td>0.71</td>
</tr>
<tr>
<td>12.5</td>
<td>32</td>
<td>0.63</td>
<td>13</td>
<td>14</td>
<td>0.59</td>
</tr>
<tr>
<td>14</td>
<td>30</td>
<td>0.55</td>
<td>14</td>
<td>32</td>
<td>0.52</td>
</tr>
<tr>
<td>15</td>
<td>19</td>
<td>0.52</td>
<td>15</td>
<td>37</td>
<td>0.42</td>
</tr>
<tr>
<td>16</td>
<td>37</td>
<td>0.48</td>
<td>16</td>
<td>30</td>
<td>0.25</td>
</tr>
<tr>
<td>17</td>
<td>31</td>
<td>0.22</td>
<td>17</td>
<td>19</td>
<td>0.11</td>
</tr>
<tr>
<td>18</td>
<td>14</td>
<td>0.19</td>
<td>18</td>
<td>31</td>
<td>0.08</td>
</tr>
<tr>
<td>19</td>
<td>41</td>
<td>-0.03</td>
<td>19</td>
<td>41</td>
<td>-0.14</td>
</tr>
<tr>
<td>20</td>
<td>39</td>
<td>-0.29</td>
<td>20</td>
<td>47</td>
<td>-0.28</td>
</tr>
<tr>
<td>21</td>
<td>33</td>
<td>-0.43</td>
<td>21</td>
<td>39</td>
<td>-0.39</td>
</tr>
<tr>
<td>22</td>
<td>3</td>
<td>-0.50</td>
<td>22</td>
<td>33</td>
<td>-0.44</td>
</tr>
<tr>
<td>23</td>
<td>47</td>
<td>-0.57</td>
<td>23</td>
<td>46</td>
<td>-0.59</td>
</tr>
<tr>
<td>24</td>
<td>38</td>
<td>-0.74</td>
<td>24</td>
<td>3</td>
<td>-0.64</td>
</tr>
<tr>
<td>25</td>
<td>36</td>
<td>-0.75</td>
<td>25</td>
<td>36</td>
<td>-0.79</td>
</tr>
<tr>
<td>26</td>
<td>46</td>
<td>-1.04</td>
<td>26</td>
<td>38</td>
<td>-0.83</td>
</tr>
<tr>
<td>27</td>
<td>16</td>
<td>-1.16</td>
<td>27</td>
<td>4</td>
<td>-1.30</td>
</tr>
<tr>
<td>28</td>
<td>4</td>
<td>-1.87</td>
<td>28</td>
<td>23</td>
<td>-1.37</td>
</tr>
<tr>
<td>29</td>
<td>7</td>
<td>-1.89</td>
<td>29</td>
<td>16</td>
<td>-1.55</td>
</tr>
<tr>
<td>30</td>
<td>23</td>
<td>-1.94</td>
<td>30</td>
<td>22</td>
<td>-2.04</td>
</tr>
<tr>
<td>31</td>
<td>45</td>
<td>-2.01</td>
<td>31</td>
<td>45</td>
<td>-2.09</td>
</tr>
<tr>
<td>32</td>
<td>22</td>
<td>-2.12</td>
<td>32.5</td>
<td>9</td>
<td>-2.13</td>
</tr>
<tr>
<td>33</td>
<td>9</td>
<td>-2.32</td>
<td>32.5</td>
<td>7</td>
<td>-2.13</td>
</tr>
<tr>
<td>34</td>
<td>1</td>
<td>-2.99</td>
<td>34</td>
<td>1</td>
<td>-2.48</td>
</tr>
</tbody>
</table>
the acceptable limits. All participant fit statistics were found to be sufficiently within the acceptable limits such that no participant was found to degrade the measurement system. As a result, no items and no participants were removed from the analysis.

The item and participant separation statistics were then examined. The item separation statistics were examined to determine whether the items are of varying difficulties along the less-to-more continuum. The participant separation statistics were examined to determine whether the items were useful for identifying participants of varying abilities. The separation statistics for the items can be found in Table 4.10. Separation statistics for participants can be found in Table 4.11; data for extreme participants were not included in the table in order to report fit statistics.

Table 4.9

<table>
<thead>
<tr>
<th>Short Form Rating Scale Category Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Count</td>
</tr>
<tr>
<td>Disagree</td>
</tr>
<tr>
<td>Agree</td>
</tr>
<tr>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Missing</td>
</tr>
</tbody>
</table>

Table 4.10

<table>
<thead>
<tr>
<th>Short Form Summary Statistics for 15 Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Score</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Std. Dev.</td>
</tr>
<tr>
<td>Max.</td>
</tr>
<tr>
<td>Min.</td>
</tr>
</tbody>
</table>

Real: Separation: 11.47  Reliability: .99
Model: Separation: 11.73  Reliability: .99
A principal contrast analysis was conducted to determine the amount of variance for which the primary linear measure accounts. Variance explained by the primary linear measure was reported to be 79.8% of the total variance. No residual contrasts accounted for more than 3.1% of the residual variance; see Table 4.12.

The 15 items’ difficulty measures from the short analysis were then compared with those obtained during the original analysis. This was done to ensure that the ordering of the items was preserved in the short form of the data collection instrument and that the item difficulty measurements had remained stable within error. Table 4.13 displays the item difficulties and the item rank order from the short-form analysis and the original analysis.

Also investigated were the participants’ ability measures. The participants’ ability measures from the short-form analysis were compared to those obtained from the original analysis to determine if they differed between analyses. A paired-samples t test was conducted to compare the ability measures from the original analysis ($n = 247, M = 1.10, SD = 1.66$) and the measures from the short-form analysis ($n = 247, M = 1.08, SD = 1.72$). The result was not significant, $t(245) = .73, p = .466$. A Pearson correlation was then run to determine if there was a relationship between the two measures of ability. The
Table 4.12
Short Form Explained and Unexplained Variance

<table>
<thead>
<tr>
<th></th>
<th>Eigenvalue</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance explained by the primary linear measure</td>
<td>59.4</td>
<td>79.8</td>
</tr>
<tr>
<td>Total unexplained variance</td>
<td>15.0</td>
<td>20.2</td>
</tr>
<tr>
<td>Unexplained variance in 1st contrast</td>
<td>2.3</td>
<td>3.1</td>
</tr>
<tr>
<td>Unexplained variance in 2nd contrast</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Unexplained variance in 3rd contrast</td>
<td>1.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Unexplained variance in 4th contrast</td>
<td>1.2</td>
<td>1.6</td>
</tr>
<tr>
<td>Unexplained variance in 5th contrast</td>
<td>1.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Table 4.13
Comparison of Short Form and Original Item Difficulties and Rank Orders

<table>
<thead>
<tr>
<th>Rank</th>
<th>Short Form Item</th>
<th>Measure</th>
<th>Rank</th>
<th>Original Item</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>2.92</td>
<td>1</td>
<td>11</td>
<td>2.92</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>2.39</td>
<td>2</td>
<td>35</td>
<td>2.40</td>
</tr>
<tr>
<td>3</td>
<td>44</td>
<td>2.11</td>
<td>3</td>
<td>44</td>
<td>2.13</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>1.25</td>
<td>4</td>
<td>34</td>
<td>1.28</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
<td>1.03</td>
<td>5</td>
<td>42</td>
<td>1.04</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>0.79</td>
<td>6</td>
<td>25</td>
<td>0.81</td>
</tr>
<tr>
<td>7</td>
<td>32</td>
<td>0.54</td>
<td>7</td>
<td>32</td>
<td>0.56</td>
</tr>
<tr>
<td>8</td>
<td>31</td>
<td>0.12</td>
<td>8</td>
<td>31</td>
<td>0.14</td>
</tr>
<tr>
<td>9</td>
<td>47</td>
<td>-0.42</td>
<td>9</td>
<td>47</td>
<td>-0.41</td>
</tr>
<tr>
<td>10</td>
<td>46</td>
<td>-0.81</td>
<td>10</td>
<td>46</td>
<td>-0.81</td>
</tr>
<tr>
<td>11</td>
<td>16</td>
<td>-1.34</td>
<td>11</td>
<td>16</td>
<td>-1.35</td>
</tr>
<tr>
<td>12</td>
<td>23</td>
<td>-1.64</td>
<td>12</td>
<td>23</td>
<td>-1.65</td>
</tr>
<tr>
<td>13</td>
<td>7</td>
<td>-2.00</td>
<td>13</td>
<td>7</td>
<td>-2.00</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>-2.21</td>
<td>14</td>
<td>9</td>
<td>-2.22</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>-2.72</td>
<td>15</td>
<td>1</td>
<td>-2.72</td>
</tr>
</tbody>
</table>

result was significant, $r(245) = .966, p < .001$. A coefficient of determination was calculated, and it indicated that the ability measures from one analysis could be associated with 93.3% of variance in the ability measures from the other analysis, $R^2 = .933$. 

