Causal Attributions and Student Success in Developmental Mathematics

By Jacob Arthur Dasinger

Placement in developmental mathematics may put students behind in their graduation schedule.

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Abstract: ***This research examined differences in causal attributions and an exam score in a developmental mathematics course based on student classification: traditional, minimally nontraditional, moderately nontraditional, and highly nontraditional as well as grade and gender among nontraditional students. Statistical analysis revealed significant differences on the Revised Causal Attribution Scale (CDSII) in the Personal Controllability dimension for low-graded students, and in both the Personal and External Controllability dimensions for high-graded students. Based on gender, low-graded, nontraditional students showed a significant difference in the Locus of Causality dimension whereas no significant differences appeared among high-graded, nontraditional students.***

Every semester, more nontraditional students are returning to college in order to further their career opportunities (NCES, 2010a). These students may have been out of school for several years and are being asked to pick up right where they left off in their previous education setting. Hence, more returning students are being placed in developmental courses, especially in mathematics. The National Center for Education Statistics (NCES; 2010a) reported that enrollment of people 25 and older at degree-granting institutions increased by 13% between 1995 and 2006 and is predicted to rise by 19% between 2006 and 2017. These students are often referred to as nontraditional. According to the NCES (2010b), a nontraditional student is defined as a student who falls into one of the following categories:

(a) a student who does not enter postsecondary school in the same calendar year as graduating high school,

(b) a student who attends part-time,

(c) a student who works full-time (35 hours or more) while enrolled,

(d) a student who is considered financially independent when evaluated for financial aid,

(e) a student who has dependents other than a spouse,

(f) a student who is a single parent, and/or

(g) a student who does not have a high school diploma (obtained GED or completion certificate).

More often than not, nontraditional students begin their college careers at community colleges as opposed to universities (Choy, 2002; Robert, 2010). Community colleges offer underrepresented populations, in particular, older and/or returning students, a greater chance at higher education, either through associate degrees or by providing foundations for transfer to four-year universities. According to Kraemer (1996), students' mathematics abilities have an impact on whether they will graduate from community college or transfer and graduate from a four-year university. Older students who have a more positive attitude towards mathematics tend to do better in their college mathematics classes than younger students (Gupta, Harris, Carrier, & Caron, 2006). This finding has led the authors to believe adult students enter college with a "sense of urgency and readiness to learn."

Having more returning, older students graduate with bachelor's degrees is vital to fill the increasing demand for jobs in the areas of science, mathematics, engineering, and technology. Understanding factors that impact success is important in all mathematics courses, especially developmental mathematics. Success in developmental mathematics has been shown to lead to success in later mathematics courses such as college algebra, a common requirement of most college majors (Head & Lindsey, 1984; Johnson, 1996; Penny & White, 1998; Waycaster, 2001; Wheland, Konet, & Butler, 2003). Placement in a developmental mathematics course is done with the purpose of providing a solid foundation which will allow a better chance at success in a course like college algebra (Hagedorn, Siadat, Fogel, Nora, & Pascarella, 1999). However, the mathematical background of students in developmental mathematics is often so deficient that high failure rates in these courses still exist (Adelman, 1995). Also, placement in developmental mathematics may put students behind in their graduation schedule, requiring them to stay in college longer than planned. Berkovitz and O'Quin (2006) claim the only significant demographic variable which predicts college graduation is age, with younger students being more likely to graduate than older students. If the student fails a developmental course, time will be added to his or her schedule as these courses are usually offered sequentially, with admission into the next course dependent on passing the previous one. This additional time adds to the likelihood of the student growing more frustrated with a graduation date that keeps getting pushed back.

Since at least half of all nontraditional students will be placed into developmental mathematics courses at one point in their college careers (Twigg, 2005), it is important to get a better understanding of how this population attributes success or failure in mathematics and how these outcomes occur in their opinions. The study of an individual's reasoning for succeeding or failing at a particular task is called causal attribution theory. Attribution theory has been used to explain the relationship between student beliefs of success and failure and academic achievement (Forsyth & McMillian, 1981; Kivilu & Rogers, 1998). Little to no research has been done in which attribution theory is applied specifically to nontraditional students, to developmental mathematics, or to a combination of the two. If there is a difference in attribution styles between traditional and nontraditional students, then measures could be taken in order to adapt teaching styles and learning environments to the different populations.

