Achievement goal orientation of community college mathematics students and the misalignment of instructors' perceptions

Vilma Mesa

University of Michigan

Annual Meeting of the American Educational Research Association

New Orleans, April 2011

3111 SEB School of Education
610 East University Ann Arbor MI 48109-1259
e-mail: vmesa@umich.edu
phone: 734 647 0628

Author note: This work has been funded in part by the National Science Foundation through award DRL 0745474. Opinions are those of the author. Special thanks to Andrea Parker for assisting with the research reported here and to the members of the Teaching Mathematics in Community Colleges research group at the University of Michigan.

Achievement goal orientation of community college mathematics students and the misalignment of instructors' perceptions

Abstract

This study reports findings regarding the application of a survey of achievement goal orientations to a sample of mathematics 777 students enrolled in remedial and college mathematics courses at a community college. The survey was based on the Patterns of Adaptive Learning Scales [PALS] and it included questions from the Views About Mathematics Survey [VAMS]. Interviews with faculty teaching these students gave us their perceptions of how their students would score in the scales measured with the survey. Survey results indicate that students' achievement goal orientations are consistent with adaptive learning patterns: students are interested in developing competence, expect and believe they can handle challenging work, avoid self-handicapping behaviors, and exhibit a positive mathematics self-concept. Interviews reveal that instructors perceive that their students are more concerned with external judgments regarding their ability and less interested in developing competence, that they engage in self-handicapping behaviors, have a poor sense of their own capacity to do the work, routinely press for reducing challenge in the classroom, and have a low mathematics self-concept. In addition, students in remedial classes and their instructors hold more positive perceptions than students and instructors of college classes. These discrepancies suggest that instructors might benefit from learning the goal orientations that community college mathematics students have, so they can take advantage of the high confidence and motivation to learn that their students bring to the mathematics classroom.

Key words: achievement goal orientations, community colleges, mastery goals, performance goals, academic self-efficacy, academic pressure, self-handicapping behaviors,

mathematical self-concept

Earning a college degree is becoming more prominent in the national discourse (Office of the Press Secretary, 2010) as it has been associated with high paying jobs and increased levels of health, wealth, and civic participation (Baum & Ma, 2007; Baum & Payea, 2005; Dowd, et al., 2006). The rising costs of higher education have made the community college an important institution in our educational landscape. In fact, one out of two undergraduate students were enrolled in a community college in 2003 (Lutzer, Rodi, Kirkman, & Maxwell, 2007) and the trend is increasing. Simultaneously, there is a pressing concern that the U.S. is lagging behind other countries in maintaining a science technology engineering and mathematics [STEM] workforce that can handle the needs of our society (Committee on Science Engineering and Public Policy, 2007). At the core of these concerns is the need to ensure, first, access to higher education programs, in particular to the STEM fields, second, retention in those programs, and finally, success, understood as graduation within a certain number of years. Community colleges can make an important contribution, yet the transfer rates from community colleges to STEM fields is low (Phillippe & Gonzalez Sullivan, 2005).

Whereas there is substantial documentation on how community college student characteristics such as age, prior achievement, ethnicity, and patterns of course taking, including whether they require remediation or not, are related to retention and success (Adelman, 2005; Feldman, 1993; Goldrick-Rab, 2007; Pascarella, Wolniak, Pierson, & Terenzini, 2003; Stigler, Givvin, & Thompson, 2010; Waycaster, 2001) there is little research on the factors associated with mathematical instruction that can be closely related to questions of retention and success in community colleges (Mesa, 2007), particularly in connection to STEM fields. In other studies, our group has attended to the opportunities to learn mathematics that are generated in community colleges mathematics classrooms, by looking at how students and teachers discuss mathematical content (Mesa, 2010b, accepted; Mesa & Herbst, 2011) and by analyzing textbook content (Mesa, 2010a; Mesa & John, 2009; Suh, Mesa, Blake, & Whittemore, 2010a, 2010b). In this paper I present another aspect regarding the opportunities to learn that can be afforded in the classroom, namely, the match between what community colleges students indicate their goals and orientations towards learning are, and their instructors perceptions of those goals. This is an important aspect because research on learners' attributions of their ability to learn (intelligence as a fixed characteristic or dependent on effort) and the types of achievement goal orientations they bring suggests that such attributions have a direct impact on learning and classroom work (Bruinsma, 2004; Dweck, 1986; Meece, 1991) because teachers can fundamentally change students' orientations towards learning (Friedel, Cortina, Turner, & Midgley, 2010).

The lack of information about community college mathematics students' achievement goal orientations, together with perceptions that community colleges student bring unclear or conflicting goals towards learning (Cox, 2009; Mesa, 2008; Seidman, 1985; Wheeler & Montgomery, 2009) prompted this study. Using scales of the Patterns of Adaptive Learning Scales [PALS] (Midgley, Maehr, Hruda, Anderman, & Others, 2000) and scales from the Views About Mathematics Survey [VAMS], I sought to establish community college mathematics students' achievement goal orientations and their instructors' perceptions of those orientations.

This study contributes to our understanding of the nature of mathematics instruction in community colleges and opens the path to further investigations on the ways in which instruction can promote student success in community colleges. In the next section I provide the theoretical background that supports the investigation together with a synthesis of the literature on students' goals. That section is followed by a description of the methods used and the main findings. In the discussion section I present interpretations for those findings and conclude with suggestions for further work.

Background

This study is framed under a goal theory model of achievement motivation proposed by Maehr and colleagues (Anderman & Maehr, 1994; Anderman & Midgley, 1997; Kaplan & Midgley, 1999) which states that students' beliefs about their efficacy in learning are predicted by their personal achievement goals, which are immersed in sociocultural contexts and are the result of prior and current experiences in those contexts (Friedel, et al., 2010). In achievement goal theory, achievement goal orientations refer to students' reasons or purposes for engaging in academic behavior together with the standards used to assess performance (Friedel, et al., 2010; Meece, Blumenfeld, & Hoyle, 1988; Midgley, et al., 2000). The achievement goal framework includes two types of goals—a mastery goal orientation and a performance goal orientation (Dweck & Leggett, 1988; Meece, 1991). A mastery goal orientation is characterized by a drive to develop competence, and extend mastery and understanding with learning perceived as an end on itself with judgment of performance "in terms of improvement over time or progress relative to an absolute standard" (Friedel, et al., 2010, p. 103; Midgley, et al., 2000). On the other hand, performance goal orientation is characterized by interest in demonstrating ability or the ease with which a task can be done relative to performance by others as a measure of success (Muis, Winne, & Edwards, 2009). Substantial research has been conducted to establish the connection between each type of goal (mastery or performance) and educational outcomes such as academic performance, cognitive engagement, self-efficacy, affect, test anxiety, and help-seeking behaviors. Positive associations have been found between mastery goals and learning-related outcomes such as self-regulation, self-efficacy, interest, positive affect, help seeking, emotional well-being, persistence, and transfer (see Ciani, Ferguson, Bergin, & Hilpert, 2010; Muis, 2004; Muis, et al., 2009). Individuals with a mastery orientation, as compared to performance orientation, are less likely to react defensibly in the face of failure or other difficulties and more likely to pursue challenging tasks (Ciani, et al., 2010, p. 379).

Goal theory highlights that contexts play an important role in developing ones' goals, in particular, that students "are sensitive to the emphasis teachers place on different types of achievement goals as expressed through instructional practice and the ways in which teachers respond to students' accomplishments or shortcomings" (Friedel, et al., 2010, p. 103). Not only can students reliably identify when their teachers foster a competitive versus a cooperative classroom or if the teacher focuses on individual improvement rather than on ability relative to others, students' espoused beliefs are strongly shaped by their teacher behaviors (Ames, 1992; Anderman & Midgley, 1997; Church, Elliot, & Gable, 2001; Meece, 1991; Middleton, Kaplan, & Midgley, 2004; Patrick, Anderman, Ryan, Edelin, & Midgley, 2001; Turner, Thorpe, & Meyer, 1998; Urdan & Schoenfelder, 2006).

These studies have shown more specifically that when teachers are perceived as focusing on performance, their students' sense of self-efficacy declines, as do their orientations towards mastering content. In addition it has been shown that when students perceive teachers emphasize mastery their perceptions of self-efficacy increase which in turn results in an increase of students' mastery goal orientation (Friedel, et al., 2010).