74
4.3 Statistical Tests

A measure of self-reported student-centered teaching is a primary outcome of the Rasch analysis. These measures were used in statistical tests to determine the relationship between levels of student-centered teaching and contextual and demographic variables (α = .05). Descriptive statistics related to the participants’ measures of student-centered teaching can be found in Table 4.14.

Table 4.14
Descriptive Statistics for Student-centered Teaching Measures

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>251</td>
<td>1.18</td>
<td>1.76</td>
<td>-2.50</td>
<td>6.58</td>
<td>9.08</td>
</tr>
</tbody>
</table>

The first test investigated the relationship between levels of student-centered teaching and class size. A Pearson correlation was run. The results were not significant, \( r(249) = -0.07, p = .266 \).

This test was followed by an investigation of the relationship between levels of student-centered teaching and whether instructors were teaching at the graduate or undergraduate level. An independent samples \( t \) test was conducted, comparing the measures of participants teaching graduate courses (\( n = 39, M = 1.21, SD = 1.86 \)) and participants teaching undergraduate courses (\( n = 204, M = 1.14, SD = 1.75 \)). The result was not significant, \( t(241) = -0.196, p = .844 \).

This test was followed by an additional test in which course level was divided between graduate courses, courses at the 3000-4000 level, and courses at the 1000-2000 level. A one-way analysis of variance was conducted, comparing the measures of instructors teaching courses at the 1000-2000 level (\( n = 109, M = 1.02, SD = 1.9 \)), instructors teaching courses at the 3000-4000 level (\( n = 95, M = 1.28, SD = 1.56 \)), and
instructors of graduate courses \( n = 39, M = 1.21, SD = 1.86 \). The test was not significant, \( F(2, 240) = .566, p = .569 \).

The next variable to be investigated was course discipline. A one-way analysis of variance was conducted, comparing the measures of instructors teaching courses categorized as pure soft \( n = 42, M = 1.11, SD = 1.69 \), pure hard \( n = 40, M = .10, SD = 1.19 \), applied soft \( n = 104, M = 1.63, SD = 1.78 \), and applied hard \( n = 59, M = 1.10, SD = 1.76 \). The test was significant, \( F(3, 241) = 7.99, p < .001 \). Omega squared was calculated to determine the effect size, and it indicated that 7.8% of the variance in student-centered teaching could be associated with course discipline, \( \omega^2 = .078 \).

A post-hoc Scheffe test was conducted. The test showed that there were significant differences between the courses categorized as pure hard and those categorized as either applied soft or as applied hard. No other differences were reported to be significant.

The number of participants teaching courses categorized as applied soft \( n = 104 \) was much larger than the number of participants teaching in the pure soft \( n = 42 \), pure hard \( n = 40 \), and applied hard \( n = 59 \) disciplines. A second one-way analysis of variance was conducted for which a random sample of 38 instructors from each discipline was selected. The result was significant, \( F(3, 148) = 7.54, p < .001 \). A post-hoc Scheffe test again indicated that the difference between groups was between the pure hard discipline and both the applied soft and applied hard disciplines. No other differences were reported as significant. With equal group sizes, the effect size increased slightly, \( \omega^2 = .114 \).
The next statistical test examined the relationship between levels of student-centered teaching and instructor sex. A point-biserial correlation was conducted. Women were coded as “0”, and men were coded as “1”. The result was significant, $r_{pb}(240) = -.16, p = .013$. A coefficient of determination was calculated and indicated that sex accounts for 2.5% of variance in the measure of student-centered teaching, $R^2 = .025$.

This was followed by an investigation of the relationship between levels of student-centered teaching and years of teaching experience. A Pearson correlation was conducted. The test was not significant, $r(246) = -.01, p = .859$.

Next, the relationship between levels of student-centered teaching and instructor age was examined. A Pearson correlation was run. The results were not significant, $r(238) = .11, p = .066$.

The next statistical test investigated the relationship between levels of student-centered teaching and instructor rank. A one-way analysis of variance was run; descriptive statistics for the various ranks compared in the analysis can be found in Table 4.15. The test was not significant, $F(7, 240) = .91, p = .498$.

In the previous analyses, two variables were found to be significantly related to levels of student-centered teaching: course discipline and instructor sex. An additional test was run to investigate any potential interaction effects of discipline and sex on levels of student-centered teaching. A two-way analysis of variance was run; see Table 4.16 for descriptive statistics for the grouping variables. The results showed a significant main effect for discipline, $F(3, 228) = 7.61, p < .001$. Omega-squared was calculated to determine the amount of variance in student-centered teaching which could be associated with discipline, $\omega^2 = .051$. The effect for instructor sex was also significant, $F(1, 228) =$
Table 4.15
Descriptive Statistics for Instructor Ranks

<table>
<thead>
<tr>
<th>Rank</th>
<th>n</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>45</td>
<td>1.22</td>
<td>1.85</td>
</tr>
<tr>
<td>Associate professor</td>
<td>40</td>
<td>1.06</td>
<td>1.49</td>
</tr>
<tr>
<td>Assistant professor</td>
<td>40</td>
<td>1.49</td>
<td>1.72</td>
</tr>
<tr>
<td>Lecturer</td>
<td>32</td>
<td>1.33</td>
<td>1.80</td>
</tr>
<tr>
<td>Instructor/visiting (Ed.D. or Ph.D.)</td>
<td>8</td>
<td>0.13</td>
<td>1.62</td>
</tr>
<tr>
<td>Instructor/visiting (M.A.)</td>
<td>13</td>
<td>0.99</td>
<td>1.24</td>
</tr>
<tr>
<td>Part-time faculty</td>
<td>40</td>
<td>1.48</td>
<td>2.18</td>
</tr>
<tr>
<td>Graduate Assistant/teaching assistant</td>
<td>30</td>
<td>0.93</td>
<td>1.36</td>
</tr>
</tbody>
</table>

Table 4.16
Descriptive Statistics for Discipline-sex Two-way Analysis of Variance

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Sex</th>
<th>n</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure soft</td>
<td>Women</td>
<td>26</td>
<td>1.73</td>
<td>1.68</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>16</td>
<td>0.10</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>42</td>
<td>1.11</td>
<td>1.69</td>
</tr>
<tr>
<td>Pure hard</td>
<td>Women</td>
<td>14</td>
<td>0.17</td>
<td>1.32</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>24</td>
<td>0.03</td>
<td>1.12</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>38</td>
<td>0.08</td>
<td>1.18</td>
</tr>
<tr>
<td>Applied soft</td>
<td>Women</td>
<td>66</td>
<td>1.59</td>
<td>1.63</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>35</td>
<td>1.68</td>
<td>2.11</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>101</td>
<td>1.62</td>
<td>1.80</td>
</tr>
<tr>
<td>Applied hard</td>
<td>Women</td>
<td>25</td>
<td>1.38</td>
<td>1.72</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>30</td>
<td>1.08</td>
<td>1.72</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>55</td>
<td>1.22</td>
<td>1.71</td>
</tr>
<tr>
<td>Total</td>
<td>Women</td>
<td>131</td>
<td>1.43</td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>105</td>
<td>0.89</td>
<td>1.80</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>236</td>
<td>1.19</td>
<td>1.75</td>
</tr>
</tbody>
</table>

4.26, $p = .04$. Omega-squared was calculated to determine the amount of variance in student-centered teaching which could be associated with sex, $\omega^2 = .008$. The interaction effect was not significant, $F(3, 228) = 2.53, p = .057$.

As was the case in the one-way analysis of variance for discipline, the number of participants in each of the disciplines was unequal. Therefore, a second two-way analysis of variance was conducted with 38 randomly selected participants per discipline;
descriptive statistics for the second two-way analysis of variance can be found in Table 4.17. The analysis showed a significant main effect for discipline, $F(3, 144) = 7.64, p < .001$. Omega-squared was calculated to determine the amount of variance in student-centered teaching which could be associated with discipline, $\omega^2 = .08$. The main effect for sex was not significant, $F(1, 144) = 2.67, p = .104$. The interaction effect was not significant, $F(3, 144) = 2.04, p = .111$.