Determining the attribution styles of nontraditional students could also lead to breaking the belief of "learned helplessness." Seligman (as cited in Parsons, Meece, Adler, & Kaczala, 1982) states learned helplessness follows from a perception of little or no control over aversive events. Abramson, Seligman, and Teasdale (1978) suggest the attributions a person makes for the perceived lack of control over outcomes are vital predictors of learned helplessness. People who attribute failures to lack of ability often showed an increase in the perception of learned helplessness whereas people who attribute failures to task difficulty or lack of effort tended to show no increase in learned helplessness. Students who attribute success to ability and failure to lack of effort tend to have higher achievement motivations for future tasks; students who attribute success to factors such as luck and failure to lack of ability tend to have lower achievement motivations for future tasks. If uninterrupted, this second pattern could lead to an overall lack of effort and motivation on future tasks (Seegers, Van Putten, & Vermeer, 2004). Understanding which attribution styles are predominant among nontraditional students will help in the identification and disruption of learned helplessness.

Theoretical Framework

Causal attribution theory is the study of how people explain positive and negative occurrences in their lives. Following the result of an outcome, a motivational sequence is initiated by the subject. The motivational sequence is one in which the subject searches for causality of said outcome, particularly when the outcome is unexpected, negative, or important. The causality one determines for a particular outcome is dependent on the person's beliefs about oneself and the given situation.

Heider (1958) has described the distinction of causes for events to fall into one of two categories: causes that can be attributed to the person and causes that can be attributed to the environment. This *Locus of Causality* is the first causal dimension and the concept has been further identified as internal and external; internal causes are within the person (ability, effort, etc.) and external causes are outside of the person (environment, tasks, etc.).

Weiner, Frieze, Kukla, Reed, Rest, and Rosenbaum (1971) have identified a second causal dimension based on the idea that an individual's internal and external causes can fluctuate related to some opinions and remain relatively constant in others. This new dimension is referred to as *Stability*. According to Bar-Tal (1978), the Locus of Causality dimension influences the affective reactions in people, whereas the Stability dimension influences affective cognitive changes. For Locus of Causality, if people succeed due to ability or effort (both internal attributes), they will have a sense of increased pride, more so than if they feel success came from luck or task difficulty. Opposite responses are expected if one fails due to ability or effort: The person will feel increased shame, and less so if the failure resulted because of task difficulty or luck. For Stability, if one perceives success or failure due to stable factors of ability or task difficulty, he or she will expect the same result in future performance. If one feels success or failure is a result of unstable factors like luck or effort, different results could occur at other times.

The causality one determines for a particular outcome is dependent on the person's beliefs about oneself and the given situation.

According to Weiner (1986), a third causal dimension has been identified to help explain miscellaneous reasons, such as fatigue, mood, and other temporary effects that may contribute to a particular outcome. This new causal dimension, called *Controllability*, can be applied to both internal and external causes.

When interpreting success and failure, a person's causal tendency has been shown to influence achievement striving. In similar experiments conducted by Weiner and Kukla (1970) and Kukla (1972), subjects were asked to correctly determine the next number (either 0 or 1) in a sequence of digits. What was unknown to the subjects was the next number could not be determined by any means; correct or incorrect answers were strictly by chance. Students deemed "high-ability" tended to attribute success to ability and effort, and failure to lack of effort. Students deemed "low-ability" attributed success to luck and failure to lack of ability.

This is important because of where these causes lie in the attribution model. "High-ability" students attribute failure to lack of effort, an internal, unstable, controllable attribution. These students see failure at a task as something they could have prevented and something that can be prevented in the future. "Low-ability" students attribute failure to lack of ability, an internal, stable, uncontrollable attribution. These students feel failure is something that they cannot control, no matter how much effort is exerted (Weiner, 1972).

