Exploring Pre-Service Teachers' Perceptions of Student Attributions in Mathematics

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This paper investigated pre-service teachers' perceptions of student attributions and mathematics performance. Participants from two universities in Alabama (N=80) consisted of 72.5% female, 75.9% white, 21.5% African American, 2.6% other, 44.3% juniors, 38% seniors, 16.5% graduate, and 1.3% sophomores. Results indicate 87.6% of participants agreed that when a student succeeds in mathematics it is because of his/her effort, while 93.8% agree that when a student fails in mathematics it is because the tasks are hard. The results point to the need for both pre-service and in-service teachers to be aware of their own views related to students' success/failure in mathematics.

Introduction

The most dangerous, yet most persistent myth associated with mathematics education is that "success in mathematics depends more on innate ability than on hard work" (National Research Council, 1991, p. 10). In order to increase success in mathematics it is imperative that researchers and teachers understand what is causing students to fall behind. This starts with what they attribute success and/or failure to and what is considered actual success for them. While studies define what attribution is and causes of success and/or failure, they have fallen short in providing practical information for the regular classroom teacher.

Because much of the research is outdated, new studies could provide evidence as to whether or not teachers are aware of their own attributions and how their own attributions could impact their approaches to teaching mathematics. Awareness of student attributions could prove useful in assisting pre-service teachers and how they deal with students in the classroom regarding success and failure. Therefore, there seems to still be a need to examine factors that affect mathematics achievement for these groups of students. In particular, there exists a need to further examine attribution and how it impacts the learning and success of mathematics.

Theoretical Background

According to attribution theory, individuals attribute their successes and failures to either internal or external causes (Dweck, 1986; Weiner, 1974). Individuals who are internally motivated attribute their success to ability or effort and take personal responsibility for their performance. On the other hand, individuals who are externally motivated attribute their success to factors outside of their control such as luck or task difficulty (Powell & Caseau, 2004).

Others (e.g., Frieze, 1976; Frieze & Snyder, 1980; Weiner, 1985) have identified ability and effort as perceived causes of individual success or failure. Success is often seen as the result of personal competence, whereas failure can be overcome by effort. Ability can be characterized as consisting of aptitude and learned skills, while effort is the level of exertion applied

to a situation, either temporarily or over time (Weiner, 1979). These principles can be applied to classrooms when a teacher wants to explore a student's classroom performance in order to increase his or her academic success.

House (2006) reported that students who felt that success in mathematics in school required memorizing the textbook or notes and good luck were more likely to have earned lower algebra test scores. In addition, two self-belief variables (mathematics is not one of my strengths and success in mathematics at school requires memorizing the textbook or notes) showed significant negative relationships with algebra knowledge. Students who attributed their success in mathematics at school to external factors (such as good luck) tended to earn lower algebra test scores while students who reported that they enjoyed learning mathematics tended to show higher test scores.

Numerous studies report similar findings in their research studies (Wentzel & Wifield, 1998; Schunk & Gunn, 1985; Frieze, 1980; Harari & Covington, 1981; Nicholls, 1978). For instance, students who attribute success to external factors (i.e., good luck) tend to show lower achievement than students who attribute success to internal factors (i.e., ability). A second similar finding is that students often attribute their success to ability and effort with ability increasing and effort decreasing with the increasing age of the student. Research also demonstrates that attributional feedback liking children's learning with attributions can have important effects. For example, teacher verbal feedback that attributes students' successes to their abilities (e.g., "you're good at this") leads to higher motivation, self-efficacy and skill development than feedback linking successes to effort (e.g., "you've been working hard"). When children learn a task readily, ability feedback for their early successes promotes achievement outcomes better than ability feedback for later successes. Teachers who judiciously deliver attributional feedback during classroom learning activities may help to develop students' skills and self-efficacy for applying them.

Statement of Purpose

The purpose of this study was to investigate pre-service teachers' perceptions of student attributions and how student attributions can influence the success and failure of students in mathematics.

Methods

Participants

The subjects in this study consisted of eighty (N=80) pre-service teachers from two universities in Alabama, The University of Alabama at Birmingham (UAB) and The University of Alabama (UA). Of these students, 72.5% were female, 75.9% described themselves as white, 21.5% described themselves as African American, and 2.6% indicated other. Thirty-five (44.3%) indicated they were juniors, thirty (38%) indicated they were seniors, thirteen (16.5%) indicated they were graduate, and one (1.3%) indicated they were a sophomore.