Table 4.17
Descriptive Statistics for Equal Group Size Discipline-sex Two-way Analysis of Variance

<table>
<thead>
<tr>
<th>Sex</th>
<th>Discipline</th>
<th>n</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>Pure soft</td>
<td>25</td>
<td>1.53</td>
<td>1.39</td>
</tr>
<tr>
<td></td>
<td>Pure hard</td>
<td>14</td>
<td>0.17</td>
<td>1.32</td>
</tr>
<tr>
<td></td>
<td>Applied soft</td>
<td>28</td>
<td>1.63</td>
<td>1.70</td>
</tr>
<tr>
<td></td>
<td>Applied hard</td>
<td>17</td>
<td>1.74</td>
<td>1.86</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>84</td>
<td>1.38</td>
<td>1.65</td>
</tr>
<tr>
<td>Men</td>
<td>Pure soft</td>
<td>13</td>
<td>0.28</td>
<td>1.21</td>
</tr>
<tr>
<td></td>
<td>Pure hard</td>
<td>24</td>
<td>0.03</td>
<td>1.12</td>
</tr>
<tr>
<td></td>
<td>Applied soft</td>
<td>10</td>
<td>2.14</td>
<td>2.09</td>
</tr>
<tr>
<td></td>
<td>Applied hard</td>
<td>21</td>
<td>0.87</td>
<td>1.70</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>68</td>
<td>0.65</td>
<td>1.63</td>
</tr>
<tr>
<td>Total</td>
<td>Pure soft</td>
<td>38</td>
<td>1.10</td>
<td>1.45</td>
</tr>
<tr>
<td></td>
<td>Pure hard</td>
<td>38</td>
<td>0.08</td>
<td>1.18</td>
</tr>
<tr>
<td></td>
<td>Applied soft</td>
<td>38</td>
<td>1.77</td>
<td>1.79</td>
</tr>
<tr>
<td></td>
<td>Applied hard</td>
<td>38</td>
<td>1.26</td>
<td>1.80</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>152</td>
<td>1.05</td>
<td>1.68</td>
</tr>
</tbody>
</table>

### 4.4 Developmental Path

Construction of a suggested developmental path was based on the item separation and reliability statistics. Item separation was reported as 9.74 with a Rasch reliability of .99. This indicated that the items could be divided into nearly 10 levels of items with varying difficulties. Items were assigned to groups based on their difficulty measures and
associated errors. Table 4.18 presents the items arranged by difficulty and divided into 10 groups.

Table 4.18  
*Suggested Item Groupings for a Developmental Path*

<table>
<thead>
<tr>
<th>Group</th>
<th>Item Number</th>
<th>Measure</th>
<th>Model Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 10*</td>
<td>11</td>
<td>2.92</td>
<td>0.14</td>
</tr>
<tr>
<td>Group 9*</td>
<td>35</td>
<td>2.40</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>2.18</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>44</td>
<td>2.13</td>
<td>0.14</td>
</tr>
<tr>
<td>Group 8</td>
<td>34</td>
<td>1.28</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>1.24</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>1.14</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>42</td>
<td>1.04</td>
<td>0.14</td>
</tr>
<tr>
<td>Group 7</td>
<td>29</td>
<td>0.95</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>0.89</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>0.81</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>0.68</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>0.56</td>
<td>0.14</td>
</tr>
<tr>
<td>Group 6</td>
<td>37</td>
<td>0.46</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>0.39</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>0.38</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>0.30</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>-0.09</td>
<td>0.14</td>
</tr>
<tr>
<td>Group 5</td>
<td>39</td>
<td>-0.35</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>-0.41</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>-0.44</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-0.58</td>
<td>0.14</td>
</tr>
<tr>
<td>Group 4</td>
<td>36</td>
<td>-0.77</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>-0.79</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>46</td>
<td>-0.81</td>
<td>0.14</td>
</tr>
<tr>
<td>Group 3*</td>
<td>16</td>
<td>-1.35</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-1.58</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>-1.65</td>
<td>0.15</td>
</tr>
<tr>
<td>Group 2*</td>
<td>7</td>
<td>-2.00</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>-2.05</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>-2.08</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>-2.22</td>
<td>0.15</td>
</tr>
<tr>
<td>Group 1*</td>
<td>1</td>
<td>-2.72</td>
<td>0.16</td>
</tr>
</tbody>
</table>

* The group is clearly separated from surrounding groups based on measures and errors.
Chapter 5

Discussion

This chapter reviews the results of the analyses presented in Chapter 4, focusing on defining and measuring student-centered teaching. The chapter begins by defining the construct of student-centered teaching based on the results of the Rasch analysis and presenting an instrument for measuring student-centered teaching. This is followed by a discussion of the current level of student-centered teaching at The University of Toledo as self-reported by the instructors, which serves as the performance analysis of the Pershing Performance Improvement Process. There is then a discussion of the relationships between levels of student-centered teaching and various contextual and demographic variables. A developmental path for increasing in student centeredness based on item difficulties, item errors, and the item separation statistics is discussed next, followed by a concluding discussion of recommendations for The University of Toledo and future research.

5.1 Defining Student-centered Teaching

This paper’s definition of student-centered teaching grew out of the qualitative work of Gilis et al. (2008), who interviewed higher education instructors to investigate “the
knowledge, attitudes and skills that student-centred [sic] teachers need” (p. 534). Gilis et al. produced a competency profile of 15 competencies, which “not only can serve as a starting point to identify better what is essential for teaching in a student-centred [sic] way, but also for the instructional development of teachers in, for example, workshops supporting them to implement student-centred [sic] teaching” (p. 534).

The 15 competencies are each represented by indicators, which were used to develop the items for the data collection instrument used for this paper. The items were written in collaboration with the first author of Gilis et al. (2008) to ensure that they represent the substantive theory of student-centered teaching expressed in Gilis et al. The Rasch analysis conducted for this paper provides feedback on the theory, based on data collected from the items. As Bond and Fox (2007) explain: “As theory tells the investigator how to go about the data collection process, the results of that process informs about the theory” (p. 270). Therefore, the results of the Rasch analysis reflect back on the theory of student-centered teaching, allowing for the theory to be reconsidered and redeveloped.

Research Questions 1.a. through 1.g. were written to represent the requirements of the Rasch model; the collected data needed to conform to these requirements to determine that the data represent the theory expressed in the items. Answering Research Question 1.a. required determining whether or not the participants were able to effectively communicate through the rating scale. The initial rating scale structure indicated that the participants were able to effectively communicate through the original four-point rating scale, which ranged from strongly disagree to strongly agree. However, as the analysis progressed and misfitting items and participants were removed from the
analysis, the number of responses in the strongly disagree category fell below acceptable limits. The strongly disagree and disagree categories were therefore collapsed together into one disagree category. Subsequent analysis of the rating scale structure indicated that participants were able to effectively communicate through the revised, three-point rating scale.

Research Questions 1.b. and 1.c. ask, respectively, whether or not the data for the items and the participants meet the requirements of the Rasch model. The survey consisted of 47 items, which, according to Gilis et al. (2008), represented student-centered teaching. Of the 47 items, 34 items produced data that conformed to the requirements of the Rasch model sufficiently that they did not degrade the measurement capability of the instrument; the data for 13 items did not fit the model and were removed from the analysis.

The 13 removed items were analyzed for underlying patterns of misfit. There were no patterns found collectively among the 13 items. However, the one item representing Competency 3 and all three items representing Competency 5 misfit, indicating that those competencies, as represented by the misfitting items, do not belong to the same construct of student-centered teaching as the other competencies, which after removal of misfitting items all retained at least one item. A list of fitting items arranged by competency can be found in Table 5.1; a list of misfitting items arranged by competency can be found in Table 5.2.
Table 5.1
*Fitting Items Arranged by Competency*

