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Relationships and Gender Differences in Math Anxiety, Math Self-Efficacy, Geoscience Self-Efficacy, and Geoscience Interest in Introductory Geoscience Students

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Abstract: While the role of affective factors in learning is well understood in geoscience, math attitudes have been overlooked. This study sought to explore the relationships between math attitudes and geoscience attitudes, namely math anxiety, self-efficacy, and geoscience interest. Baseline data were collected from 245 undergraduate students enrolled in introductory geoscience courses at three colleges and universities in the United States, with self-report measures of math anxiety, math self-efficacy, geoscience self-efficacy, geoscience interest, and demographic information. Results show strong relationships and predictive values of math attitudes for students' geoscience attitudes, particularly for female-identifying students. This research provides important empirical support for the study of math attitudes in geoscience; additionally, educators can use this knowledge to inform their understanding of their students' math attitudes and possible interest in geoscience.

Keywords: geoscience; math anxiety; self-efficacy; interest; gender differences

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1. Introduction

The role that quantitative skills play in students' success in introductory geoscience courses has been the focus of many studies since the beginning of this century (e.g., [1–9]). Additionally, in the past decade and a half, many geoscience-discipline-based education researchers have focused on the affective domain as an important aspect of teaching and learning [10–18]. However, studies that explore the development of interest and self-efficacy in geoscience have generally focused on the role of field and research experiences [19–23], with little attention paid to the role of math attitudes in student success. The current study provides initial evidence for the complex relationships that math and geoscience attitudes have and the role they play as predictors of geoscience interest.

The current research explores relationships among math anxiety, math self-efficacy, geoscience self-efficacy, and geoscience interest and, based on these relationships, examines whether geoscience interest is predicted by the other three measures. Additionally, the current study investigates gender differences among the study variables and prediction of interest.

This research was guided by the following questions:

- RQ1: What are the relationships among math anxiety, math self-efficacy, geoscience self-efficacy, and geoscience interest in a sample of undergraduate students in introductory geoscience courses?
- RQ2: Is students' geoscience interest predicted by math anxiety, math self-efficacy, and geoscience self-efficacy?
- RQ3: Are there gender differences in the relationship between study variables or in how study variables predict interest?

1.1. Math Skills as a Barrier in Geoscience

Geoscience educators, particularly those who teach introductory courses, have been concerned about their students' quantitative skills and literacy for decades (e.g., [2,3,5–9]). Despite the public misperception of geoscience as being less mathematically intensive than other sciences [24,25], quantitative skills and topics regularly and recurrently appear in geoscience content [7]. Thus, the public misperception may attract math-averse students to introductory geoscience courses. As a result, these courses are often populated by students with negative attitudes toward math and/or low quantitative skills and literacy. Negative math attitudes and poor math skills can be significant barriers to learning geoscience, particularly when students are asked to apply or transfer mathematics concepts to unfamiliar contexts [26–28].

Many studies have shown that students are more likely to succeed at quantitative tasks when mathematical concepts or statistical approaches have a meaningful context [7,9,29,30]. Providing occasions to apply mathematics to well-conceived contextual examples throughout introductory courses can increase students' motivation and self-efficacy [8,31,32]. Furthermore, providing support for students to learn quantitative content in context may result in a more "level playing field" for all students, providing multiple opportunities to succeed [9]. Support that has intentionally been designed to encourage students to succeed at contextual mathematics applications within a quantitative introductory STEM course has been successful at increasing student skills [9,31].