Literature Review

There has been a recent resurgence of interest in students' attribution characteristics as related to their success, although investigations were relatively dormant for many years. Elliot (1990) performed a study in which he investigated if the relationship between causal attribution, confidence in learning mathematics, and perceived usefulness of mathematics and mathematics achievement was different for nontraditional and traditional college males and females. A total of 140 students (35 nontraditional female, 35 nontraditional male, 35 traditional female, 35 traditional male) were randomly selected from a basic algebra class. Traditional students were classified as 18–20 years old and nontraditional students were deemed over 25 years of age. These students were given an algebra pretest and the Causal Attribution Scale at the beginning and a posttest at the end of the semester. For all students, pretest content scores were significant predictors of posttest achievement; No responses on the Causal Attribution Scale were significant predictors of posttest achievement for traditional students. However, from the Causal Attribution Scale, failure due to effort for nontraditional males and success due to luck for nontraditional females were significant predictors for posttest achievement. This finding tends to support the idea that causal attributions could contribute more to mathematics success for nontraditional students than for traditional students.

Cortés-Suárez and Sandiford (2008) studied the differences between the attributions given by passing and failing students in a college algebra course. A total of 410 students were asked to self-report their performance after an in-class exam. The students used the Revised Causal Dimensions Scale (CDSII) asking them to explain their score along the dimensions of Locus of Causality, Stability, Personal Controllability, and External Controllability. Results of the CDSII showed significant differences between the passing and failing groups in the dimensions of Locus of Causality, Stability, and Personal Controllability. Students in the passing group attributed their success in the direction of internality, stability, personal controllability, and external controllability. Students in the failing group attributed their failures in the direction of externality, instability, other than personal controllability, and external controllability. These results indicate a clear difference in attribution patterns between passing and failing students.

Wolleat, Pedro, Becker, and Fennema (1980) tested causal attribution theory in mathematics and examined the effects of level of mathematics achievement, sex, and the interactions of the two on attribution patterns. The subjects of the study were 647 female and 577 male high school students enrolled in college preparatory algebra and geometry classes. The students were given an achievement test to measure performance in mathematics. The Mathematics Attribution Scale (MAS) was used to measure student perceptions about their performance on the achievement test. Analysis showed statistically significant differences between males and females. Males attributed success on the achievement test to ability more than did females, whereas females attributed success to effort more than did males. These results follow along previously stated assumptions that successful students tend to attribute passing to ability and effort. Statistically significant differences also appeared among failing students. Females attributed failure on the mathematics achievement test to lack of ability or difficulty of task.

Beyer (1997) set out to determine differences by gender in causal attributions of success and failure among college students. A sample of 247 students filled out four questionnaires–the Life Orientation Test (which measures optimism), the locus of causality scale, Zung's self-rating of depression scale (SDS), and the Rosenberg self-esteem scale–about a hypothetical grade (A or F) in three different classes, one of which was college algebra. Based on gender, females selected "motivated" more often than males as a reason for an A in college algebra, whereas males checked "ability" most often. Males also rated "interest" as a more important cause for an A in college algebra than did females. As far as reasons for receiving an F, females rated "task difficulty" as a cause more than males. Beyer concluded females tend to give credit for success to effort attributions as opposed to males, and success in college algebra is more motivating for females than males.

The literature concerning nontraditional students and causal attributions is sparse and is not available in one particular study. From literature that is available, there are several important gaps which need to be considered:

1. The research spans over several decades (1980s to today) and is sporadic.
2. Of the research which distinguished between traditional and nontraditional students, none used a definition of nontraditional students resembling what NCES uses. Most of the research used a broad definition based on age.

The purpose of this research is to attempt to provide evidence to fill the outlined gaps.

This research focused particularly on the causal attributions of success and failure of nontraditional students in a developmental mathematics class, and if these attributions differ from those of traditional students. Also explored was the possibility of causal attributions differing among nontraditional students based on gender.

> *Results indicate a clear difference in attribution patterns between passing and failing students.*

Method

Research Design

The research design for this study was correlational using a self-report questionnaire. Students were asked to report their particular grades on a given in-class test and report attributions along four dimensions: Locus of Causality, Stability and Controllability (Personal and External). The independent variables were student classification (traditional, minimally nontraditional, moderately nontraditional, highly nontraditional) and exam grade classification (low or high) on a single test. The dependent variables were the scores of the four dimensions measured by the Revised Causal Dimension Scale (CDSII; McAuley, Duncan, & Russel, 1992).