Although the literature is very consistent regarding these findings, most of the studies base their conclusions on middle- or high-school students and on one specific aspect of goal orientation, self-efficacy. Two studies have focused on college students and merit a more elaborated description here. Carmichael and Taylor (2005) studied the self-efficacy of adult students (median age 29 years) enrolled in a college mathematics preparatory course at the University of Southern Queensland to determine whether motivation could be a factor determining student success in this course. The course has an average enrollment of 800 students per semester and includes students with non-traditional backgrounds and with negative past experiences about mathematics. Attrition and failure in this course are quite high (an average of 30% of students withdraw each semester; between 40% and 45% fail the course, p. 716). The authors speculated that low motivation could explain the high attrition and failure; using the Motivation and Self-regulated Learning Questionnaire (Pintrich & DeGroot, 1990) with a sample of 120 students, they found a very moderate effect of these scales on student achievement, suggesting either that they had a too small a sample or that for this particular population of students, there might be other variables at play. For example, they reported that female students had lower levels of confidence than males but that there was no difference between the academic performances of these two groups; a similar finding is reported for students who have interrupted their post-secondary studies when compared to students who started post-secondary education immediately after graduating from high school.

Hall and Ponton (2005) compared the self-efficacy reported by students in calculus to those of students placed in remedial mathematics (intermediate algebra) at the University of Mississippi. Using a revision of the Mathematics Self-Efficacy Scale (Betz & Hackett, 1993) they found that students in calculus reported higher levels of self-efficacy than students placed in the remedial course. They found no effects by gender. The authors explain the differences in terms of the assumed past experiences that students placed in remedial courses might have had, indicating that these students' lack of exposure to mathematics could explain their lower sense of self-efficacy because "it is difficult for students to objectively evaluate themselves on topics for which they have little knowledge" (p. 28). Although Hall and Ponton also suggest that teachers of remedial courses are under greater pressure to make their students succeed, given the connection between math courses taken and success, they do not provide evidence for this statement.

Studies on motivation are based on self-reported measures collected via surveys. This approach makes sense, given that the interest in establishing students' perceptions about their learning and their environment. It has been determined that students' ratings of teachers' behaviors are consistent with practice (e.g., Patrick, et al., 2001), thus providing a balanced view of students' perceptions of their learning environment. Missing from the literature, however, are inquiries regarding instructors' perceptions of their students' goal orientations. A common theme in the literature on school reform in mathematics is that teachers are usually unaware of the resources—cognitive, personal, and cultural—that students bring to class (Cohen, Raudenbush, & Ball, 2003). When teachers are aware of the resources their students bring, they can plan lessons that are more effective and that involve all students, especially minorities, with authentic learning (Civil, 1996, 1998; Fennema, Carpenter, Franke, & Carey, 1992; Fennema, Franke, Carpenter, & Carey, 1993; Khisty, 1995; Ladson-Billings; Moll, et al., 1990). Students' goal orientations are a type of personal resource and teachers can capitalize on it as they teach.

Because the literature is mostly based on school-aged children we sought to fill a gap in our understanding of goal orientation in a community college setting. In addition, we augment the information with teachers' perceptions of their students' orientations. In this study I asked the following questions:

1. What are the achievement goal orientations of students enrolled in remedial and non-remedial mathematics courses at a community college?

2. Are there differences in achievement goal orientations between students taking remedial mathematics courses and students taking college mathematics courses?
3. What are teachers' perceptions of their students' achievement goal orientations?
4. Are there differences between remedial courses teachers' perceptions of their students' described achievement goal orientations and college courses teachers' perceptions?

Methods

Sampling

The survey is part of a larger study that seeks to characterize community college mathematics instruction. The data for this study come from a sample of 777 students enrolled in remedial and college mathematics courses taught at a large suburban community college in the Midwest. The mathematics department in the college is similar to other mathematics departments in large community colleges in the United States in terms of courses offered (e.g., remedial, college preparatory, courses for professional and technical careers), proportion of students in the college enrolled in the department (45%), class size (~22 students per class), and composition of the faculty (75% are part-time faculty, E Community College, 2010; Lutzer, et al., 2007). The study was approved by the Institutional Review Boards of both institutions. During an in-service teacher meeting prior to the data collection, an invitation to take part of the study was extended to all instructors in the department who were teaching an entry-level course, remedial or college preparatory course (i.e., courses at the level of calculus and beyond were excluded, because the focus of the study was on courses that could lead to a STEM major). Twenty-five instructors, four of them full-time, consented to participate and gave the survey to the students in the courses they were teaching. The survey, which took between 15 and 20 minutes to complete, was administered to 40 sections of 10 courses between Fall 2009 and Fall 2010, about six weeks after the semester had started (see Table 1). The courses were offered at different times of the day (from 8:30am to 9pm) and at different days of the week (Monday through Saturday), thus including a wide range of students taking courses in the college; this is important because instructors perceive that there are "different colleges," meaning different students who take courses at different times of the day. Of 852 surveys collected, 75 (9%) were not analyzed because of incomplete responses (e.g., less than 15% of items responded) or large number of invalid answers (over 50% of items had more than one response).

Table 1: Courses and Sections Surveyed.

Name	#Sections Surveyed	Type of course
Foundations of Mathematics	6[a]	Remedial
Foundations of Algebra	12[b]	Remedial
Intermediate Algebra	4	Remedial
Everyday College Math	2	College Level
Functional Math for Elementary Teachers	3	College Level
Math Applications for Health Science	1	College Level
College Algebra	2[c]	College Level
Trigonometry	8[d]	College Level
Pre-calculus	2[e]	College Level
Total	40	

Note: Twenty-five different instructors administered the survey in their courses. a. 1 section taught by a full-time instructor. b. 2 sections taught by two full-time instructors. c. 2 sections taught by a full-time instructor. d. 4 sections taught by two full-time instructors. e. Both sections taught by a full-time instructor.

Sixty nine percent of student respondents were Caucasian, 51% were female, 48% were between 18 and 21 years old, 16% were between 22 and 24 years old, 30% were between 25 and

45 years old, and 5% were older then 45 years. The proportions for ethnicity and gender are similar to those of the college. The proportions for age in our sample differ from those in the college; the proportion of students in the 18-21 age group is larger than the overall proportion of the school. In our sample, the majority of the students (68%) are single and the majority reports not taking care for children or family members (75%). About one fifth of the students sampled do not work in a paid job. As it can be expected, a large proportion of students have achieved a degree up to a high-school diploma and a large proportion expect to transfer (about 80%). Personal funds, Loans, and Grants are important sources for funding, although it is notable that about two fifths of the sampled students receive help from their families. About one fifth of students (18%) reported that they have repeated a math course in college and 41% of the sample was taking a remedial course (see Table 2).

Table 2: Frequency and percent of students in the sample by gender, age, marital status, ethnicity, hours of employment, level of education, academic goals, sources of funding, course repetition, and remediation.

Characteristic (N of responses)	n	%
Female (768)	392	51
Age (768)		
18-21 years old	369	48
22-25 years old	123	16
26-45 years old	230	30
46 and over	38	5
Marital status (766)		
Single	521	68
Married or marriage-like relationship	207	27
Number of caregiver (777)		
Not a caregiver	583	75

Characteristic (N of responses)	n	%
Caregiver for 1 or 2 persons	117	15
Caregiver for 3 or more persons	78	10
Ethnicity (542)		
Caucasian	374	69
Non-Caucasian	114	21
Hours of employment (751)		
Not employed	158	21
1-20 Hours per week on paid job	158	21
21-40 hours per week on paid job	323	43
More than 40 hours per week on paid job	113	15
Level of education[a] (756)		
High-school or less	522	69
Some college or Associate's degree	212	28
Bachelor's or more	234	31
Goals[a] (764)		
GED	15	2
Associate's degree	252	33
Transfer	604	79
Technical Certificate	53	7
Career Change	107	14
Enrichment	115	15
Sources of Funding (minor or major)[a]		
Own (393)	287	73
Family (355)	142	40
Employer (332)	60	18
Grants (383)	245	64
Loans (370)	207	56
Public Assistance (326)	46	14
Repetition and Remediation		
Repeated college course? (758)	136	18

Characteristic (N of responses)	n	%
Taking a remedial course? (777)	319	41

Note: a. Percentages with the category do not add to 100 because students could choose more than one option.

The respondents indicated that they had taken about 2 college math courses ($M = 1.91$, SD = .74) and reported a better experience with mathematics in college than in high school ($t(524) = 10.22$, $p < .001$, see Table 3).

Table 3: Mean and Standard Deviation of Academic Variables

Variable	N	Mean	SD
Number of College Math Courses	762	1.91	.740
Math Experience before College	565	3.23	1.36
Math Experience in College	534	3.91	.999

Twenty-one percent of students enrolled in a college course were taught by a full-time instructor, whereas part-time instructors taught 38% of these students. These proportions are aligned with reports of the distribution of instruction between full- and part-time instructors at community colleges that indicate that full-time mathematics instructors in general tend to teach more college courses than remedial ones (Lutzer, et al., 2007). Because the sampling excluded more advanced college courses, full-time instructors taught fewer students in the sample taking college courses (see Table 4).