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Number</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>9</td>
<td>I am willing to permanently improve my teaching.</td>
</tr>
<tr>
<td>2.2</td>
<td>14</td>
<td>I critically evaluate proposed new ways of teaching.</td>
</tr>
<tr>
<td>4.1</td>
<td>23</td>
<td>I am open and empathetic toward students.</td>
</tr>
<tr>
<td>4.2</td>
<td>29</td>
<td>When preparing for my class, I place myself in the position of the students.</td>
</tr>
<tr>
<td>6.1</td>
<td>22</td>
<td>I listen to and communicate with students.</td>
</tr>
<tr>
<td>6.2</td>
<td>4</td>
<td>I cooperate with students to find solutions to problems.</td>
</tr>
<tr>
<td>7.1</td>
<td>3</td>
<td>I discuss teaching related issues with colleagues.</td>
</tr>
<tr>
<td>7.2</td>
<td>39</td>
<td>I am open to colleagues’ opinions regarding teaching-related issues.</td>
</tr>
<tr>
<td>8.1</td>
<td>33</td>
<td>I create an environment that facilitates learning.</td>
</tr>
<tr>
<td>8.2</td>
<td>44</td>
<td>I design course components adapted to students’ characteristics.</td>
</tr>
<tr>
<td>8.3</td>
<td>42</td>
<td>I develop activating support (e.g., content, teaching method, learning materials) and evaluation.</td>
</tr>
<tr>
<td>9.1</td>
<td>30</td>
<td>When preparing lessons, I consider how students have reacted to previous educational experiences.</td>
</tr>
<tr>
<td>9.2</td>
<td>32</td>
<td>I accommodate different learning styles by using a variety of teaching methods and learning materials.</td>
</tr>
<tr>
<td>10.1</td>
<td>35</td>
<td>I collaborate in designing a balanced learning environment by consulting with colleagues to ensure students are taught with a variety of teaching methods.</td>
</tr>
<tr>
<td>10.2</td>
<td>11</td>
<td>I collaborate in designing balanced learning environments by consulting with faculty to understand students’ study loads.</td>
</tr>
<tr>
<td>10.4</td>
<td>40</td>
<td>I collaborate in designing a balanced learning environment by consulting with colleagues to ensure that my class is aligned with courses in this subject which my students have already taken and will go on to take.</td>
</tr>
<tr>
<td>11.1</td>
<td>1</td>
<td>I actively listen to students.</td>
</tr>
<tr>
<td>11.2</td>
<td>46</td>
<td>I challenge and motivate students.</td>
</tr>
<tr>
<td>11.3</td>
<td>37</td>
<td>I recognize students’ studying problems and offer them support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I use real-life problems, case-studies, and examples to concretize, model, and structure the subject matter.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I stimulate cooperation among students.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I explain to students why I teach the way I do.</td>
</tr>
</tbody>
</table>

### Competency 12: To integrate the evaluation of the students’ development in student support.

|   |   | I am aware of my students’ learning approaches and follow-up with students whose approaches could be improved to produce better learning outcomes. |

### Competency 13: To reflect on one’s own teaching practice.

|   |   | I am open to student signals about the appropriateness of my teaching approach. |
|   |   | I evaluate my teaching approach. |
|   |   | I adjust my teaching approach when necessary. |
|   |   | I place my teaching approach within the larger framework of my students’ education. |
|   |   | I reflect on my teaching approach and make adjustments when necessary. |

### Competency 14: To cooperate with colleagues to adjust teaching practice.

|   |   | I make my teaching practice visible for colleagues. |
|   |   | I cooperate with colleagues about the course content and student performance. |
|   |   | I discuss problems and ways to improve my teaching with colleagues. |
|   |   | I give feedback to colleagues and receive feedback from them. |

### Competency 15: To have the required expertise content wise.

|   |   | I know content matter from areas related to the curriculum and am able to judge the relevance for my own teaching. |
|   |   | I know how my course is relevant for the subject area and the profession. |

As for the participants, 336 instructors fully completed the survey. Of the 336 instructors, the data for 251 instructors sufficiently conformed to the requirements of the Rasch model such that they did not degrade the measure. The data for 87 participants did not sufficiently meet the requirements of the Rasch model, and these participants were removed from the analysis. The misfitting participants were examined for underlying patterns of misfit. No patterns were found. In addition, a principal contrast analysis was run on all 336 participants after the misfitting items had been removed from the data.
<table>
<thead>
<tr>
<th>Competency</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>12</td>
</tr>
<tr>
<td>2.1</td>
<td>15</td>
</tr>
<tr>
<td>3.1</td>
<td>20</td>
</tr>
<tr>
<td>5.1</td>
<td>17</td>
</tr>
<tr>
<td>5.2</td>
<td>28</td>
</tr>
<tr>
<td>5.3</td>
<td>6</td>
</tr>
<tr>
<td>6.3</td>
<td>13</td>
</tr>
<tr>
<td>10.3</td>
<td>2</td>
</tr>
<tr>
<td>11.4</td>
<td>5</td>
</tr>
<tr>
<td>11.6</td>
<td>43</td>
</tr>
<tr>
<td>12.2</td>
<td>10</td>
</tr>
<tr>
<td>12.3</td>
<td>26</td>
</tr>
<tr>
<td>15.1</td>
<td>21</td>
</tr>
</tbody>
</table>

* No indicators for this competency met the requirements of the Rasch model.
The results indicated that all participants belonged to one group; in other words, the sample was not a combination of disparate groups. Furthermore, misfit status was not found to be related to any contextual variables related to the course being taught. Additionally, no relationships to instructor demographic variables were found.

While there were individual items and individual participants whose data did not conform to the requirements of the Rasch model, once these were removed from the dataset, both the items and participants sufficiently met the requirements of the Rasch model.

Research Question 1.d. questions whether the items are of varying difficulties such that they represent a linear continuum from less student-centered to more student-centered. The item separation statistics indicate that the items can be separated into between nine and 10 groups. This indicates that there are nine or 10 groups of items with varying difficulties. The easiest group requires the least amount of student centeredness to endorse. The following groups of items require the participant to have increasing amounts of student centeredness before being endorsed by the participant. Figure 5.1 displays the items along the continuum in the form of an item-map, and Table 5.3 lists the items in order of difficulty.

The items do work together to form a less-to-more continuum along the student-centered teaching continuum. There is some psychometric redundancy in the items (i.e., multiple items of the same difficulty). In Group 2, for example, three items have similar measures: Item 3 (-2.00), Item 45 (-2.05), and Item 22 (-2.08); similar groupings are found elsewhere. This indicates that the same level of student-centeredness could be detected by fewer items, creating a shorter survey. However, being psychometrically
Figure 5.1. Item map displaying items along the continuous logit scale according to their Rasch difficulty measures.
<table>
<thead>
<tr>
<th>Group</th>
<th>Indicator</th>
<th>Item No.</th>
<th>Measure</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 10</td>
<td>10.2</td>
<td>11</td>
<td>2.92</td>
<td>I collaborate in designing balanced learning environments by consulting with faculty to understand students’ study loads.</td>
</tr>
<tr>
<td>Group 9</td>
<td>10.1</td>
<td>35</td>
<td>2.40</td>
<td>I collaborate in designing a balanced learning environment by consulting with colleagues to ensure students are taught with a variety of teaching methods.</td>
</tr>
<tr>
<td></td>
<td>14.4</td>
<td>27</td>
<td>2.18</td>
<td>I give feedback to colleagues and receive feedback from them.</td>
</tr>
<tr>
<td></td>
<td>8.2</td>
<td>44</td>
<td>2.13</td>
<td>I design course components adapted to students’ characteristics.</td>
</tr>
<tr>
<td>Group 8</td>
<td>14.2</td>
<td>34</td>
<td>1.28</td>
<td>I cooperate with colleagues about the course content and student performance.</td>
</tr>
<tr>
<td></td>
<td>12.1</td>
<td>24</td>
<td>1.24</td>
<td>I am aware of my students’ learning approaches and follow-up with students whose approaches could be improved to produce better learning outcomes.</td>
</tr>
<tr>
<td></td>
<td>10.4</td>
<td>40</td>
<td>1.14</td>
<td>I collaborate in designing a balanced learning environment by consulting with colleagues to ensure that my class is aligned with courses in this subject which my students have already taken and will go on to take.</td>
</tr>
<tr>
<td></td>
<td>8.3</td>
<td>42</td>
<td>1.04</td>
<td>I develop activating support (e.g., content, teaching method, learning materials) and evaluation.</td>
</tr>
<tr>
<td>Group 7</td>
<td>4.2</td>
<td>29</td>
<td>0.95</td>
<td>When preparing for my class, I place myself in the position of the students.</td>
</tr>
<tr>
<td></td>
<td>14.1</td>
<td>8</td>
<td>0.89</td>
<td>I make my teaching practice visible for colleagues.</td>
</tr>
<tr>
<td></td>
<td>14.3</td>
<td>25</td>
<td>0.81</td>
<td>I discuss problems and ways to improve my teaching with colleagues.</td>
</tr>
<tr>
<td></td>
<td>11.8</td>
<td>18</td>
<td>0.68</td>
<td>I explain to students why I teach the way I do.</td>
</tr>
<tr>
<td></td>
<td>9.2</td>
<td>32</td>
<td>0.56</td>
<td>I accommodate different learning styles by using a variety of teaching methods and learning materials.</td>
</tr>
<tr>
<td>Group 6</td>
<td>11.3</td>
<td>37</td>
<td>0.46</td>
<td>I recognize students’ studying problems and offer them support.</td>
</tr>
<tr>
<td></td>
<td>9.1</td>
<td>30</td>
<td>0.39</td>
<td>When preparing lessons, I consider how students have reacted to previous educational experiences.</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td>14</td>
<td>0.38</td>
<td>I critically evaluate proposed new ways of teaching.</td>
</tr>
</tbody>
</table>
13.4 19 0.30 I place my teaching approach within the larger framework of my students’ education.
11.7 31 0.14 I stimulate cooperation among students.
13.1 41 -0.09 I am open to student signals about the appropriateness of my teaching approach.