Survey

Participants were asked to complete a Mathematics Attribution Scale which included demographic information as well as questions asking them to consider the relation that certain factors have relative to students' success and failure in mathematics.

An attribution scale was constructed which included five success attributions and five failure attributions in relation to students in mathematics. The questions included were Likert-scale (4 point; almost never, sometimes, often, or almost always) items with five success attributions including ability, effort, luck, rapport with the teacher, and task difficulty (e.g., the assigned task seemed

easy) and with five failure attributions including lack of ability, lack of effort, bad luck, poor rapport with the teacher, and task difficulty (e.g., the assigned task seemed hard). Following each item, students were asked to comment in order to gain a deeper understanding of their response to the item.

The mathematics attribution scale (MAS) is an adaptation of the Attribution Survey previously used to explore the relationship between high school students' beliefs about mathematics and their mathematical performance (Schoenfeld, 1989). Reliability results from the original study were not reported and were unable to be retrieved despite personal communication with Schoenfeld. Reliability coefficients for the success subscale and failure subscale from the first adaptation were .27 and .65.

Cronbach's alpha coefficient for internal reliability of the attribution scores was determined for this study. Reliability coefficients for the success subscale and failure subscale were .34 and .65. Frequencies for each item were assessed using SPSS 15.0 version for Windows. Reliability was further assessed using a procedure by Withall (1949) designed when using a judge and a reliability coder. In order to assess reliability for this adaptation of the MAS, a graduate student was recruited as an outside coder. 100 cases were selected and coded by the researcher and the one outside coder in order to establish themes. An 80% level of agreement was reached between coders.

Procedure

Participants were selected from two universities in Alabama who were majoring in mathematics education and were currently enrolled in a mathematics methods course. Of the two universities that participated, surveys were distributed to the instructors of the mathematics methods courses and were completed either during a class period or outside of class. The survey completion time was at the discretion of the instructor. A total of 93 surveys were distributed to the participating instructors and 80 were returned, resulting in a response rate of 86%. Each participate completed a survey instrument that included sections pertaining to demographics and the relation that certain factors have relative to students' success and failure in mathematics.

Results

In order to examine pre-service teachers' perceptions of students' attributions each attribution factor was examined in relation to students' success and failure in mathematics. For each of the ten items (Appendix A) frequencies were calculated (Table 1). Results for the success factors indicate that 48 (60.0%) agreed when a student succeeds in mathematics, it is often or "almost always" because of his/her ability. Seventy (87.6%) felt that when a student succeeds in mathematics, that it is "often" or "almost always" because of his/her effort. When a student succeeds in mathematics, 61 (76.3%) agreed that it is "almost never" because of luck. When asked if when a student succeeds in mathematics it is because he/she does not get along with the teacher, 61 (76.3%) indicated "almost never". Sixty-three (78.7%) felt that when a student succeeds in mathematics that it is because "sometimes" the tasks are easy.

Results for the failure factors indicate that 52 (65.0%) felt that when a student fails in mathematics it is "sometimes" because of his/her lack of ability. When a student fails in mathematics, 61 (76.3%) believed that it was "sometimes" or "often" because of his/her lack of effort while 19 (23.8) felt that it was "almost always" the case. Seventy-five (93.8%) agreed that "almost never" did a student fail in mathematics because of bad luck and seventy-nine (98.8%) indicated that it is "almost never" or "sometimes" because he/she does not get along with the teacher. When a student fails in mathematics, 75 (93.8%) believed that it was "sometimes" or "often" because the task are hard.

Table 1 Success and Failure Factors

Factors		Frequency 0-100 (N=80)	Percentage 0-100%
Success			
	Item 1	48.0	60.0
	Item 2	70.0	87.6
	Item 3	61.0	76.3
	Item 4	61.0	76.3
	Item 5	63.0	78.7
Failure			
	Item 6	52.0	65.0
	Item 7	61.0	76.3
	Item 8	75.0	93.8
	Item 9	79.0	98.8
	Item 10	75.0	93.8

Following each survey item, participants were given the opportunity to provide open-ended responses relative to the item. Responses were categorized into common themes and then percentages were calculated for each occurring them (Table 2 and Table 3). For Item 1 (success-ability), the most common theme reported was related to the teacher (26.1%) (e.g., "teacher is a huge part", "the teacher is easy", etc.). For item 2 (success-effort), the theme that occurred the most was related to effort (34.2%) (i.e., "effort must be given", "effort is the most important aspect", etc.). The most common theme to emerge for Item 3 (success-luck) was related to no luck (77.4%). For example, "there isn't any luck in math", "luck doesn't make you succeed", and "there is no such thing as luck". For Item 4 (success-relation with teacher), the majority of the comments were categorized as "other" because they did not yield clear responses. "Sometimes" (27.3%) was the most common theme to emerge for Item 5 (success-task easy).