Instrumentation

A self-report questionnaire was administered to gather demographic information consisting of three parts: (a) a demographic data section; (b) seven questions with yes/no answer choices which were used to determine the students' classification as traditional, minimally nontraditional, moderately nontraditional, or highly nontraditional; (c) a short answer section asking the student to report his or her exam grade; and (d) the Revised Causal Dimension Scale (CDSII). The Revised Causal Dimension Scale (CDSII) contains 12 items, each with a semantic differential scale of 9 to 1. Each of the three items from the CDSII relate to Locus of Causality, Stability, Personal Controllability, and External Controllability. The controllability dimension has been separated into Personal Controllability and External Controllability by the authors of the CDSII due to internal inconsistency on the controllability dimension in the Causal Attribution Scale (McAuley, Duncan, & Russell, 1992). Reliability analysis revealed Cronbach's alpha coefficients of 0.748, 0.648, 0.884, and 0.735, respectively. Written permission was given by one of the authors to use the CDSII in this study.

Participants

Freshmen and sophomore students enrolled in a developmental mathematics course, Intermediate Algebra MAT 1233, at a southeastern community college during the Spring 2011 semester provided the sample for the study. MAT 1233 Intermediate Algebra is a 3-credit-hour course that does not fulfill any requirements for a degree. This course covers linear equations and their graphs, inequalities and number line graphs, rational expressions, factoring, exponents, radicals, and polynomials. Students in Intermediate Algebra MAT 1233 have satisfied one of the following requirements: (a) successfully completed MAT 1203 Beginning Algebra with a D or better, (b) passed algebra 1 and algebra 2 in high school with a C or better and have an ACT Math Score between 1 and 12 or a COMPASS Math score between 0 and 15, and/or (c) passed only algebra 1 in high school with a C or better and have an ACT Math score between 13 and 21 or a COMPASS Math score between 16 and 50 (MGCCC, 2009, p. 13).

Overall, the study utilized 24 sections of intermediate algebra containing a total of 488 students enrolled at the beginning of the Spring 2011 semester. Each instructor was given copies of the self-report questionnaire, which contained the Revised Causal Dimension Scale (CDSII), to distribute in the Spring 2011 semester. The instructors were allowed to distribute the questionnaires at their convenience but were encouraged to do so as early as possible. Therefore, each section's students completed the questionnaire about different topics covered in intermediate algebra. A total of 331 completed questionnaires were returned from these 24 sections for a response rate of 68%.

Data Analysis

Data from the self-report questionnaire was compiled from all participating students. Descriptive

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statistics were calculated on student demographics and responses to the CDSII. Statistical analysis of the four subscale scores on the CDSII was conducted on low-graded students and high-graded students using Multivariate Analysis of Variance (MANOVA) with a p value = 0.05. The independent variable was student classification (traditional, minimally nontraditional, moderately nontraditional, highly nontraditional). Four dependent scaled variables were considered as measured by average score of questions related to subscales in the CDSII: Locus of Causality, Stability, Personal Controllability, and External Controllability. A second analysis was conducted using only nontraditional (minimally, moderately, highly) students to see if a relation existed in causal attribution scores based on gender.

Descriptive analysis of data. The first three parts to the self-report questionnaire contained questions regarding student demographics. Of the 331 participants who returned questionnaires, 58% were female, 35.6% were male, and 6.3% did not respond. Ethnicity distribution was as follows: 62.8% Caucasian, 21.5% African-American, 4.2% Hispanic, 2.1% Asian-American, 2.1% other, and 7.3% no response. Participants' ages ranged from 18 to 59: 30.6% 18-19, 19.5% 20-21, 16% 22-25, 12.8% 26-30, and 21.1% 31-59.

Using the definition provided by Horn and Carroll (1996), the next seven questions classified the students in the sample as traditional, minimally nontraditional, moderately nontraditional or highly nontraditional. Horn and Carroll defined nontraditional students based on number of characteristics a student has of the NCES (2010a) definition: traditional = 0 characteristics; minimally nontraditional = 1 characteristic; moderately nontraditional = 2 or 3 characteristics; highly nontraditional = 4 or more characteristics. On Questions 2 through 7 of the survey, the student would receive a score of 0 if he or she answered "No" and a score of 1 if he or she answered "Yes." Question 1 was reverse-scored with "Yes" being scored 0 and "No" being scored 1. Student classification distributions were as follows: 16.3% traditional, 19.0% minimally nontraditional, 40.5% moderately nontraditional, 23.9% highly nontraditional, and 0.3% no response.