Group 5
7.2 39 -0.35 I am open to colleagues’ opinions regarding teaching-related issues.
15.2 47 -0.41 I know content matter from areas related to the curriculum and am able to judge the relevance for my own teaching.
8.1 33 -0.44 I create an environment that facilitates learning.
7.1 3 -0.58 I discuss teaching related issues with colleagues.

Group 4
13.2 36 -0.77 I evaluate my teaching approach.
13.5 38 -0.79 I reflect on my teaching approach and make adjustments when necessary.
11.2 46 -0.81 I challenge and motivate students.

Group 3
13.3 16 -1.35 I adjust my teaching approach when necessary.
6.2 4 -1.58 I cooperate with students to find solutions to problems.
4.1 23 -1.65 I am open and empathetic toward students.

Group 2
11.5 7 -2.00 I use real-life problems, case-studies, and examples to concretize, model, and structure the subject matter.
15.3 45 -2.05 I know how my course is relevant for the subject area and the profession.
6.1 22 -2.08 I listen to and communicate with students.
1.1 9 -2.22 I am willing to permanently improve my teaching.

Group 1
11.1 1 -2.72 I actively listen to students.

redundant is not the same as being theoretically redundant (Bond & Fox, 2007). In Group 2, these three items address different aspects of the theory of student-centered teaching.

In only one instance did it appear that an item might be both psychometrically and theoretically redundant. In Group 4, items 36 and 38 have measures of -0.77 and -0.79 respectively; they are psychometrically redundant. Item 36 reads: “I evaluate my teaching approach.” Item 38 reads: “I reflect on my teaching approach and make adjustments when necessary.” In addition, Item 16 reads, “I adjust my teaching approach when
necessary.” Item 38 could be viewed as a combination of Items 36 and 16 with no substantive difference between the phrases I evaluate and I reflect on. As all three items fall under Competency 13, the author believes Item 38 to be psychometrically and theoretically redundant—but not degrading to the measurement system.

To define a construct of student-centered teaching, the items were grouped according to meaning, creating eight broader categories of items (see Figure 5.2); these categories are similar to the 15 competencies in Gilis et al. (2008). The easiest category of items relate to how instructors interact with their students. This is followed by three categories of roughly equal difficulty: instructor subject knowledge, instructional delivery, and instructor self-reflection on teaching practice. These are followed three categories that also share roughly equivalent difficulties: student support, collaborating with colleagues about teaching practice, and course design. The most difficult category of items relates to collaborating with colleagues to coordinate instruction throughout a program.

Research Question 1.e. is similar to 1.d., only it is concerned with the dispersion of participants along the continuum rather than items. The items must be able to discriminate between participants of varying difficulties. The participant summary statistics indicate that the items are able to distinguish participants of varying levels of student-centered teaching. The participant separation statistic is 4.13, which indicates that the items can identify four groups of participants with varying levels of student-centered teaching.

Research Question 1.f. asks if the items work together to represent a unidimensional construct. The results of a principal contrast analysis indicated that the
Figure 5.2. Item map displaying the items according to difficulty and grouped into content categories.
primary linear measure accounted for 79.4% of variance in the data; this is above the
minimum recommendation that the primary linear measure account for at least 60% of
variance in the data. Furthermore, no residual contrast accounted for enough of the
unexplained variance to be considered as a secondary dimension. Therefore, the items
measure one unidimensional construct.

Research Question 1.g. addresses the notion of item measure invariance. The
relative difficulty of items should remain stable across samples for which the data
collection instrument is appropriate—especially important is the rank ordering of items
from easiest to most difficult. To examine the invariance of the item measures across
samples, the 251 participants whose data fit the Rasch model were randomly assigned to
two groups. Separate Rasch analyses were run for the groups and the item difficulties and
rank ordering of the items from the analyses were compared. A Pearson correlation
demonstrated that the item measures from the two analyses were significantly and highly
correlated with each other. Spearman’s rank correlation coefficient was calculated and
demonstrated that the rankings of items from the analyses were significantly and highly
correlated with each other. These analyses provide evidence that the item measures are
stable across different samples.

The answers to Research Questions 1.a. through 1.g. indicate that the data
collection instrument produces data that meet the requirements of the Rasch model.
Therefore, Research Question 1 can be answered by stating that the data collection
instrument is useful for measuring student-centered teaching. The original form of the
instrument needed to be altered, however, by collapsing the rating scale and removing
items whose data did not meet the specifications of the Rasch model. The current,
working version of the data collection instrument consists of 34 items, which are answered on a three-point Likert-type scale; response categories are disagree, agree, and strongly agree.

Because the items comprising the data collection instrument become the operational definition of the construct (Wright & Stone, 1979), the outcome of the Rasch analysis not only indicates that the data collection instrument is useful for measurement but that the fitting items can provide a definition of student-centered teaching. In other words, the items reveal behaviors in which student-centered teachers engage.

In regard to a cultural change, the fitting items can serve as a description of student-centered teaching. A university promoting student centeredness, such as The University of Toledo, could adopt this definition of student-centered teaching. The university would then be able to communicate to its faculty which behaviors it considers student-centered. The faculty would then have a university-endorsed description of student-centered teaching to which they can look when making decisions regarding their courses; the faculty would be equipped to make decisions aligned with the overall mission, values, and goals of the university.

The 13 items that were removed from the instrument might be reintroduced in a subsequent version. Participants did not respond to these items in the same manner as they did the 34 fitting items. As was stated, there were no patterns within the data which indicated why the items misfit. It might be that these indicators are actually not part of the same construct as the remaining 34 items. In other words, these 13 misfitting indicators are not a part of student-centered teaching as expressed in the other 34 items—despite emerging from the same qualitative study (Gilis et al., 2008).
However, there might be other explanations for their misfitting. There might have been confusion based on the wording of the items. Or, there might have been a lack of applicability for instructors of certain courses. Misfitting Item 2 asks about aligning courses at the same level (e.g., 1000) in the same subject area. Not all courses necessarily have other courses in the subject area at the same level with which to be aligned. Such a situation could have led to some participants being uncertain about how to answer. Reintroducing the items into the instrument in future analyses, perhaps in an altered form, would provide a more definitive answer as to whether these misfitting indicators are part of the same student-centered teaching construct as the 34 fitting items.

5.2 Measuring Student-centered Teaching

Through the Rasch analysis, the 34-item form of the data collection instrument was demonstrated to be useful for measuring student-centered teaching. Some items, while expressing different aspects of student-centered teaching, had difficulty measures that were very similar. Such items are psychometrically redundant, making the same determination about the participants and adding little to the measurement capabilities of the instrument.

Where pairs or groups of psychometrically redundant items appear, items can be eliminated from the instrument without damaging the construct. The 34-item data collection instrument defined the construct of student-centered teaching; all of these items express the theory of student-centered teaching. However, not all of the items are necessary to effectively measure student-centered teaching. A short form of the instrument was created, using 15 items; see Table 5.4 for a list of the items included in
Table 5.4
*Short Form Items Arranged According to Difficulty*

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Item Number</th>
<th>Measure</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2</td>
<td>11</td>
<td>2.92</td>
<td>I collaborate in designing balanced learning environments by consulting with faculty to understand students’ study loads.</td>
</tr>
<tr>
<td>10.1</td>
<td>35</td>
<td>2.39</td>
<td>I collaborate in designing a balanced learning environment by consulting with colleagues to ensure students are taught with a variety of teaching methods.</td>
</tr>
<tr>
<td>8.2</td>
<td>44</td>
<td>2.11</td>
<td>I design course components adapted to students’ characteristics.</td>
</tr>
<tr>
<td>14.2</td>
<td>34</td>
<td>1.25</td>
<td>I cooperate with colleagues about the course content and student performance.</td>
</tr>
<tr>
<td>8.3</td>
<td>42</td>
<td>1.03</td>
<td>I develop activating support (e.g., content, teaching method, learning materials) and evaluation.</td>
</tr>
<tr>
<td>14.3</td>
<td>25</td>
<td>0.79</td>
<td>I discuss problems and ways to improve my teaching with colleagues.</td>
</tr>
<tr>
<td>9.2</td>
<td>32</td>
<td>0.54</td>
<td>I accommodate different learning styles by using a variety of teaching methods and learning materials.</td>
</tr>
<tr>
<td>11.7</td>
<td>31</td>
<td>0.12</td>
<td>I stimulate cooperation among students.</td>
</tr>
<tr>
<td>15.2</td>
<td>47</td>
<td>-0.42</td>
<td>I know content matter from areas related to the curriculum and am able to judge the relevance for my own teaching.</td>
</tr>
<tr>
<td>11.2</td>
<td>46</td>
<td>-0.81</td>
<td>I challenge and motivate students.</td>
</tr>
<tr>
<td>13.3</td>
<td>16</td>
<td>-1.34</td>
<td>I adjust my teaching approach when necessary.</td>
</tr>
<tr>
<td>4.1</td>
<td>23</td>
<td>-1.64</td>
<td>I am open and empathetic toward students.</td>
</tr>
<tr>
<td>11.5</td>
<td>7</td>
<td>-2.00</td>
<td>I use real-life problems, case-studies, and examples to concretize, model, and structure the subject matter.</td>
</tr>
<tr>
<td>1.1</td>
<td>9</td>
<td>-2.21</td>
<td>I am willing to permanently improve my teaching.</td>
</tr>
<tr>
<td>11.1</td>
<td>1</td>
<td>-2.72</td>
<td>I actively listen to students.</td>
</tr>
</tbody>
</table>

the short form. The retained items were selected to represent the more-to-less continuum. Items that shared similar difficulty measures with these 15—taking error into account—were removed from the instrument.