When considering failure, the most common theme for Item 6 (failure-ability) was "other" (36.7%). Item 7 (failure-effort) had "effort" (51.7%) to emerge as the most common theme

Table 2 Emerging Themes (Success Items 1-5)

Theme		N 0-100 (N=80)	% 0-100%
Item 1			
	Work Hard	9	19.6
	Ability	6	13.0
	Study Habits	3	6.5
	Effort	8	17.4
	Naturally Talented	8	17.4
	Ability with Effort	1	2.2
	Teacher	12	26.1
	Student	7	15.2
Item 2			
	Effort	13	34.2
	Teacher	2	5.3
	Try	10	26.3
	Ability with Effort	2	5.3
	Natural Ability/ Talent	2	5.3
	Determined	1	2.6
	Work Hard	4	10.5
	No Effort	3	7.9
	Improvement	1	2.6
Item 3			
	No Luck	24	77.4
	Teacher	1	3.2
	Guessing	3	9.7
	Multiple Choice	3	9.7
Item 4			
	Effort	1	3.2
	No Difference	7	22.6
	Possible	2	6.5
	Relationship	4	12.9
	Prove Wrong	2	6.5
	Other	15	48.4

vwhile for Item 8 (failure-luck), luck did not seem

Theme		N 0-100 (N=80)	% 0-100%
Item 5			
	Sometimes	9	27.3
	Hard Work	3	9.1
	Student	2	6.1
	Teacher	5	15.2
	Effort	1	3.0
	Practice	1	3.0
	Not Always	2	6.1
	No Difference	3	9.1
	Prove Wrong	1	3.0
	Other	6	18.2

*Some themes may add to more than 100% due to a comment fitting into more than one theme.

to have anything to do with failure as the most common theme to emerge was no luck (20.0%). The most common theme to emerge for Item 9 (failure-relation with teacher) was relationship with the teacher (57.7%) and for Item 10 (failure-task difficult), other (40.0%) was the most common theme due to inconsistent responses.

Discussion

The results of this study confirmed many of the previous findings related to attribution theory in general and to mathematics learning in particular. Internal and external attributions of success and failure were consistent with that predicted by attribution theory. This study does look at attribution from the viewpoint of future teachers. The results point to the need for both pre-service and in-service teachers to be aware of their own views related to students' success or failure in mathematics.

Internal attributions of success, respectively ability and effort, are important in determining if future teachers hold fast to the myth that success

Table 3 Emerging Themes (Failure Items 6-10)

Theme		N 0-100 (N=80)	% 0-100%
Item 6			
	Sometimes	1	3.3
	Lack of Effort	2	6.7
	Math Skills	2	6.7
	Lack of Ability	2	6.7
	Not Trying	3	10.0
	Teacher	3	10.0
	Student	5	16.7
	Work Hard	1	3.3
	Overwhelmed	1	3.3
	Other	11	36.7
Item 7			
	Effort	15	51.7
	Other	3	10.3
	No Effort	1	3.4
	Capable	1	3.4
	Attitude	1	3.4
	Motivation	3	10.3
	Willing to Try	1	3.4
	Lack Drive	2	6.9
	Teacher	1	3.4
	Learning Disability	1	3.4
	Lacks Foundation	1	3.4
Item 8			
	Back Luck	2	10.0
	No Luck	14	70.0
	Don't Try	1	5.0
	Other	2	10.0
	Not Prepared	1	5.0
Item 9			
	Bad Teacher	2	7.7
	Student Choice	1	3.8
	Relationship with Teacher	15	57.7
	Other	8	30.8

Table 3 Cont.

Theme		N 0-100 (N=80)	% 0-100%
Item 10			
	Didn't Study	1	4.0
	Hard	9	36.0
	Other	10	40.0
	Lack of Ability	2	8.0
	Teacher Hard	1	4.0
	Trying	1	4.0
	Effort	1	4.0

*Some themes may add to more than 100% due to comment fitting into more than one theme.

in mathematics depends more on innate ability than on hard work. While 60% of respondents agreed that success in mathematics was strongly influenced by ability, 70% agreed that success could be attributed to effort. This is encouraging in that, although they see ability as an important factor in success, effort appears to be an even stronger factor in their view. Thus, they don't seem to hold strongly to the myth of success in mathematics being attributed to innate ability. Hopefully, this will translate into their teaching practices and to their belief that all children can learn mathematics.