Table 4: Frequency and percent of responses by type of course and instructor status.

	Instructor Status		
Course	Part-time	Full-Time	Total
Remedial Courses	259 (32%)	65 (8%)	315 (41%)
College Courses	296 (38%)	166 (21%)	462 (60%)

Total	546 (70%)	231 (30%)	777

Note: percentages do not add up to 100 due to rounding.

Instrument

From the original 20 scales included in the PALS survey, we selected seven (Student Mastery, Student Performance, Teacher Mastery, Teacher Performance, Academic Press, Self-Efficacy, and Self-Handicapping Behaviors) that were relevant to our study. We did not include three scales that asked students about their perceptions of the classroom goal structure (e.g., "in our class, getting good grades is the main goal"), six about academic beliefs (e.g., cheating), and four about their parents, home life, and neighborhood (e.g., "my parents want my work to be challenging to me"; "I don't want my parents come to school because their ideas are very different from my teacher's ideas"). Some items referred to a year-long course and we modified those to reflect the semester-long nature of the courses at the college. The PALS items were rated on a 1-5 Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

The PALS survey is non-content specific. Because our interest in students' perceptions about mathematics we included 17 items associated with four scales, adapted from the Views About Mathematics Survey [VAMS] (Carlson, 1999). These scales, Mathematics Self-Concept, Attitudes Towards Problem Solving, Talent, and Effort, were intended to measure perceptions of behaviors associated with success in mathematics (Table 5). The VAMS items were adapted to reflect the same 1-5 Likert scale of the other PALS items. The survey included 11 items on student demographic (gender, ethnicity, age, marital status) and background information (prior experience with mathematics courses, number of college mathematics courses, repetition, academic goals, work status, and funding). In all, the survey had 71 items and took between 15 and 20 minutes to complete (see Appendix 1 for the full list of items). All surveys were administered at the beginning of class.

Table 5: Scales Description and Reliability.

Scale	Description	# Items	Reliability Cronbach's α
Student Mastery	Students' purpose or goal is to develop their competence. They seek to extend mastery and understanding	5	.844
Student Performance	Students' purpose is to demonstrate competence or avoid demonstrating incompetence; focused on the self.	7	.880
Teacher Mastery	Students' perceptions that their teachers' goals are oriented towards mastery	5	.802
Teacher Performance	Students' perceptions that their teachers' goals are oriented towards performance	6	.828
Academic Press	Students' perceptions that their teachers press them towards challenging work and thinking	7	.810
Self-Efficacy	Students' perceptions that they can do academic work	5	.831
Self-Handicapping Behaviors	Students' perceptions that they engage in behaviors that can reduce their opportunities for success in college	6	.847
Mathematics Self-Concept	Students' self image as mathematics learners. A low score represents positive self-image and a high score represents negative self-image.	5	.767
Attitudes Towards Problem Solving	Students' engagement in productive mathematical problem solving patterns.	6	.592

Scale	Description	# Items	Reliability Cronbach's α
Talent	Students' perceptions that talent is needed for succeeding in mathematic	3	.564
Effort	Students' perception that effort is needed for succeeding in mathematics	3	.545

Because of the adaptation of the items in the survey, we conducted a Confirmatory Factor Analysis to ensure that the items were loading accordingly. After generating the factors we analyzed the internal consistency of the reliability of the scores within each scale using Cronbach's alpha, which estimates the proportion of the true score variance that is captured by the items in the scale. All, but four items were kept within their scales (see Appendix 1). The Cronbach's alpha of the PALS adapted scales (Table 5) were within the ranges reported by Midgley and colleagues, .71 to .89 (e.g., Anderman & Midgley, 2004; Midgley, et al., 2000) and thus, the data gathered by the instrument were considered suitable for analysis. The original VAMS instrument does not have information on scale reliability. The factor analysis confirmed the original constructs, but we decided to keep scales with Cronbach's alphas greater than .70, which resulted in the exclusion of three VAMS scales (Attitudes Towards Problem Solving, Talent, and Effort) from the analysis.

In order to generate the scales, we averaged the items within each scale, reversing items to maintain the direction of the responses. The scores obtained followed similar trends as those given in the literature (e.g., Friedel, et al., 2010; Muis, et al., 2009) which gave more confirmation about the suitability of the measures (see Table 6).

We calculated correlations between the scales in order to make sure that these were in the expected directions (Table 6).

Table 6: Descriptive statistics and Pearson correlations for the scales of interest (N = 777[a]).

	Student Variables	1	2	3	4	5	6	7	8
1	Student Mastery	-							
2	Student Performance	0.03	-						
3	Teacher Mastery	.43**	0.01	-					
4	Teacher Performance	-.14**	.36**	-.13**	-				
5	Academic Self-Efficacy	.49**	-0.02	.51**	-.16**	-			
6	Self-Handicapping Behavior	-.22**	.29**	-.11**	.44**	-.18**	-		
7	Academic Press	.42**	.12**	.66**	-0.04	.41**	-0.03	-	
8	Math Self-Concept	-.29**	.25**	-.16**	.34**	-.37**	.45**	-0.05	-
	Mean	4.23	2.67	3.97	2.00	4.15	2.16	3.75	2.58
	SD	.59	.80	.60	.70	.63	.82	.56	.53

Note: a. N = 489 for Math-Self Concept, because the question was omitted in some surveys.

**. Correlation is significant at the 0.01 level (2-tailed).

Analysis

I performed five different analyses with the survey data in order to answer each of the four research questions. To establish community college students' achievement goal orientations, we estimated 95% confidence intervals for each of the means in the scales (Analysis 1). To determine whether there are differences in achievement goal orientations between students taking remedial math courses and students taking college courses, we conducted independent samples comparison using Mann-Whitney-Wilcoxon tests of differences between the median scores in remedial and college courses for each of the scales. This test is preferred over the standard t-test, because the median captures better the nature of responses in the survey (Analysis 2)[1]. To answer the third question, regarding teacher's perceptions of their students' described achievement goal orientations, I calculated independent samples t-tests of the

[1] There is no difference between the t-test or the Mann-Whitney-Wilcoxon results. We are following advice from reviewers, regarding the appropriate test for the data we collected.

difference between students' scores and instructors' predictions, for each of the scales using the full sample (Analysis 3a), and repeated this analysis by type of course, that is, contrasted the responses by remedial students and their teachers, and college courses and their teachers (Analysis 3b). Finally, to answer the fourth question, regarding differences between college course instructors' perceptions and remedial course instructors' perceptions, I conducted independent samples t-tests of these differences (Analysis 4).

Instructors' Interviews

Instructors were invited to discuss the results of the survey applied in their courses. Fifteen out of the 25 instructors agreed to be interviewed; two of them were full-time instructors and seven were teaching college level courses (see Table 7). During the interview, before showing the aggregated scores for their courses, each instructor was asked to predict the score that his or her students, as a group, would give to each of the scales and to give a justification for the prediction. After the predicted scores for all scales were recorded, instructors received the scores for their groups of students. They were then asked to comment on the scores and the similarities and differences between the scores they assigned and those of their students. These interviews were audio-recorded and relevant portions (those related to the anticipated scales and those related to their reasons for the differences) were transcribed. The instructors' anticipated scores were collected into a spreadsheet and used for the comparison with the scores obtained from their students' surveys. Verbatim quotes from the interviews are used in this paper to present instructors' perspectives. No further interpretation was conducted, and thus inter-rater reliability for this portion of the analysis was not considered necessary.

Table 7: Courses taught by the 15 interviewed instructors.

Course (Type)	Instructor
Foundations of Mathematics (R)	E5, E22, E28*
Foundations of Algebra (R)	E5, E11, E12, E14, E22, E28*
Intermediate Algebra (R)	E3, E6, E10
Everyday College Math (C)	E14
Functional Math for Elementary Teachers (C)	E9, E15
Math Applications for Health Science (C)	-
College Algebra (C)	E27*
Trigonometry (C)	E21, E29, E30
Pre-calculus (C)	-

Note: * Denotes a full-time instructor.

Results

I present the results of each type of analysis conducted.