A Rasch analysis was performed in the same manner as that of the original instrument’s analysis. The results indicated that the 15 items worked together to construct a unidimensional measure—just as the 34-item instrument had. The results of the analyses indicated that the two instruments were quite similar in their measurement
capabilities. The rating scale structure remained virtually unchanged; the Rasch-Andrich thresholds moved from -2.25 and 2.25 in the original analysis to -2.20 and 2.20 in the short-form analysis. All items and participants in the short-form analysis continued to sufficiently fit the Rasch model. The amount of variance in the data accounted for by the primary linear measure also remained virtually unchanged: 79.4% in the original analysis and 79.8% in the short-form analysis.

There were changes in the separation statistics for both the items and participants. The separation statistic for the items increased in the short-form analysis from 9.74 to 11.73—this was despite virtually no changes in the item difficulty measures for the items or their associated errors. The increase in the separation statistic indicates that the items are working together to define areas of the less-to-more continuum of the construct better than the original analysis would indicate.

The separation statistic for the participants decreased, however, from 4.13 to 2.65. In comparison to the original instrument, the ratio of participants to items increased in the short form from around 7:1 to over 16:1; fewer items were used to distinguish between the same number of participants. The participants’ associated errors increased from the original analysis ($M = .40, SD = .10$) to the short-form analysis ($M = .60, SD = .10$). The enlarged errors make differences in abilities less clear and help explain the decrease in the separation statistic. However, 2.65 is still large enough to determine that the instrument can discriminate between participants with varying levels of student-centered teaching.

Comparison of the participant ability measures from the original analysis and the short-form analysis revealed that the two instruments produced similar ability measures.
A paired-samples $t$ test indicated that there were no differences in the ability measures from the original analysis and the ability measure from the short-form analysis. A follow-up Pearson correlation indicated a strong relationship between the two sets of measures. This indicates that despite the larger errors, the ability measures derived from the short form of the instrument are statistically the same as the measures from the original analysis. In other words, both forms of the instrument make the same judgment about the ability of the participants.

In defining student-centered teaching and communicating which instructional behaviors are associated with being student-centered, the original form of the data collection instrument provides a more comprehensive description of student-centered teaching. The short form of the instrument, with only 15 items, does not define the construct as comprehensively, but it is able to measure student-centered teaching as effectively as the 34-item instrument. The appropriateness of using either form of the instrument is dependent upon the preference and intention of the researcher; both forms should provide the same measure for participants’ abilities.

5.3 Performance Analysis

One of the key steps in a Human Performance Technology model is the performance analysis. At this stage, the desired performance has been described. The performance analysis is conducted to determine if a gap exists between actual performance and the desired performance. In regard to the cultural change to student centeredness at The University of Toledo, a performance analysis was needed to determine the level of
student-centered teaching throughout the university in order to determine whether or not the teaching was aligned with the student-centered mission and values of the university.

The University of Toledo has not defined student-centered teaching for itself. Therefore, the performance analysis in this paper was conducted based on the definition of student-centered teaching developed through the original Rasch analysis conducted for this paper. As mentioned in Chapter 3, the instrument created for this paper collects self-reported data. There is the potential that participants answered in socially acceptable ways or ways that they thought the researcher might prefer, rather than accurately responding based on their actual teaching practice. In practical terms, the participants might have reported being more student-centered than they actually were. Also, this performance analysis was based solely on the instructors’ self-reports. Students, administrators, and so forth might have provided a different assessment of instructor performance.

Making a judgment about the student centeredness of the teaching at The University began by visually inspecting an item map displaying both the items according to difficulty and the participants according to ability along the logit scale; see Figure 5.3. The general dispersion of items and participants indicated that the items were fairly well targeted to the sample. Summary statistics also indicated that the item difficulties ($M = 0.0, SD = 1.41$) were fairly well suited to the ability of the participants ($M = 1.19, SD = 1.76$); the mean of each fell within one standard deviation of the other.

For instruments containing dichotomous items, an item targeted to a participant (i.e., the difficulty measure and the ability measure are the same) would indicate that the participant is equally likely to endorse either category. For items on a test, where the
Figure 5.3. Item map displaying participants according to ability and items according to difficulty along the logit scale.
response is judged either correct or incorrect, a participant would be equally likely to respond correctly or incorrectly. However, with a rating scale such as the one used in this study, the interpretation is not as straightforward. Matching participant abilities and item difficulties does not indicate the point at which a participant would be equally likely to disagree and agree. To determine likely responses, the rating scale structure must be considered, specifically the Rasch-Andrich thresholds.

For this paper, the threshold where participants had an equal probability of responding either disagree or agree is -2.25. In other words, in a situation where a participant’s ability was 2.25 logits less than the difficulty of an item, the participant had an equal probability of responding either disagree or agree. The threshold where participants had an equal probability of responding either agree or strongly agree was 2.25; in a situation where a participant’s ability was 2.25 logits greater than the difficulty of an item, the participant had an equal probability of responding either agree or strongly agree.

For items whose difficulty measure matched the ability measure of a participant, the participant would have been expected to respond by endorsing the agree category. Therefore, in this paper, having items targeted to the sample, in practical terms, means having items for which participants are generally expected to respond agree. This is an indication that the reported levels of student-centered teaching were generally high.

There were some participants—roughly 10%—whose abilities were greater than the difficulty of the hardest item; see Figure 5.2. For these participants, the items were not well targeted. For the purposes of this performance analysis, these participants were interpreted as reporting high levels of student-centered teaching.
Another indication of the overall level of student-centered teaching was found in the rating scale structure statistics. Table 4.4 displays the observed count for each response category (i.e., the total number of times each category was endorsed). Comparing the number of responses in each category, the number of responses was much greater for the agree and strongly agree categories than the disagree category. There were nearly nine agree or strongly agree responses for every one disagree response. This again indicated that generally high levels of student-centered teaching were being reported by the participants.

By considering the Rasch-Andrich thresholds from the rating scale structure, it was possible to probabilistically determine the likely response from any person to any item, based on the ability of the person and the difficulty of the item. This provided another indication of the overall level of student-centered teaching. The disagree-agree threshold (-2.25) was particularly important as it represented the point at which participants reported whether they were engaging in certain behaviors or not. The agree-strongly agree threshold was somewhat less important because in either case, the participant reported engaging in the behavior represented by the item to some extent.

Beginning with the most difficult item, which had a difficulty of 2.92, it was determined that a participant would need an ability level of less than 0.67 to have a greater probability of responding disagree than responding agree. Considering that the mean of participant abilities was 1.19, it was apparent that less than half of the sample would have been expected to disagree with even just one item. This indicated that the overall reported level of student-centeredness was high.
A similar procedure was undertaken for the least able participant. The lowest ability measure was -2.50. Therefore an item would have needed a difficulty measure of at least -0.25 before the least able participant would have been expected to disagree more than agree. This meant that even the least able participant would have been expected to report engaging in (i.e., responding agree or strongly agree) nearly half of the 34 behaviors represented in the items (44%). This was another indication that the reported level of student-centered teaching was generally high.

The same was done for the mean participant ability. The mean ability measure was 1.19. In order for the average participant to be more likely to disagree with an item than agree, the item difficulty measure would need to be greater than 3.44. The most difficult item has a difficulty of only 2.92. Therefore, the average participant, for each individual item, is more likely to agree than disagree. Again, this indicates high levels of student-centered teaching being reported by the faculty.