1.2. Math Anxiety and Efficacy as Barriers in Geoscience

While math can serve as a barrier to student success in geoscience due to low math skills, for between 25 and 80% of students in the United States [33,34], math is a barrier to their success, due to math anxiety. Students with high math anxiety experience a fear-based reaction to learning, using, and thinking about math that results in worry and tension [35,36]. Neurological research shows the activation of neural pain networks when highly math-anxious students think about math, suggesting that for math-anxious students, math is actually painful [37]. Research consistently shows that math anxiety is negatively correlated with math performance; that is, students with high levels of math anxiety generally experience low levels of math achievement [33,38]. Higher levels of math anxiety can disadvantage students as early as preschool [39] and are shown to negatively correlate with children's math performance beginning in elementary school [40] and continuing through college [41] and into their professional lives [42]. Students with high math anxiety are also likely to hold negative attitudes toward math [43] and themselves [44,45] and to have a propensity to avoid new or potentially evaluative situations even outside of mathematics [46]. Headley [47] recently successfully explored an intervention for math anxiety in geoscience courses, showing geoscience instructors' awareness of math anxiety as an issue for geoscience students.

While those with high math anxiety may experience a math performance deficit due to a lack of foundational quantitative skills [48], it is more likely that a combination of cognitive (e.g., reduced working memory capacity) [49,50] and affective (e.g., lowered math self-efficacy) [45,51] variables interfere with students' math ability. Math self-efficacy, confidence in one's ability to successfully complete specific math tasks, has been revealed as a particularly important variable in math anxiety; Palestro and Jameson [52] found that math self-efficacy mediates the relationship between anxiety and performance, while emotional self-efficacy (i.e., confidence in one's ability to recognize and regulate their emotions) does not. Akin and Kurbanoglu's [53] path analysis showed that math self-efficacy negatively predicted math anxiety with low levels of self-efficacy corresponding to high levels of math anxiety. Math self-efficacy is considered central in how math anxiety affects performance and attitudes.

1.3. Math Attitudes and Geoscience Interest

Interest is generally defined as an individual having knowledge about something and placing value on having that knowledge [54,55]. High levels of interest in a topic typically lead to increased exposure, enhanced learning, and subsequent engagement with that topic [56–59]. Interest and self-efficacy are associated and, together, they shape an individual's future goals [60–62]. Social cognitive career theory (SCCT) research has shown that math and science attitudes (e.g., self-efficacy, anxiety, and outcomes expectations) are predictive of students' level of interest in science, generally, and students with higher levels of science interest are more likely to select and persist in science majors [62,63]. Specifically within geoscience, interest is an important reason that students select a geoscience major [21,64–66]. Interest in geoscience can be triggered by affective experiences during or connected to a geoscience event [12,67].

Because of research in science, generally, and the role of affective variables in geoscience interest, a relationship likely exists between math attitudes and geoscience interest. However, no known studies examine how math attitudes, like math anxiety and math self-efficacy, are associated with geoscience interest.

1.4. Gender, Math Attitudes, and Geoscience Interest

The number of women enrolled in and graduating from undergraduate geoscience programs has remained stable at around 40% over the last 20 years [68]. For these women, and those who leave the major, many barriers exist within departments and classes that can make it more difficult for them to succeed. These barriers can detract from recruitment efforts directed toward attracting women to the geosciences [69]. One such barrier is a persistent unwelcoming and hostile climate [70,71], resulting from gender stereotypes, microaggressions, sexual harassment, and gender discrimination [71–73]. Male-dominated academic disciplines (e.g., STEM fields) tend to contain and support more negative gender ideologies and science/math stereotypes about women [74] than disciplines with more equitable gender representation (e.g., humanities). The sciences are stereotyped as a 'masculine' domain, requiring more 'masculine' traits and skills, particularly due to the connection between science and math [75,76]. The existence of a gender–math stereotype can activate stereotype threat for women, in which fear of confirming the stereotype arouses and increases anxiety and leads to reduced performance [77]. Women's belief in the gender–math stereotype is directly correlated with decreased math performance and a decrease in desire to pursue math-related degrees in university [78–81]. Women who are successful in STEM are less likely to believe gender–math stereotypes and are less influenced by stereotype threat [82]. Women also tend to experience higher levels of math anxiety and lower levels of math self-efficacy than men [83,84], even in research using implicit measures of anxiety [85].