Community college students' achievement goal orientations (Analysis 1)

Table 8 shows the means, standard deviations, and lower and upper bounds for the estimate of the values of the scales. First it is important to notice that none of the intervals include the score of 3, which would be a hypothetical score indicating neutrality regarding the measured scale. The results suggest that the measures are indeed not neutral, thus representing strong views from the students. The students in this sample rated the mastery scales higher than the performance scales. These ratings were consistent across all subgroups (gender, age, ethnicity, marital status, work and education levels, goals, funding, and type of course) and they were in the expected direction. That is, students' goals are oriented towards developing competence and understanding, rather than to attending to external judgments regarding their ability, an orientation that has been associated with higher student academic achievement

(House, 2006). These results are further confirmed with the ratings of Academic Self-Efficacy, Self-Handicapping Behaviors, and Academic Press: students indicate that they believe that they can master the material and work hard, that they tend not to engage in self handicapping behaviors, and that they expect their teachers to press them to do challenging work. In addition, the score in Mathematics Self-Concept indicates that students have a better than neutral perception of their own ability to do mathematical work. These results are also similar when analyzing the sample by gender, age, ethnicity, marital status, work and education levels, goals, funding, and type of course.[2]

Table 8: Confidence intervals for the scales ($N = 777^{a}$).

Scale	Mean	SD	Lower Bound	Upper Bound
Student Mastery	4.23	0.59	4.19	4.27
Student Performance	2.67	0.80	2.62	2.73
Teacher Mastery	3.97	0.60	3.93	4.01
Teacher Performance	2.00	0.70	1.95	2.05
Self-Efficacy	4.15	0.63	4.11	4.20
Self-Handicapping Behaviors	2.16	0.82	2.10	2.22
Academic Press	3.75	0.56	3.71	3.79
Mathematics Self-Concept	2.58	0.53	2.53	2.63

Note: a. Only 489 students had valid data for the Math Self-Concept scale, as it was omitted from some surveys.

[2] Specific results are available upon request.

Differences in achievement goal orientation, Remedial and College courses (Analysis 2)

Table 9 shows the students' scores and standard deviations of the assessed scales by type of course in which the students were enrolled.

Table 9: Scale Ratings for the full Sample and by Type of Course (Remedial and College)

Scale	Total Sample (n = 777[a])	Remedial Courses (n = 315)	College Courses (n = 462)
Student Mastery	4.23 (.588)	4.33 (.557)	4.16 (.599)***
Student Performance	2.63 (.801)	2.72 (.809)	2.63 (.794)
Teacher Mastery	3.97 (.599)	4.11 (.560)	3.87 (.605)***
Teacher Performance	2.00 (.698)	2.09 (.733)	1.94 (.665)**
Self-Efficacy	4.15 (.626)	4.21 (.561)	4.11 (.649)*
Self-Handicapping Behaviors	2.16 (.530)	2.16 (.876)	2.16 (.773)
Academic Press	3.75 (.562)	3.86 (.519)	3.67 (.577)***
Mathematics Self-Concept	2.58 (.530)	2.58 (.525)	2.58 (.536)

Notes: *: The Mann-Whitney-Wilcoxon test of the difference between the median scores in remedial and college courses is statistically significant, $p < .05$; **$p < .01$; ***$p < .001$. a. Only 489 students had valid data for the Math Self-Concept scale.

Students taking remedial courses rated their orientations towards mastery, their sense of self-efficacy, and their interest in being challenged to think and work hard higher than students taking college courses; they also rated their teachers as exhibiting an orientation towards mastery and performance higher than students in college courses. These results portray students taking remedial mathematics courses as highly motivated towards success and more motivated than students who are taking more advanced courses.

Teachers' perceptions of their students' achievement goals (Analysis 3a).

Instructors' predictions of how their students would rate the scales differed for all of them (Table 10). Instructors rated their students' orientations towards mastery, their perception of teachers' goals towards performance, their inclination to accepting press for challenging work, their sense of academic self-efficacy *lower* than what students did. In addition, by rating their students' self-concept in mathematics higher, teachers indicated a more negative perception of students' self concept in mathematics than what their students did.

Table 10: Mean and Standard Deviation of Students' Scores and of Instructors' Predictions

Scale	Students' Scores	Instructors' Predictions
Student Mastery	4.23 (.588)	**3.64 (.544)** ***
Student Performance	2.63 (.801)	3.21 (.819) ***
Teacher Mastery	3.97 (.599)	4.10 (.394) **
Teacher Performance	2.00 (.698)	**1.90 (.712)** **
Academic Self-Efficacy	4.15 (.626)	**3.22 (.673)** *
Self-Handicapping Behaviors	2.16 (.530)	2.66 (.696) ***
Academic Press	3.75 (.562)	**3.67 (.348)** ***
Mathematics Self-Concept	2.58 (.530)	3.14 (.839) ***

Notes: The t-test of difference between students' scores and instructors' mean predictions is statistically significant, * $p < .05$; ** $p < .01$; *** $p < .001$. Bolded entries indicate lower instructors' predictions than students' scores.

For example, referring to the Student Mastery scale, a full-time instructor said prior to seeing the results of his classes:

> They don't care if they understand it, as long as they can do it and get a good grade on the test. But at the same time, they may interpret as wanting to understand it may be a stress-reliever for them… so much of their dislike of mathematics has to do with anxiety. So I'm sure if they understood it, they'd be less anxious and maybe they wouldn't hate it so much. (…) I don't think there's a lot of internal intrinsic motivators in a lot of my students. I think they're

> motivated by getting a good grade […], a good enough grade that they can keep their financial aid. That is a motivator for my students. (E28)[3]

Referring to the Teacher Performance scale, one part-time instructor who rated the scale as a 1, said, "I don't do any of these things; I don't rank, and I don't compare among students. These are all negative perceptions and I don't encourage them." (E15)

Regarding Academic Press, one part-time instructor who rated the scale with a 3.5 said:

> Some students in [second remedial course] wanted to move beyond the class but with the short amount of time available I wanted them to understand the material instead; so I wasn't pushing them to press the understanding of all the students just for the benefit of one single student. (E14)

A part-time instructor who was teaching the second remedial course in a sequence of two, rated Self Efficacy with a 3, saying

> This class is [the second remedial course]; they have taken [the first remedial course] and had learned the process of how to take class; had done that in the last semester so [they] have a better feeling of how to handle college work. They know more about help available for them in the college; if it were Fall, they would probably had forgotten from the spring, though. (E12)

One part-time instructor who was teaching two remedial courses, one prerequisite for the next, and rated the Mathematics Self-Concept, at 3.0 and 3.2 for each course, and said:

> I have so many students say they hate math! [In the first remedial course] they are more likely to give up. They did not want to do the problems more than

[3] Instructors are identified with a letter and a number.

> one way; they are more frustrated. But confidence is more of an issue in the [first remedial course] than in [the second]. (E22)

Simultaneously, instructors predicted their students' orientations towards performance, their perception of teachers' goals towards mastery, and their engagement in self-handicapping behavior higher than what students did. For example, referring to the Student Performance scale, a part-time instructor who rated it as a 4.1 said:

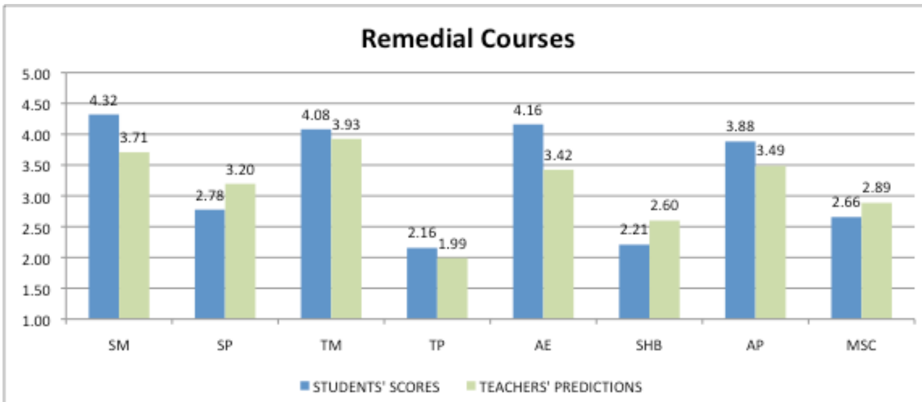
> Well they are competitive, they want to look good, when was this? Not sure I had had the time to impress in them the teaching philosophy I [have]; it was too early in the term, perhaps? [interviewer mentioned it was before midterm] well… no student wants to think they are dumber or for his or her teacher to think that. (E6)

Regarding Teacher Mastery, one part-time instructor who rated the scale with a 4.0, said, "I hope it is high. I think most of them will feel that way" (E10). And regarding Self-Handicapping Behaviors, a part-time instructor who rated the scale as a 3.3 said "I think this is probably true for students who don't do well, but they won't admit that." (E11).