External attributions of success such as found in Item 3, luck, were not viewed as key reasons for success in mathematics. The respondents perceive luck as having little impact on success in mathematics. Again, coming from future teachers, this is encouraging. They view success as being in the control of the learner rather than as a result of external factors. Teachers can impact the learning of students by rewarding them with specific, sincere praise of their abilities when they succeed on tasks. Likewise, encouragement and praise for strong efforts can result in improved achievement. Almost 79% of respondents did see that task difficulty, such as having an easy task, could be a determinant in student success. This is a logical viewpoint because having tasks that are easy should yield high scores.

In making attributions related to failure, 65% of respondents did view ability as a cause and about 76% viewed lack of effort as a contributing factor in failure. The percentages for both of these reasons for failure were higher than their comparable reasons for success. Although these future teachers do see lack of ability as a cause for failure, they feel even more strongly that lack of effort is a factor in students' failure. This is noteworthy for these future teachers to be aware of in dealing with students. They should be cautious in ascribing the amount of effort given by a student. They should carefully consider if it is indeed a lack of effort or if it is merely their own perception of a student's effort. A quiet student or a student who is not confident may appear to not be giving effort based on quick observations, but indeed they may have put forth a good deal of effort out of the public eye. The teacher would need to look more closely and get to know the student well before making a quick judgment of effort. Otherwise, the teacher could develop a fatalistic view that the student fails because he/she does not try hard enough. The teacher in turn might not make as much effort to try to help the student in such a case.

The subjects' responses in the open-ended comments revealed more details about their views on attribution. Their comments about teachers indicate that they view teachers as being an important factor in the success of students. This indicates their awareness of the critical role that they will play in the mathematics education of children. Hopefully, this inspires them to learn as much about mathematics and teaching as they possibly can so that they will have a positive influence on their students. They also believe that hard work pays off for students. They can encourage their own students in regards to the value of a strong effort by their own demonstration of hard work in teaching and

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through acknowledgement of good efforts by students in problem solving. Students may also be inspired by seeing that even a teacher can struggle with a problem, but with persistence is able to solve difficult problems. Not always knowing the answer, but being willing to work to find an answer, is a good trait for teachers or future teachers to exhibit.

Limitations/Recommendations

One of the major limitations is the low reliability of the instrumentation, especially for the success subscale. A second limitation included the fact that the subjects agreed to participate. In addition, there was no randomization due to the participants previously being enrolled in mathematics methods courses.

While it has increased some since the first adaptation, considerable efforts need to be made in order to increase the reliability of this particular instrument. Thus far mathematics education research in this area has been rather limited over the past few years. Future research should focus on the development and study of intervention strategies involving beliefs related to ability and further development of a model involving mathematics learning, attributional styles, and specific attributions. The objective is to help mathematics students develop successful strategies for coping with or avoiding failure. Further examination of the ways in which young children explain success and failure under a variety of school conditions could prove to be of significance.

A new direction of research could examine when and at what age students develop or form distinct conceptions of ability and effort. Awareness of student attributions could prove useful in assisting both pre-service and in-service teachers and how they deal with students in the classroom regarding success and failure.

This study looked at the views of pre-service teachers on attributions. Perhaps they are naïve in their views, or their views are shaped due to only thinking in the role of a student for most of their lives. Will their views change once the realities of teaching hit them when they enter the classroom? Will they maintain idealistic views such as all children are capable of learning mathematics? Or, will they fall back to the pessimistic view that some children are born with innate abilities and some aren't, and thus fate has set them up for success or failure? A longitudinal study might look at the degree to which a pre-service teacher's beliefs about attribution remain stable over a number of years of actual teaching.

As the subjects in this study have indicated, teachers do play a key role in the success or failure of students. If teachers are aware of their own beliefs and the impact of such beliefs on children, then they are in a better position to help students succeed and to help students deal with failures.

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Appendix

Appendix A Survey Items

Factor	Survey Item
Success	
"When a student succeeds in mathematics":	
	Item 1: it is because of his/her ability
	Item 2: it is because of his/her effort
	Item 3: it is because of luck
	Item 4: it is because he/she does not get along with the teacher
	Item 5: it is because the tasks are easy
Failure	
"When a student fails in mathematics":	
	Item 6: it is because of his/her lack of ability
	Item 7: it is because of his/her lack of effort
	Item 8: it is because of bad luck
	Item 9: it is because he/she does not get along with the teacher
	Item 10: it is because the tasks are hard