The self-report questionnaire asked the students to report their grade on the returned exam. All reported exam grades were converted to a percentage grade. The mean of all exam grades was 74.1% with a standard deviation of 23.3%. The range of grades was from 0% to 110%. Some exam grades reported were allowed extra credit. Exam grades were classified into two groups based on the distribution of data: exam grades 69% or below, low and exam grades 80% or above, high. Using these criteria, the exam grade distribution was as follows: 29% Low, 50.2% High, 14.5% Other (70 – 79% exam grades), and 6.3% No Response. Table 1 illustrates the mean scores for all four causal dimensions, based on classification, of low-graded and high-graded students.

Inferential statistics. The first two inferential analyses were conducted using only low-graded students first and then only high-graded students. MANOVA was conducted with the independent variable being student classification (traditional, minimally nontraditional, moderately nontraditional, and highly nontraditional) and the dependent variables being scores on the four dimensions of the CDSII for both analyses. Using Pillai's trace, there was a significant relation between student classification and scores on the CDSII for low-graded students, $V = 0.263$, $F(12, 267) = 2.138$, $p = 0.015$, and on the CDSII for high-graded students, $V = 0.169$, $F(12, 462) = 2.300$, $p = 0.008$. Table 2 shows the results from the MANOVA on the four dimensions for low-graded and high-graded students.

For low-graded students, the dimension of Personal Controllability was statistically significant. A post-hoc Tukey test showed the minimally nontraditional and highly nontraditional students differed significantly from the moderately nontraditional students at $p = 0.05$.

For high-graded students, there was a statistically significant difference in the dependent variables of Personal Controllability and External Controllability scores. A post-hoc Tukey test showed moderately nontraditional and highly nontraditional students differed significantly from the traditional students in Personal Controllability, and the minimally nontraditional students differed significantly from the moderately nontraditional and highly nontraditional students in External Controllability at $p = 0.05$.

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Table 1

Mean Scores of Causal Dimensions of Low-Graded and High-Graded Students Based on Classification

Student Dimension Classification	Locus of Causality		Stability		Personal Controllability		External Controllability	
	Low-Graded	High-Graded	Low-Graded	High-Graded	Low-Graded	High-Graded	Low-Graded	High-Graded
Traditional	6.26	6.69	4.21	6.08	6.19	6.91	4.04	4.39
Minimally Nontraditional	6.15	6.93	4.22	6.00	7.32	6.96	4.00	5.25
Moderately Nontraditional	5.72	7.15	4.08	5.61	5.32	7.78	3.85	3.42
Highly Nontraditional	6.71	7.21	4.20	6.10	6.89	7.84	4.38	3.38

Table 2

MANOVA Results for CDSII Scores of Low-Graded and High-Graded Students Based on Student Classification

Student Dimension Classification	*df*		*df* error		*F*		*p* value	
	Low-Graded	High-Graded	Low-Graded	High-Graded	Low-Graded	High-Graded	Low-Graded	High-Graded
Locus of Causality	3	3	90	155	1.326	0.729	0.271	0.536
Stability	3	3	90	155	0.049	0.778	0.986	0.508
Personal Controllability	3	3	90	155	5.380	3.804	0.002*	0.011*
External Controllability	3	3	90	155	0.290	5.577	0.832	<0.01*

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A third analysis was conducted on only nontraditional students to examine differences in attributions based on gender. Table 3 shows the mean attribution scores of low-graded nontraditional and high-graded nontraditional students based on gender.

MANOVA was conducted with the independent variable being gender and the dependent variables being scores on the four dimensions of the CDSII. For the high-graded, nontraditional students, Pillai's trace indicated no significant relation between gender and scores on the CDSII, $V = 0.062$, $F(4,122) = 2.004$, $p = 0.10$. When only low-graded, nontraditional students were used, Pillai's trace indicated a significant relation between gender and scores on the CDSII, $V = 0.148$, $F(4, 66) = 2.863$, $p = 0.03$. Table 4 shows the results from the MANOVA on the four dimensions for low-graded, nontraditional students based on gender. Based on gender, the Locus of Causality dimension was statistically significant for low- graded, nontraditional students.