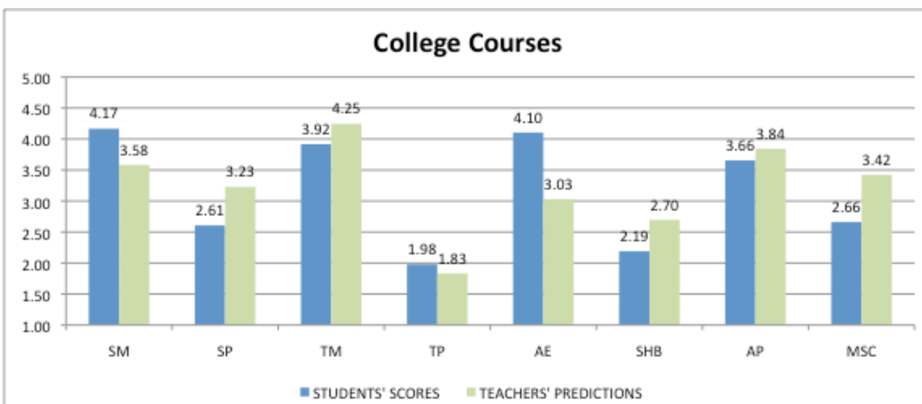
These findings suggest a mismatch in perception, by which instructors underestimate their students' orientations and interest in mathematical course work in college. It is important to note that some of the instructors accurately predicted their students' scores; and in some cases their predicted score were the same as the averages across all students.

Teachers' perceptions of their students' achievement goals by type of course (Analysis 4)

These differences were also found when the analysis was performed by type of course. Instructors of college courses and of remedial courses made predictions that did not match with those of their students (Figure 1). The trends observed in Analysis 3a are replicated in the subsamples, except for Academic Press. College courses teachers' predictions were higher than their students' scores, suggesting that instructors in college courses perceive their students as more inclined to be challenged to do harder work than what the students indicate. It is interesting to note, that College Courses instructors perceive that their students have a worse self concept than what their students report, and that this perception is lower than that of instructors of remedial courses.



(a)



(b)

Figure 1: Students' scores and Instructors' predictions for (a) Remedial Courses and (b) College Courses. All the t-test of the differences between students' scores and instructors' predictions is statistically at $\alpha = .001$, except for Teacher Performance for both College and Remedial courses ($\alpha = .05$), and Mathematics Self-Concept for Remedial students ($\alpha = .01$).

College instructors' perceptions versus Remedial courses instructors' perceptions (Analysis 4)

Instructors of College Courses made lower predictions than instructors of Remedial Courses in the Student Mastery, Teacher Performance, and Academic Self-Efficacy scales, and had a more negative perception of students' Mathematics Self-Concept (see Table 11). They also made higher predictions than instructors of Remedial Courses in the Teacher Mastery and Academic Press scales, thus positioning themselves as more oriented towards mastery, and perceiving their students more inclined to be pressed to do challenging work.

Table 11: Instructors' perceptions of students' ratings by type of course.

Scale	Remedial Courses	College Courses	Significance
Student Mastery	3.71 (.520)	3.58 (.557)	*
Student Performance	3.20 (.201)	3.22 (1.08)	
Teacher Mastery	3.93 (.219)	4.24 (.442)	***
Teacher Performance	1.99 (.673)	1.83 (.737)	*
Academic Press	3.49 (.277)	3.84 (.320)	***
Academic Self-Efficacy	3.42 (.678)	3.03 (.613)	***
Self-Handicapping Behaviors	2.60 (.521)	2.69 (.788)	
Mathematics Self-Concept	2.89 (.704)	3.42 (.893)	***

Note: * $p < .05$; ** $p < .01$; *** $p < .001$.

It appears that instructors perceive their remedial students differently than their college students. Instructors of remedial courses see their students as more motivated (better mathematics self-concept and self-efficacy, higher mastery orientation) than instructors of students in college courses, although they perceive these students to be less inclined to accept challenging work than instructors of college courses.

Discussion

The purpose of this study was to investigate community college mathematics students' achievement goal orientations and their instructors' perceptions of those goals. In addition we sought to investigate whether there were differences between college and remedial students. I discuss the findings, by answering the four research questions of the study.

Achievement goal orientations of community college mathematics students.

Consistent with the literature on achievement goal orientations, based mostly on middle school students, the surveyed students in the college favor mastery over performance, have high sense of self-efficacy, expect their teachers to challenge them and press them to work hard, and avoid engaging in self-handicapping behaviors. A possible explanation for these findings is that, in general, people have a preference for setting goals that put mastering and understanding as more important than showing competence relative to others. It might be possible that the open-door admissions policy of the community colleges might attract students who are more intrinsically motivated to learn, as they seek to overcome difficulties that they may have experienced in the past or the complexity of their personal circumstances. In order to test this possibility, it would be important to apply the survey in post-secondary institutions without an open-access policy, which attract a different profile of students.

Comparison between goal orientations exhibited by students taking remedial courses and those exhibited by students taking college courses.

Contrary to the findings reported by Hall and Ponton (2005) students taking remedial courses in this college indicated higher motivation towards mastering content, higher self efficacy, more appreciation for teachers' academic press, and better math self-concept than students taking the college courses. The difference could be due to the different instruments that each study used. It is possible, however, that the differences also stem from the different populations taking these surveys. Hall and Ponton's students came all from a four-year institution, in which there might be more stigma associated with taking remedial courses than in a community college in which a large number of students need the remediation. In addition, community college students might see the opportunity of studying in college—even if the course is remedial—as a fundamental needed step to advance their goals, whereas students in a four-year institution may perceive their taking of remedial courses as a reminder of some failure in their own academic preparation. It would be important to replicate the study with samples of students in remedial and college courses at community colleges and at four-year institutions to determine how robust these findings are.

Teachers' perceptions of their students' achievement goal orientations.

In this analysis of students' achievement orientation goals, we found discrepancies regarding students' self-reported goals and their instructors' perceptions of those goals. Instructors in general tended to rate their students lower on measures of their orientations towards mastering the content, their sense of self-efficacy, their expected academic press, and their mathematics self-concept. They also tended to rate their students higher on their orientations towards performance and their engagement in self-handicapping behaviors. These results suggest that instructors systematically underestimate the motivation, goal orientations, and expectations that their students bring to the math classes. One reason for this situation might stem from the organization of community colleges. Community colleges are commuter campuses, with most students coming to take one or two classes per term. In addition, instructors have either a higher teaching load (full-time instructors are responsible for an average of 15 credit hours of teaching per term, Lutzer et al., 2007) or they commute too to teach one or two courses per term. Thus the opportunities that instructors and students have for getting to know each other are limited to the class or to office hours. Whereas classes are usually devoted to presenting content, and therefore reduce opportunities for students to talk about their goals, office hours tend to be attended by the students who are more likely to need help. In either case, there are little opportunities for learning about students' goals. The information that instructors gain from office hours might be used to wrongly generalize the characteristics of the students who seek help to the whole group of students they teach.

That these assumptions are problematic is revealed by the discrepancies in students' ratings of their teachers' emphasis on goal orientations and how teachers expected students to rate the scales that referred to teachers (Teacher Mastery and Teacher Performance). Students perceive their instructors as less oriented towards mastering the content than what their teachers expect students to see, and students perceive their instructors more oriented towards performance than what their teachers expect students to perceive. How instructors behave in class sends important messages to the students, and if the goal is to maintain an attitude in which what matters is an orientation towards mastering the material, the discrepancy perceived reveals that instructors themselves might be, in spite of their intentions, more worried about ensuring students' success through performance. In the absence of classroom data it is difficult to describe how is that instructors are making evident their orientations towards mastery or their orientations towards performance to their students. The current study only hints at an important discrepancy between what instructors and students perceive in the class and therefore a further study would require an analysis of classroom data that would indicate which goal orientations do instructors convey in classrooms.

The particular profile of students taking these courses might explain part of these results. Community college students know that they need to master basic mathematical knowledge in order to continue with their studies, and because of the openness of the college admission process, they might assume that the college, and their instructors' priority is to ensure that they become competent in learning the material. In principle, they are willing to do what it takes for succeeding. What instructors see is a wide range of competencies that the students bring to class that put them in different positions to learn the given content. Instructors might either adapt their plans to address students' difficulties, which result in less time to cover the required syllabi, or continue, leaving difficulties unaddressed. In either case, the perception *from the instructors' point of view* is that students have unrealistic goals of what they need in order to be successful or that the students will need more resources than what they have at hand (e.g., time) to master the material, thus instructors will tend to rate their students lower on several of these scales.

Comparison between remedial courses teachers' perceptions of their students' achievement goal orientations and college courses teachers' perceptions.