The information from the performance analysis was used to answer Research Question 2, which asks how student-centered the teaching of the faculty of The University of Toledo, as reported by the faculty, is. All indications were that the faculty reported high levels of student-centered teaching. The disagree category was endorsed much less frequently than the agree and disagree categories. Investigations of likely responses to well-targeted items, to the most difficult item, by the least able participant, and by the average participant all indicated high levels of student-centered teaching being reported by the faculty.
5.4   Relationships Between Contextual and Demographic Variables and Student-centered Teaching

5.4.1   Contextual Variables

Research Question 3 asks if there are relationships between contextual variables and levels of student centeredness. Using the ability measures of participants, statistical tests were run to determine the relationship of the ability measures to contextual variables, which had previously been investigated by other researchers. The results of these statistical tests indicated that there were no practically significant relationships between contextual variables and student-centered teaching.

Three contextual variables were investigated: class size, course level, and course discipline. Data for these contextual variables were provided by the participants as they described the course in reference to which they would answer the questions. The relationship of class size to student-centered teaching was examined through a Pearson correlation. The results were not significant, which indicates that there is no relationship between the two variables.

Two tests were run to investigate the relationship of course level to student-centered teaching. The first test was an independent samples t test, comparing the means of participants instructing graduate level courses and those instructing undergraduate level courses. The second test was a one-way analysis of variance. This was similar to the first test, except that the instructors of undergraduate courses were divided into instructors of 1000-2000 level courses and 3000-4000 level courses. Both tests were not significant, indicating no relationship between course level and student-centered teaching.
The relationship between course discipline and student-centered teaching was investigated with a one-way analysis of variance. Participants were asked to indicate the subject area of the course in reference to which they would answer the questions. As had been done in previous studies, the subject areas were then classified as pure soft, pure hard, applied soft, or applied hard following the disciplinary descriptions of Becher (1989). The result of the test was statistically significant, indicating a relationship between discipline and student-centered teaching. However, calculation of the effect size indicated that only 7.8% of variance in the ability measures could be associated with course discipline.

In this analysis, there were large differences in group sizes. Therefore a second one-way analysis of variance was run for which 38 participants from each discipline were randomly selected. This test was statistically significant. However, as with the original one-way analysis of variance, the amount of variance in ability measure associated with course discipline was low: 11.4%. While course discipline and student-centered teaching appear to be statistically related, it is a low-level relationship. Course discipline does not account for enough variance in student-centered teaching to be practically significant.

5.4.2 Demographic Variables

Research Question 4 asks if there are relationships between demographic variables and levels of student centeredness. Using the ability measures of participants, statistical tests were run to determine the relationship of the ability measures to demographic. Four demographic variables were investigated: instructor sex, years of teaching experience, instructor age, and instructor rank. The results of these statistical tests indicated that there
were no practically significant relationships between demographic variables and student-centered teaching.

The relationship of instructor sex to student-centered teaching was investigated through a point-biserial correlation. The result of the test were statistically significant but revealed only a very low correlation, $r_{pb}(240) = -.16$. The coefficient of determination demonstrated that instructor sex accounted for only 2.5% of variance in student-centered teaching. This low amount of associated variance indicated that, while statistically significant, the relationship between instructor sex and student-centered teaching was not practically significant.

The relationship of years of teaching experience to student-centered teaching was investigated through a Pearson correlation. The results were not significant, which indicated that there was no relationship between these variables. A Pearson correlation was also run to examine the relationship between instructor age and student-centered teaching. This test was not significant, indicating no relationship between instructor age and student-centered teaching.

The final demographic variable to be considered was instructor rank. The relationship of instructor rank to student-centered teaching was done by conducting a one-way analysis of variance. The test was not significant; there were no differences between the ability measures of instructors of varying rank. There was no relationship between instructor rank and student-centered teaching.
5.4.3 Course Discipline and Instructor Sex

In the previous statistical tests, two variables were found to have statistically significant relationships with student-centered teaching: course discipline and instructor sex. However, each variable was only associated with a small amount of variance in the participant ability measures. Therefore, they were of no practical significance. An additional test was conducted to determine whether there might be a significant interaction effect between these two statistically significant variables that might account for additional variability in the ability measures.

A two-way analysis of variance was conducted. The participants’ ability measures were the dependent variable. The dependent variables were course discipline and instructor sex. The results of the two-way analysis of variance showed a significant main effect for both course discipline and instructor sex. The effects sizes for these significant main effects were even lower in this analysis than when the variables had been investigated separately. In this analysis, course discipline was associated with 5.1% of variance in student-centered teaching; instructor sex was associated with 0.8%. The interaction effect was not significant.

Considering the results of all the statistical tests, there were no practically significant relationships of contextual variables or demographic variables to student-centered teaching. Two variables were statistically significant. Neither of these variables accounted for enough variance in the ability measures to be considered practically significant.
5.5 Developmental Path

Research Question 5 asked if the construct of student-centered teaching revealed a developmental path that could be useful for training and development in student-centered teaching. The basis for answering this research question is the item separation statistic, which was 9.74. This means that there were between nine and 10 groups of items, with each group being of a lesser or greater difficulty. The items were grouped by item difficulty into 10 groups; see Table 5.3. Group 1 represents the items that were easiest for the participants to endorse. Difficulty progressed, group by group, to Group 10, the most difficult group for participants to endorse.

These groups could be used as developmental stages for professional development in student-centered teaching. This could be done either independently by lone instructors who wish to increase the student centeredness of their teaching or as part of a broader professional development initiative. To illustrate, consider instructors with low levels of student-centered teaching such that the instructors’ ability levels are below the difficulty of Group 1 items. These instructors would then begin a process of progressively incorporating the student-centered teaching indicators into their teaching practice, beginning with Group 1.

Group 1 is represented by only one item: “I actively listen to students.” The instructors would begin actively listening to students. Once the instructors were comfortable with active listening and were ready to increase their student centeredness, they would move on to Group 2, incorporating those indicators into their teaching practice. After the Group 2 indicators had been incorporated into the instructors’ teaching
practice, they would move to Group 3. Training and development would continue until
the instructors reached a satisfactory level of student-centeredness.

The same sequence would occur for instructors who would begin the process
while already teaching in a somewhat student-centered manner, only they would not
begin with Group 1. Instructors would need to identify the group of items that represents
their current level of student centeredness. This would place them at a point along the
developmental path from which they could proceed to becoming more student-centered.

An important consideration is that this suggested developmental path would serve
only as a basis for the design and development of a training and development initiative.
The items describe behaviors, which could be converted into a series of objectives; the
items are not a training program in and of themselves. How to lead instructors from their
current levels of student-centered teaching to increased levels must be designed.
Furthermore, from a systemic perspective, careful consideration must be given to other
aspects of an organization when implementing an intervention. In the case of a university
that would like its instructors to take a more student-centered approach to teaching,
considerations might be, for example, whether there is support from the administration,
whether the instructors are receptive to student-centered teaching, and whether the
proposed changes are aligned with the goals and mission of the university. These are only
suggested considerations and do not represent all the university-wide considerations
which must be made before initiative training initiative is undertaken.
5.6 Conclusion

Two main objectives of this paper were to define student-centered teaching and to create a measure of student-centered teaching. Defining student-centered teaching was based upon the qualitative work of Gilis et al. (2008), who identified indicators of student-centered teaching through interviews with higher education instructors. These indicators were translated into survey items to which instructors were asked to respond. Data collected from these items were analyzed following the Rasch measurement model. The results of the analysis provided the data necessary for developing the construct of student-centered teaching.

At its lowest levels, student-centered teaching involves the manner in which instructors interact with their students. With increased levels of student-centered teaching, instructors have knowledge of their subject area and related areas. Similar levels of student-centered teaching involve the delivery of instruction and self-reflection on teaching practice. From there, a further increase in student-centeredness involves behaviors related to student support, collaborating with colleagues about teaching practice, and course design. The highest levels of student-centered teaching require instructors to collaborate with colleagues to coordinate instruction throughout a subject area or program.

Creating a measure of student-centered teaching was based on the indicators in Gilis et al. (2008). The indicators were translated into 47 items that were used to collect self-reported data from instructors. The results of a Rasch analysis indicated that the data from 34 items fit the requirements of the Rasch model. These items form a data collection instrument that is useful for measuring student-centered teaching based on instructor self-
reports. A short form of the instrument composed of 15 items was also developed; it is equally useful for measuring student-centered teaching.

In addition to defining and measuring student-centered teaching, this paper also contributed to the literature on the relationship of contextual variables and teacher demographic variables to student-centered teaching. Two variables were found to be statistically significantly related to student-centered teaching: course discipline and instructor sex. However, each of these variables was associated with small amounts of variance in student-centered teaching; therefore, they were judged to not be practically significant. No other variables were found to be significantly related to student-centered teaching; the other variables investigated were class size, student level, years of teaching experience, instructor age, and instructor rank.