Summary and Discussion

In all subsets of students, the Locus of Causality and Stability means were greater in the high-graded students than in the low-graded students. This indicates students who graded high tended to attribute their success more towards the internal and stable direction. The Personal Controllability means were greater in the high-graded students than in low-graded students for all groups but minimally nontraditional students. For external controllability, both traditional and minimally nontraditional students' attribution scores were higher in the high-graded students as compared to low-graded students. The opposite phenomenon appeared in moderately nontraditional and highly nontraditional students.

Statistical analysis of scores on the Revised Causal Dimension Scale (CDSII) indicated no significant differences in the Locus of Causality dimension or the Stability dimension based on student classification for either low-graded or high-graded students. For both low-graded and high-graded students, statistical analysis of the Personal Controllability dimension indicated significant differences based on student classification. A post-hoc Tukey's test revealed a significant difference between low-graded minimally nontraditional ($M = 7.32$) and highly nontraditional ($M = 6.89$) students, and low-graded moderately nontraditional ($M = 5.32$) students. This finding could indicate moderately nontraditional students are more susceptible to ideas of "learned helplessness" than minimally and highly nontraditional students.

For high-graded students, post-hoc Tukey's test indicated moderately nontraditional ($M = 7.78$) and highly nontraditional ($M = 7.84$) students differed significantly from traditional ($M = 6.91$) students in Personal Controllability dimension. Highly and moderately nontraditional students attributing their high exam scores in the direction of personally controllable more so than traditional students could be explained by what Gupta, Harris, Carrier, and Caron (2006) mentioned as a sense of urgency to learn among older students.

For the External Controllability dimension, there was no significant difference among all low-graded students' scores. However, for high-graded students, statistical analysis of the External Controllability dimension revealed significant differences based on student classification. Post-hoc Tukey's test revealed high-graded minimally nontraditional ($M = 5.25$) students differed significantly from moderately nontraditional ($M = 3.42$) and highly nontraditional ($M = 3.38$) students. The occurrence of moderately nontraditional and highly nontraditional students scoring higher on Personal Controllability than External Controllability may represent the notion that these dimensions represent the opposite poles of a single dimension. However, the model of using four factors has been shown to provide a better fit of data than a combination in which these two dimensions are collapsed into one (McAuely, Duncan, & Russell, 1992).

Although a statistically significant difference between student classifications did occur among high-graded students in Personal Controllability and External Controllability scores, it was not considered a meaningful difference. All high-graded students attributed their scores towards personally controllable aspects, and all but the minimally nontraditional high-graded students leaned towards externally uncontrollable aspects (see Table 1). The differences came in how strongly they felt about these aspects. Both moderately nontraditional and highly nontraditional students felt their high grades came from a more personally controllable aspect and from more of an externally uncontrollable aspect than did the traditional and minimally nontraditional students.

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Table 3

Mean Attribution Scores for Low-Graded and High-Graded Nontraditional Students by Gender

Student Dimension Classification	Male		Female	
	Low-Graded	High-Graded	Low-Graded	High-Graded
Locus of Causality	5.48	6.80	6.40	7.27
Stability	3.98	5.45	4.34	6.00
Personal Controllability	5.87	7.77	6.34	7.64
External Controllability	4.47	3.63	3.78	3.64

Table 4

MANOVA Results for CDSII Scores of Low-Graded, Nontraditional Students by Gender

Student Dimension Classification	*df*	*df* error	*F*	*p* value
Locus of Causality	1	69	5.258	0.025*
Stability	1	69	0.716	0.400
Personal Controllability	1	69	0.824	0.362
External Controllability	1	69	2.470	0.121

* Statistically significant using p value = 0.05

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Attribution Differences of Nontraditional Students by Gender

Statistical analysis of scores on the Revised Causal Dimension Scale (CDSII) indicated no significant differences between low-graded, nontraditional males and females in Stability, Personal Controllability, or External Controllability dimensions. Overall, the low-graded nontraditional males and females attributed their scores towards unstable, personally controllable, and externally uncontrollable directions. In the Locus of Causality dimension, there was a significant difference in low-graded, nontraditional students based on gender. Low-graded, nontraditional females (M = 6.40) tended to attribute the exam result more towards Internal attributes whereas low-graded, nontraditional males leaned more towards External attributes (M = 5.48).