It is intriguing that compared to instructors of remedial courses, instructors of college courses rate lower their students' orientations towards mastery, their sense of self-efficacy, and their math self-concept. In addition instructors in college courses anticipate that their students have slightly more inclination towards self-handicapping behaviors than instructors of remedial courses. Instructors of college courses do, however, think that their students are more willing to be pressed to do challenging work and that their students perceive them as illustrating more behaviors oriented towards mastery orientation than teachers of remedial courses. It appears that instructors of remedial courses are perhaps more optimistic or more willing to see their students' interest in learning in a more positive way; they might be more accepting of students' needs because remediation constitutes a first step for their students, one that will open other doors for their success, and therefore be more 'lenient' in their appraisal of students goal orientations. It might be that instructors of college courses expect their students to already know what college is about, to have clearer goals, and to need less 'hand-holding.' They may, in general, have higher expectations for students in college courses, which may lead them to be more stringent as they rate the scales. The data collected here are insufficient to explore whether there are differences due to the type of college courses that the interviewed instructors were teaching. Everyday College Math, Functional Math for Elementary Teachers, College Algebra, and Trigonometry are courses that fulfill requirements for many programs and might not be intrinsically interesting for students, they are one of many 'hoops' that students would need to go through to obtain a degree. For this reason, instructors in these courses may perceive their students as less motivated than what they should be, therefore rating students lower in the mastery, self-efficacy, and self-concept of mathematics scales. At the same time these instructors may think that because students are in a college course they want to accept the challenges of college level courses and are more willing to take on those challenges; perceiving their students as less needy in terms of what it means to be a college student, instructors may then expect to be able to press them harder. A study that with a larger number of students in each type of course would be necessary to determine the extent to which type of course is associated with these findings.

When shown the differences, instructors showed genuine surprise and were puzzled. They offered possible explanations that fell into two broad categories, survey application issues and sources of information about students.

Most instructors tried to remember when the survey was given to the students, thinking that if the survey had been given too early in the term, then the students would not have learned about the expectations in their classrooms or still had unrealistic expectations about college work. However, all surveys were administered after the 6th week in the 15-week long semester and within a week or so of a major examination; by that time, it was anticipated that most of the norms for engaging in the classroom had been well established (McClain & Cobb, 1997; Yackel & Rasmussen, 2004). Some instructors doubted that the responses could be so consistent. However, because each scale had more than three items and the confirmatory factor analysis retained most of the items in the predicted scales, this possibility is unlikely. In addition, repeated applications of the surveys with different groups of students ameliorate this issue. In our case, we applied the survey first to a small group of students in three college level courses, College Algebra, Trigonometry, and Pre-Calculus and one remedial course, Foundations of Algebra. We contrasted the results from this application with the application to a different group of students taking only trigonometry courses. Finally we extended the application to a wider sample of students and courses in the college. In each case the results were comparable and consistent. One instructor wondered whether his students had understood the questions as intended. This is a possibility with any survey that is applied with a new sample of students. Interviews with a wide range of students as they respond to the questions might determine the extent to which this is the case. Because of prior research using the instrument suggests that the instrument is valid (Jagacinski & Duda, 2001), and because differently from other applications, the students selected all possible options in the items, we think that the instrument is being interpreted accurately by the students and reflects their position on each scale.

Some instructors wondered whether the discrepancies were colored by them "hearing only from the struggling students," the ones who reach out only when they have problems or excuses for missing work; during class, they reflected, the ones who ask questions are the ones who struggle too, and some times it is because they had missed classes before. These instructors suggested that they could have made an inappropriate generalization to the whole group based on a handful of students. Other instructors wondered about the opportunities that they had created to get to know all their students on a more personal level, which would allow them to asses their goals and motivation more holistically; they felt that they had been "giving students less credit than they deserved" and were curious about ways in which they could adapt their practice to fit this new knowledge.

Limitations

The study has three limitations. First it is a single institution study, so the findings cannot be generalized to other institutions; these findings, however, give indicators that can be used for contrasting results with other studies and settings. Second, the students surveyed were those taking mathematics, so it is unclear that it would be possible to generalize to all students in the college. However, most students who plan to use their college credits to transfer require a mathematics course, and the majority of these students take the mathematics courses surveyed here; we have a large representation of transfer students in the sample, which suggests that our findings could be generalized to those students in the college who had plans to transfer to a four-year institution. Third, we do not an academic outcome measure (e.g., final course grade, or concept inventory score) that would allow us to test how these scales relate to academic performance. Our priority with the study was to determine whether the instrument was valuable, so that the connection to academic performance could be addressed in a subsequent stage. We believe it would be wrong to dismiss the findings from this study because they offer a counterintuitive view of the achievement goal orientations that the students in this college have, which might resonate with students in other colleges, and offers opportunities for instructors to capitalize on the goals students bring.

Implications

In terms of research, it is important to conduct studies that can confirm or rule out possible explanations for these findings, in particular regarding the differences between four-year and community colleges. It is important to see whether the stigma associated with remediation is a phenomenon of four-year institutions, and whether indeed the stigma is absent in community colleges. This knowledge would be crucial for changing the negative perception that exists towards remediation (Bailey, 2009), specially because students need to remediate in order to do college work.

It would be important to extend the application of the survey to other community colleges that are different from the one surveyed here. In that application, it would be of paramount importance to include measures of student achievement data that would allow us to confirm the connection between goal orientation and student outcomes. As this was an exploratory study that sought to test the robustness of the instrument, these data were not available. Student outcomes should be collected along with this survey.

Most of our instructors saw the importance of the results but did not know how to capitalize on these findings. This suggests the need for faculty development that guides instructors in community colleges in taking advantage of the motivation and goal orientations that the students bring. For example, making an initial assessment of students' achievement orientations, their level of self-efficacy, and their inclination towards academic press might give instructors the tools they need to maintain challenging work through out the semester. Likewise, creating systematic opportunities to check on all the students including the ones who are not struggling, might also help in giving instructors a different perspective on what their students are able and inclined to do. For example, having periodic anonymous reports about what is difficult or easy in class and in life, and sharing a summary of this information to the class, can help in maintaining the instructors and the class informed about each other and give a better sense of what the students want and their willingness to do what it takes to accomplish their goals.

The rising costs of higher education have made the community college a natural, and in many cases, the only, option for completing postsecondary studies (Dowd, et al., 2006). Because mathematics is an almost universal requirement for all students in community colleges (Lutzer, et al., 2007), math departments have to spend a considerable amount of resources in preparing the large number of students who are not ready for college work. Faculty in community colleges have very few tools for improving practice (Grubb & Associates, 1999), so increasing their knowledge about the achievement goal orientations their students bring to the mathematics classroom is a step towards improving the educational opportunities for students in these courses; knowing that students want to focus on developing competence, expect academic press from their instructors, and have self-confidence in their success, gives instructors the space to create classrooms in which authentic learning can be provided to the students.

Appendix 1: Survey Items and Scales

The following items were presented to the students in the individual test. The number represents the order in which they appear in the printed form. Students had to rate the items on a 1-5 scale (1-Strongly Disagree, 2-Agree, 3-Neutral, 4-Agree, and 5-Strongly Agree). This survey incorporates items from the Patterns of Adaptive Learning Scales [PALS][4] and from the Views About Mathematics Survey [VAMS][5], which address students' attitudes and perceptions towards mathematics and problem solving. The scales were generated using the average of the items in the scales. Underlined items did not load well in the factor and showed low reliability and were excluded from the scale. All the items within each scale, together with the reliability of the scale measured with the Cronbach's alpha coefficient, are given below.

***Student Mastery* [SM] (α = .843)**

When oriented to mastery goals, students' purpose or goal in an academic setting is to develop their competence and to extend their mastery and understanding. Learning is perceived as inherently interesting, and end in itself. Attention is focused on the task.
M 7. It's important to me that I learn a lot of new concepts this semester.
M 19. One of my goals in class is to learn as much as I can.
M 21. One of my goals is to master a lot of new skills this semester.
M 25. It's important to me that I thoroughly understand my class work.
M 34. It's important to me that I improve my skills this semester.

---

[4] Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E., & Others. (2000). *Manual for the Patterns of Adaptive Learning Scales*. Ann Arbor, MI: University of Michigan.

[5] Carlson, M. (1999). The mathematical behavior of six successful mathematics graduate students: Influences leading to mathematical success. *Educational Studies in Mathematics, 40*, 237-258.

***Student Performance* [SP] (α = .880)**

Performance goals are formulated in terms of either demonstrating competence or avoiding demonstrating incompetence; these goals are focused on the self. These goals have been associated with both adaptive and maladaptive patterns of learning, although the evidence appears to suggest a stronger support for maladaptive patterns (as learning appears to be extrinsically motivated). There are two different sets of items, for Performance Approach (PA) and Performance Avoidance (PAv).

PA 6. It's important to me that other students in my class think I am good at my class work.

PA 20. One of my goals is to show others that I'm good at my class work.

PA 27. One of my goals is to show others that class work is easy for me.

PA 31. One of my goals is to look smart in comparison to the other students in my class.

PA 33. It's important to me that I look smart compared to others in my class.

PAv 2. It's important to me that I don't look stupid in class.