5.7 Future Research

5.7.1 Misfitting Items

Further research on student-centered teaching is still needed. This paper has defined student-centered teaching based on a qualitative study (Gilis et al., 2008). This qualitative study suggested 15 competencies as part of student-centered teaching, each represented by indicators. This paper, through a Rasch analysis, determined that 13 of the indicators did not produce data that fit the Rasch model, meaning they are not part of the same construct of student-centered teaching as the other items. In addition, all indicators from two competencies were found to not fit to Rasch model, indicating that these competencies are not part of the same construct of student-centered teaching. More
research is needed before definitively stating that these indicators are not a part of student-centered teaching.

5.7.2 Student-centered Teaching from Other Perspectives

The data for this paper were collected from instructors who self-reported on their own teaching. The construct of student-centered teaching that was developed in this paper was based on this self-report data. Student reports on their instructors’ teaching or administrator reports might produce data that lead to different constructs. Future research could look into the differences between an instructor-reported construct of student-centered teaching and a student-reported construct of student-centered teaching.

5.7.3 Non Self-reported Data

On a similar note, the performance analysis conducted in this paper was based on self-reported data, for which the threat of inflated scores exists. There is a danger that participants might have answered in what they believed were socially acceptable ways. To conduct a more thorough performance analysis, additional measurement of the student centeredness of the teaching at The University of Toledo should be conducted. The author suggests, at a minimum, student-reported data and colleague-reported data. These two groups should be able to address all indicators of student-centeredness from the data collection instrument developed in this paper. Students could report on classroom indicators. Colleagues could report on collaborative indicators. The items would need to be altered for each group.
5.7.4 Look Outside of Higher Education

The focus of this study was limited to higher education. Student-centered teaching might take a different form at other educational settings: grade schools, high schools, vocational schools, and so forth. Further research might look into the construct of student-centered teaching in these contexts, examining the similarities and differences.

5.7.5 Student-centered Teaching in Online Environments

This study required participants to be teaching a course that met at least partially face-to-face. Therefore, it is unknown how teaching in a totally online environment might affect student-centered teaching. Future research might address this by investigating whether or not the same construct of student-centered teaching is applicable to online environments or comparing the levels of student-centered teaching in face-to-face and online environments.
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Appendix A

Original Survey Items

Below are the 47 items included in the original survey. Participants were asked to identify the degree to which they agreed with the following statements. Category choices were strongly disagree, disagree, agree, and strongly agree.

1. I actively listen to students.
2. I collaborate in designing a balanced learning environment by consulting with colleagues to align the course components for all courses in this subject at the same level (e.g., 1000).
3. I discuss teaching-related issues with colleagues.
4. I cooperate with students to find solutions to problems.
5. I teach students how to learn.
6. I act as a student coach.
7. I use real-life problems, case-studies, and examples to concretize, model, and structure the subject matter.
8. I make my teaching practice visible for colleagues.
9. I am willing to permanently improve my teaching.
10. I give students adequate feedback on how they are doing throughout the semester.
11. I collaborate in designing a balanced learning environment by consulting with colleagues to understand students' study loads.
12. I question my approach to teaching.
13. I admit to students that I make mistakes and do not know everything.
15. I am convinced that my teaching can be improved.
16. I adjust my teaching approach when necessary.
17. I give the students responsibility for their own education.
18. I explain to students why I teach the way I do.
19. I place my teaching approach within the larger framework of my students' education.
20. When planning, I reflect on what might happen during my class.
21. I know of developments in this subject area and am able to incorporate the relevant developments in this class.
22. I listen to and communicate with students.
23. I am open and empathetic toward students.
24. I am aware of my students' learning approaches and follow-up with students whose approaches could be improved to produce better learning outcomes.
25. I discuss problems and ways to improve my teaching with colleagues.
26. My grading process is very transparent to students.
27. I give feedback to colleagues and receive feedback from them.
28. I leave room for student input in determining subject matter and structure.
29. When preparing for my class, I place myself in the position of the students.

30. When preparing lessons, I consider how students have reacted to previous educational experiences.

31. I stimulate cooperation among students.

32. I accommodate different learning styles by using a variety of teaching methods and learning materials.

33. I create an environment that facilitates learning.

34. I cooperate with colleagues about the course content and student performance.

35. I collaborate in designing a balanced learning environment by consulting with colleagues to ensure students are taught with a variety of teaching methods.

36. I evaluate my teaching approach.

37. I recognize students' studying problems and offer them support.

38. I reflect on my teaching approach and make adjustments when necessary.

39. I am open to colleagues' opinions regarding teaching-related issues.

40. I collaborate in designing a balanced learning environment by consulting with colleagues to ensure that my class is aligned with courses in this subject which my students have already taken and will go on to take.

41. I am open to student signals about the appropriateness of my teaching approach.

42. I develop activating support (e.g., content, teaching method, learning materials) and evaluation.

43. I instruct and guide students but leave them responsible for their educations.

44. I design course components adapted to students' characteristics.

45. I know how my course is relevant for the subject area and the profession.
46. I challenge and motivate students.

47. I know content matter from areas related to the curriculum and am able to judge the relevance for my own teaching.
Appendix B

34 Survey Items Fitting the Rasch Model

Below are the 34 items from the original survey which fit the Rasch model; numbering reflects the original item number (see Appendix A). Participants were asked to identify the degree to which they agreed with the following statements. Category choices were strongly disagree, disagree, agree, and strongly agree.

1. I actively listen to students.
2. I discuss teaching-related issues with colleagues.
3. I cooperate with students to find solutions to problems.
4. I use real-life problems, case-studies, and examples to concretize, model, and structure the subject matter.
5. I make my teaching practice visible for colleagues.
6. I am willing to permanently improve my teaching.
7. I collaborate in designing a balanced learning environment by consulting with colleagues to understand students' study loads.
8. I critically evaluate proposed new ways of teaching.
9. I adjust my teaching approach when necessary.
18. I explain to students why I teach the way I do.

19. I place my teaching approach within the larger framework of my students' education.

22. I listen to and communicate with students.

23. I am open and empathetic toward students.

24. I am aware of my students' learning approaches and follow-up with students whose approaches could be improved to produce better learning outcomes.

25. I discuss problems and ways to improve my teaching with colleagues.

27. I give feedback to colleagues and receive feedback from them.

29. When preparing for my class, I place myself in the position of the students.

30. When preparing lessons, I consider how students have reacted to previous educational experiences.

31. I stimulate cooperation among students.

32. I accommodate different learning styles by using a variety of teaching methods and learning materials.

33. I create an environment that facilitates learning.

34. I cooperate with colleagues about the course content and student performance.

35. I collaborate in designing a balanced learning environment by consulting with colleagues to ensure students are taught with a variety of teaching methods.

36. I evaluate my teaching approach.

37. I recognize students' studying problems and offer them support.

38. I reflect on my teaching approach and make adjustments when necessary.

39. I am open to colleagues' opinions regarding teaching-related issues.
40. I collaborate in designing a balanced learning environment by consulting with colleagues to ensure that my class is aligned with courses in this subject which my students have already taken and will go on to take.

41. I am open to student signals about the appropriateness of my teaching approach.

42. I develop activating support (e.g., content, teaching method, learning materials) and evaluation.

44. I design course components adapted to students' characteristics.

45. I know how my course is relevant for the subject area and the profession.

46. I challenge and motivate students.

47. I know content matter from areas related to the curriculum and am able to judge the relevance for my own teaching.
Appendix C

15 Short Form Survey Items

Below are the 15 items from the short form survey; numbering reflects the original item number (see Appendix A). Participants were asked to identify the degree to which they agreed with the following statements. Category choices were strongly disagree, disagree, agree, and strongly agree.

1. I actively listen to students.

7. I use real-life problems, case-studies, and examples to concretize, model, and structure the subject matter.

9. I am willing to permanently improve my teaching.

11. I collaborate in designing a balanced learning environment by consulting with colleagues to understand students' study loads.

16. I adjust my teaching approach when necessary.

23. I am open and empathetic toward students.

25. I discuss problems and ways to improve my teaching with colleagues.

31. I stimulate cooperation among students.
32. I accommodate different learning styles by using a variety of teaching methods and learning materials.

34. I cooperate with colleagues about the course content and student performance.

35. I collaborate in designing a balanced learning environment by consulting with colleagues to ensure students are taught with a variety of teaching methods.

42. I develop activating support (e.g., content, teaching method, learning materials) and evaluation.

44. I design course components adapted to students' characteristics.

46. I challenge and motivate students.

47. I know content matter from areas related to the curriculum and am able to judge the relevance for my own teaching.