Limitations

Participants in this study were limited to those students enrolled in 24 sections of intermediate algebra at a community college in southern Mississippi. The participants were not randomly selected. The study was limited to the spring semester of 2011. Of these sections during this time frame, only 331 questionnaires were returned, which may not be enough responses to accurately examine the relationship between student classification and causal attributions based on exam grade. There was no uniformity in curriculum, grading scales, or in examinations for sections in which the questionnaires were administered after.

Implications for Practice and Future Research

Understanding causal attributions of students can provide additional insights related to student success and strategies to interrupt the belief of learned helplessness. Findings regarding attributions of low-graded students suggest early instructor intervention to try and improve future grades. Kloosterman (1984) says instructors can emphasize to students that it is within their power to change their performances (internal, controllable), especially in nontraditional males, and that future performances can improve (unstable). This is a form of "attributional retraining." Causal dimension scales could be administered early in the semester, perhaps after the first assessment, in hopes to identify attribution patterns among individual students. After sharing assessment results, student awareness of the impact of academic attributions on their success could be cultivated in orientation sessions and freshman seminar courses. Alternatively, part of a class session or lab could focus on attribution theory and its application to an individual student's success.

Workshops could be developed to help instructors—as well as advisors and counselors—understand how attributions towards success and failure impact achievement in mathematics courses and how the instructors can "retrain" external, unstable, and/or uncontrollable attribution tendencies among students. For low-graded, nontraditional females, Stage and Kloosterman (1995) suggest self-confidence is the key to success for these students. Boekaerts, Otten, and Voeten (2003) recommend presenting mathematical tasks as "manageable," so self-confidence is high and effort is maximized. For high-graded students, positive reinforcement for successes can be given by the instructors, specifically crediting the student's internal and stable factors, such as ability (Perry & Magnusson, 1989). For the traditional and minimally nontraditional students, instructors can be mindful that these students tended not to credit their grades to controllable aspects as much as the other students in this study. Therefore, positive reinforcement, reiterating to these students their successes were within their control, may be helpful.

> *Student awareness of the impact of academic attributions on their success could be cultivated.*

More research is needed using all three dimensions described by Weiner (1986) to identify how successful and unsuccessful students attribute results. Also, research into differences in causal attributions based on gender, race, socioeconomic status, and mathematics self-efficacy need to be explored. Continued research could be conducted with a larger sample size over several different geographic areas. The time frame could be expanded and track students over several semesters as they work through their developmental mathematics requirements to see if attributions change over time and course experience. Interviews with low-graded and high-graded students from all classifications would be beneficial in helping to identify differences in attributions. Examination of attributional intervention in a developmental mathematics course would also be helpful to determine any effect of changed or unchanged attributions. This type of study would be advantageous in deciding if attributions can be altered, if one particular subset of student is more susceptible to change than another, and if people with changed attributions experience increased success as the semester continues.

Research into predicting success or failure using causal attributions, along with other factors such as academic history, mathematics self-efficacy, demographic data and socioeconomic status, could be conducted in order to better understand the degree to which each contributes to success in mathematics. Each college mathematics course, developmental and nondevelopmental, could be explored to see if differences exist. This could help identify areas of emphasis and provide valuable indicators for instructors as to which students are more likely to succeed in their courses.

Conclusion

The results of this study provide preliminary evidence of different attributions towards exam grades in developmental mathematics based on student classification. Determining a relationship between students' attributions and grades can help educators to create a learning environment more suitable to the students and to implement strategies to disrupt the development of learned helplessness. Also, identification of differing causal attributions in traditional and nontraditional students may allow educators to address the differences and support higher rates of success in college mathematics courses, especially for the growing pool of nontraditional students.

By providing training to college personnel and individual students regarding insights to attributions' impact on academic success, low-scoring, nontraditional students in developmental mathematics courses could be refocused toward feeling more personally in control of assessments like exam grades. Having the feeling of personal control over an outcome is a significant predictor of future success (Weiner, 1986). Increasing success rates in developmental mathematics among nontraditional students is necessary to improve overall graduation rates at community colleges and universities, and hence fill much-needed science, technology, engineering, and mathematics careers for the 21st century.

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