PAv 23. One of my goals is to keep others from thinking I'm not smart in class.

PAv 35. It's important to me that my teacher doesn't think that I know less than others in class.

PAv 38. One of my goals in class is to avoid looking like I have trouble doing the work.

***Teacher Mastery* [TM] (α = .802)**

This scale measures students' perceptions that their teachers' goals are oriented towards mastery.

TM 42. My teacher recognizes us for trying hard.

TM 44. My teacher really wants us to enjoy learning new things.

TM 46. My teacher wants us to understand our work, not just memorize it.

TM 48. My teacher thinks mistakes are okay as long as we are learning.

TM 50. My teacher gives us time to really explore and understand new ideas

***Teacher Performance* [TP] (α = .828)**

This scale measures students' perceptions that their teachers' goals are oriented towards performance. There are two different sets of items, for Performance Approach (TPA) and Performance Avoidance (TPAv).

TPA 45. My teacher points out those students who get good grades as an example to all of us

TPA 47. My teacher lets us know which students get the highest scores on a test.

TPA 52. My teacher tells us how we compare to other students.

TPAv 43. My teacher says that showing others that we are not bad at class work should be our goal.

TPAv 49. My teacher tells us it's important to join in discussions and answer questions so it doesn't look like we can't do the work.

TPAv 51. My teacher tells us that it is important that we don't look stupid in class

TPAv 53. My teacher tells us it's important to answer questions in class, so it doesn't look like we can't do the work.

***Academic Press* [AP] (α = .810)**

This scale measures students' perceptions that their teachers press them towards challenging work and thinking.

Pr 4. When I've figured out how to do a problem, my teacher gives me more challenging problems to think about.

Pr 8. My teacher presses me to do thoughtful work.

Pr 12. My teacher asks me to explain how I get my answers.

Pr 14. When I'm working out a problem, my teacher tells me to keep thinking until I really understand.

Pr 16. My teacher doesn't let me do just easy work, but makes me think.

Pr 37. My teacher makes sure that the work I do really makes me think.

Pr 40. My teacher accepts nothing less than my full effort.

***Academic Self-Efficacy* [AE] (α = .831)**

This scale measures students' perceptions that they can do the work needed to succeed.

AE 1. I'm certain I can master the skills taught in class this semester.

AE 36. I can do almost all the work in class if I don't give up.

AE 39. Even if the work is hard, I can learn it.

AE 41. I can do even the hardest work in this class if I try.

AE 9. I'm certain I can figure out how to do the most difficult class work.

Self Handicapping Behaviors **[SHB] (α = .847)**

This scale measures students' perceptions that there are external factors that get in their way for doing college work.

SH 10. Some students fool around the night before a test. Then if they don't do well, they can say that is the reason. Would you agree that this statement applies to you?

SH 13. Some students purposely get involved in lots of activities. Then if they don't do well on their class work, they can say it is because they were involved with other things. Would you agree that this statement applies to you?

SH 15. Some students look for reasons to keep them from studying (not feeling well, having to help their parents, taking care of a sibling/child, etc.). Then if they don't do well on their class work, they can say this is the reason. Would you agree that this statement applies to you?

SH 28. Some students let their friends keep them from paying attention in class or from doing their homework. Then if they don't do well, they can say their friends kept them from working. Would you agree that this statement applies to you?

SH 30. Some students purposely don't try hard in class. Then if they don't do well, they can say it is because they didn't try. Would you agree that this statement applies to you?

SH 32. Some students put off doing their class work until the last minute. Then if they don't do well on their work, they can say that is the reason. Would you agree that this statement applies to you?

Math Self-Concept **[MSC] (α = .767)**

Adapted from the VAMS, these items measure students' self image as mathematics learners.

MSC 4 For me, solving math problems is usually an enjoyable experience.

MSC 13 When I experience difficulty while studying math, I give up.

MSC 20 For me, doing math problems in more than one way is a waste of time.

MSC 28 For me, solving a math problem is usually a frustrating experience.

MSC 45 For me, making unsuccessful attempts when solving a math problem is an indication that I'm not good at math.

***Problem Solving Attitude* [PSA] (α = .592)**

Adapted from the VAMS, these items measure students' engagement in productive mathematical problem solving patterns.

PS 6 After the teacher shows how to solve a problem that I got wrong, I try to figure out where the teacher's solution differs from mine.

PS 25 Even people who are good at math make many unsuccessful attempts when solving challenging math problems.

PS 26 After I have gotten an answer to a homework problem, I use at least one way to make sure that the answer is correct.

PS 29 The first thing I do when solving a story problem is search for a formula that relates to the problem.

PS 31 For me, solving math problems in more than one way helps develop my reasoning skills.

PS 32 When I experience difficulty while studying math, I try hard to figure it out on my own.

PS 68 First thing story problem, draw picture

***Talent* [T] (α = .564)**

Adapted from the VAMS, these items measure students' perceptions that talent is needed for succeeding in mathematics.

TL 35 Learning math requires a special talent.

TL 36 In order to solve math problems, I need to have seen the solution to a similar problem before.

TL 46 For me, doing well in a math course depends on how well the teacher explains things in class.

***Effort* [E] (α = .545)**

Adapted from the VAMS, these items measure students' perception that effort is needed for succeeding in mathematics

ET 3 Learning math requires serious effort.

ET 7 For me, doing well in a math course depends on how much effort I put into studying.

ET 21 When I experience difficulty while studying math, I immediately seek help from other people.

References

Adelman, C. (2005). *Moving into town-and moving on: The community college in the lives of traditional-age students.* Washington DC: U.S. Department of Education.

Ames, C. (1992). Classroom: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*, 261-271.

Anderman, E., & Maehr, M. L. (1994). Motivation and schooling in the middle grades. *Review of Educational Research, 64*, 287-309.

Anderman, E., & Midgley, C. (1997). Changes in achievement goal orientations, perceived academic competence, and grades across transition to middle-level schools. *Contemporary Educational Psychology, 22*, 269-298.

Anderman, E., & Midgley, C. (2004). Changes in self-reported academic cheating across the transition from middle school to high school. *Contemporary Educational Psychology, 29*, 499-517.

Bailey, T. R. (2009). Challenge and opportunity: Rethinking the role and function of developmental education in community colleges. *New Directions for Community Colleges, 145*(Spring), 11-30.

Baum, S., & Ma, J. (2007). *Education pays 2007: The benefits of higher education for individuals and society*. New York: The College Board.

Baum, S., & Payea, K. (2005). *Education pays 2004: The benefits of higher education for individuals and society*.

Betz, N. E., & Hackett, G. (1993). *Manual for the mathematics self-efficacy scale*. Redwood City, CA: Mind Garden.

Bruinsma, M. (2004). Motivation, cognitive processing and achievement in higher education. *Learning and Instruction, 14*, 549-568.

Carlson, M. (1999). The mathematical behavior of six successful mathematics graduate students: Influences leading to mathematical success. *Educational Studies in Mathematics, 40*, 237-258.

Charmichael, C., & Taylor, J. A. (2005). Analysis of student beliefs in a tertiary preparatory mathematics course. *International Journal of Mathematical Education in Science and Technology, 36*(7), 713-719.

Church, M. A., Elliot, A. J., & Gable, S. L. (2001). Perceptions of classroom environment, achievement goals, and achievement outcomes. *Journal of Educational Psychology, 93*, 43-54.

Ciani, K., Ferguson, Y., Bergin, D., & Hilpert, J. (2010). Motivational influences on school-prompted interest. *Educational Psychology, 30*, 377-393.

Civil, M. (1996). *Connecting home and school: Funds of knowledge for mathematics teaching.* Paper presented at the Paper presented at the Working group in Cultural aspects in the learning of mathematics of the 20th International Conference of the Psychology of Mathematics Education, Valencia.

Civil, M. (1998). *Linking students' own cultural mathematics and academic mathematics. A reaction to Presmeg.* Paper presented at the International Group for the Psychology of Mathematics Education, Stellenbosch, South Africa.

Cohen, D. K., Raudenbush, S. W., & Ball, D. L. (2003). Resources, instruction, and research. *Educational Evaluation and Policy Analysis, 25*, 119-142.

Committee on Science Engineering and Public Policy. (2007). *Rising above the gathering storm: Energizing and employing America*. Washington, D.C.: National Academy Press.

Cox, R. D. (2009). *The college fear factor: How students and professors misunderstand one another*. Boston, MA: Harvard University Press.

Dowd, A., Bensimon, E. M., Gabbard, G., Singleton, S., Macias, E., Dee, J. R., et al. (2006). *Transfer access to elite colleges and universities in the United States: Threading the needle of the American dream*: Jack Kent Cooke Foundation, Lumina Foundation, Nellie Mae Education Foundation.

Dweck, C. (1986). Motivational processes affecting learning. *American Psychologist, 41*, 1040-1048.

Dweck, C., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*, 256-273.

E Community College. (2010). *Annual student profile through 2009-2010*. Town, Midwest: E Community College.

Feldman, M. J. (1993). Factors associated with one-year retention in a community college. *Research in Higher Education, 34*, 503-512.

Fennema, E., Carpenter, T. P., Franke, M. L., & Carey, D. A. (1992). Learning to use children's mathematics thinking: A case study. In R. Davis & C. Maher (Eds.), *Schools, mathematics and the world of reality* (pp. 93-117). Needham Heights, MA: Allyn Bacon.

Fennema, E., Franke, M. L., Carpenter, T. P., & Carey, D. A. (1993). Using children's mathematical knowledge in instruction. *American Educational Research Journal, 30*, 555-583.

Friedel, J., Cortina, K. S., Turner, J. C., & Midgley, C. (2010). Changes in efficacy beliefs in mathematics across the transition to middle school: Examining the effects of perceived teacher and parent goal emphases. *Journal of Educational Psychology, 102*(1), 102-114.

Goldrick-Rab, S. (2007). *Promoting academic momentum at community colleges: Challenges and opportunities*. CCRC Working Paper No. 5. Madison, WI: University of Wisconsin.

Grubb, N. W., & Associates. (1999). *Honored but invisible: An inside look at teaching in community colleges*. New York: Routledge.

Hall, M., & Ponton, M. K. (2005). Mathematics self-efficacy of college freshman. *Journal of Developmental Education, 28*(3).

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal, 42*, 371-406.

House, J. D. (2006). Mathematics beliefs and achievement of elementary school students in Japan and the United States: Results from the Third International Mathematics and Science Study. *Journal of Genetic Psychology, 167*(1), 31-45.

Jagacinski, C. M., & Duda, J. L. (2001). A comparative analysis of contemporary achievement goal orientation measures. *Educational Psychological Measurement, 61*(6).

Kaplan, A., & Midgley, C. (1999). The relationship between perceptions of the classroom goal structure and early adolescents' affect in school. *Learning and Individual Differences, 11*, 187-212.

Khisty, L. L. (1995). Making inequality: Issues of language and meanings in mathematics teaching with Hispanic students. In W. G. Secada, E. Fennema & L. B. Adajian (Eds.), *New directions for equity in mathematics education* (pp. 279-297). New York: Cambridge University Press.

Ladson-Billings, G. *The dreamkeepers: Successful teachers of African American children*. San Francisco: Jossey-Bass Publishers.

Lin, C.-J., Hung, P.-H., Lin, S.-W., Lin, B.-H., & Lin, F.-L. (2008). The power of learning goal orientation in predicting student mathematics achievement. *International Journal of Science and Mathematics Education, 7*, 551-573.

Lutzer, D. J., Rodi, S. B., Kirkman, E. E., & Maxwell, J. W. (2007). *Statistical abstract of undergraduate programs in the mathematical sciences in the United States: Fall 2005 CBMS Survey*. Washington, DC: American Mathematical Society.

McClain, K., & Cobb, P. (1997). *An analysis of the teacher's role in guiding the evolution of sociomathematical norms.* Paper presented at the Psychology of Mathematics Education, Lahti, Finland.

Meece, J. L. (1991). The classroom context and students' motivational goals. In M. L. Maehr & P. R. Pintrich (Eds.), *Advances in motivation and achievement* (Vol. 7). Greenwich, CT: JAIPress.

Meece, J. L., Blumenfeld, O., & Hoyle, R. (1988). Students' goal orientations and cognitive engagement in classroom activities. *Journal of Educational Psychology, 80*, 514-523.

Mesa, V. (2007). *The teaching of mathematics in community colleges* (Unpublished manuscript). Ann Arbor: University of Michigan.

Mesa, V. (2008, July). *Researching mathematics instruction in community colleges.* Paper presented at the International Congress of Mathematics Education-TSG 8, Monterrey, Mexico.

Mesa, V. (2010a). Examples in textbooks: Examining their potential for developing metacognitive knowledge. *MathAmatyc, 2*(1), 50-55.

Mesa, V. (2010b). Student participation in mathematics lessons taught by seven successful community college instructors. *Adults Learning Mathematics, 5*, 64-88.

Mesa, V. (accepted). Similarities and differences in classroom interaction between remedial and college mathematics classrooms in a community college. *Journal of Excellence in College Teaching*.

Mesa, V., & Herbst, P. (2011). Designing representations of trigonometry instruction to study the rationality of community college teaching. *ZDM The International Journal on Mathematics Education, 43*, 41-52.

Mesa, V., & John, G. (2009). *Textbook analysis* (Unpublished manuscript). Ann Arbor: University of Michigan.

Middleton, M. J., Kaplan, A., & Midgley, C. (2004). The change in middle school students' achievement goals in mathematics over time. *Social Psychology of Education, 7*, 289-311.

Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E., & Others. (2000). *Manual for the Patterns of Adaptive Learning Scales*. Ann Arbor, MI: University of Michigan.

Moll, L. C., Vélez-Ibáñez, C., Greenberg, J., Whitmore, K., Saavedra, E., Dworin, J., et al. (1990). *Community knowledge and classroom practice: Combining resources for literacy instruction OBEMLA Contract No. 300-87-0131*. Tucson, AZ: University of Arizona, College of Education and Bureau of Applied Research in Anthropology.

Muis, K. R. (2004). Personal epistemology and mathematics: A critical review and synthesis of research. *Review of Educational Research, 74*(3), 317-377.

Muis, K. R., Winne, P. H., & Edwards, O. V. (2009). Modern psychometrics for assessing achievement goal orientation: A Rasch analysis. *British Journal of Educational Psychology, 79*, 547-576.

Office of the Press Secretary. (2010). President Obama signs historic health care and education legislation. Retrieved May, 31, 2010, from http://www.whitehouse.gov/the-press-office/president-obama-signs-historic-health-care-and-education-legislation

Pascarella, E. T., Wolniak, G. C., Pierson, C. T., & Terenzini, P. T. (2003). Experiences and outcomes of first-generation students in community colleges. *Journal of College Student Development, 44*, 420-429.

Patrick, J., Anderman, L. H., Ryan, A. M., Edelin, K. C., & Midgley, C. (2001). Teachers' communication of goal orientations in four fifth-grade classrooms. *Elementary School Journal, 102*, 35-58.

Phillippe, K. A., & Gonzalez Sullivan, L. (2005). *National profile of community colleges: Trends and statistics* (4th ed.). Washington, D.C.: American Association of Community Colleges.

Pintrich, P. R., & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*, 33-40.

Seidman, E. (1985). *In the words of the faculty: Perspectives on improving teaching and educational quality in community colleges*. San Francisco, CA: Jossey-Bass.

Stigler, J. W., Givvin, K. B., & Thompson, B. J. (2010). *What community college developmental mathematics students understand about mathematics*. Stanford, CA: Carnegie Foundation for the Advancement of Teaching (Accessed March 19, 2010, http://www.carnegiefoundation.org/elibrary/problem-solution-exploration-papers)

Suh, H., Mesa, V., Blake, T., & Whittemore, T. (2010a). *An analysis of examples in college algebra textbooks: Opportunities for student learning*. Paper presented at the Annual Meeting of the Michigan Chapter of the American Mathematical Association of Two-Year Colleges.

Suh, H., Mesa, V., Blake, T., & Whittemore, T. (2010b). *Cognitive demand and opportunity to learn strategies for controlling the work in examples in college algebra textbooks* (Manuscript in preparation). Ann Arbor, MI: University of Michigan.

Turner, J. C., Thorpe, P. K., & Meyer, D. K. (1998). Students; reports of motivation and negative affect: A theoretical and empirical analysis. *Journal of Educational Psychology, 90*, 758-771.

Urdan, T., & Schoenfelder, E. (2006). Classroom effects on student motivation: Goal structures, social relationships, and competence beliefs. *Journal of School Psychology, 44*, 331-349.

Waycaster, P. (2001). Factors impacting success in community college developmental mathematics courses and sybsequent courses. *Community College Journal of Research and Practice, 25*, 403-416.

Wheeler, D. L., & Montgomery, D. (2009). Community college students' views on learning mathematics in terms of their epistemological beliefs: A Q method study. *Educational Studies in Mathematics, 72*, 289-306.

Yackel, E., & Rasmussen, C. L. (2004). Beliefs and norms in the mathematics classroom. In G. Leder, E. Pehkonen & G. Törner (Eds.), *Beliefs: A hidden variable in mathematics education?* (pp. 313-330). Dordrecth, The Netherlands: Kluwer.