1.5. The Current Study

Factors such as emotions and confidence influence students' interest, choices, and performance in science-based fields. A low math anxiety in adolescence is predictive of selecting a STEM major in college [86], particularly for female students [87]. Throughout college, high levels of math anxiety predict more STEM avoidance and lower STEM performance, distinct from math ability [88]. Recent studies that explored math anxiety in chemistry found positive relationships between math anxiety and chemistry anxiety in both traditional and online settings [89,90]. Math self-efficacy is also related to interest in STEM and selecting a science-based major in college [91,92]. Though geoscience education, researchers are aware of the role of general affective factors in student learning e.g., [13] and recruitment and persistence in geoscience majors [21,64–66], there is a dearth of literature related to the role of math attitudes in geoscience.

2. Materials and Methods

2.1. Participants

Participants in this study included 245 undergraduate students enrolled in introductory geoscience courses from three colleges and universities in the United States. We focused on data collection in introductory geoscience classes, because they serve as a critical context to recruit students to be geoscience majors [64].

The entire sample was composed of 117 (47.8%) women, 106 (43.3%) men, and 22 (9%) gender minority participants, who self-reported through a question asking their gender identity. Race and ethnicity demographics of participants were self-reported as 0.8% American Indian or Alaskan Native, 2.5% Asian, 6.9% Black, 11.9% Hispanic or Latinx, 1.3% Middle Eastern, 4.9% multiracial, 6.4% who preferred not to answer, and 64.4% white. Most participants were not international students (230; 95.4%).

Approximately one-quarter of the sample identified as first-generation college students (62; 25.7%) and represented all years in school (first-year: 36.9%; sophomore: 32.8%; junior: 17.2%; senior: 10.1%; not working towards degree/not listed: 3%). In total, 11 (4.5%) participants in the sample had a declared major in geoscience, while the remaining participants were from a broad range of majors. See Table 1 for each institution's descriptive information and participant demographics. All participants provided informed consent before completing the survey.

Table 1. Descriptive information for each data collection site.

Institution and Participant Characteristics		Site A (n = 98)	Site B (n = 119)	Site C (n = 28)
Institution Information				
Type of institution		2 year	4 year, Ph.D. Granting	4 year, Ph.D. Granting
Years of data collection		2021–2022	2019–2021	2021
Region		Southeast United States	West United States	Midwest United States
Participant Information				
Gender Identity	Nonbinary	3.2%	2.4%	4%
	Men	46.93%	39.2%	48%
	Women	39.6%	55.8%	42%
	Not Reported	8%	3%	6%
Race/Ethnicity	American Indian	1.6%	1%	0%
	Asian	4.1%	2.5%	6%
	Black	11.2%	1.7%	10%
	Latinx	9.2%	11%	18%
	Middle Eastern	1%	0.9%	2.1%
	Multiracial	9%	9%	6%
	White	61.2%	68%	56%
	Not Reported	2%	2.5%	4%
First-Generation Student [a]	Yes	14.6%	30%	42%
	No	76%	65%	50%
	Not Reported	9.4%	5%	8%
Year in School	1st Year	19.5%	30%	36%
	2nd Year	22.4%	33.5%	6%
	3rd Year	--	21.8%	22%
	4th Year	--	12%	22%
	Not Reported/Other [b]	58%	3.3%	14%
International Student	Yes	3.1%	5.8%	2%
	No	94.9%	91.7%	94%
	Not Reported	2%	2.5%	4%

[a] In the United States, a first-generation student is someone whose biological or legal parent(s) have not successfully completed a four-year college degree when the student is in college. [b] Not Reported/Other refers to participants who either chose to not respond to that question or provided additional text explaining something other than the optional categories.

2.2. Materials

To measure math anxiety, the Abbreviated Math Anxiety Scale (AMAS) [93] was used. The AMAS is a nine-item Likert-type scale (1 = low anxiety, 5 = high anxiety) that prompts participants to rate each item in terms of how anxious they would be during mathematical events. Examples include "watching a teacher work an algebraic equation on the blackboard" and "thinking about an upcoming math test one day before." Scores are summed, with total scores ranging from 9 to 45; higher scores indicate higher mathematics anxiety. Hopko et al. [93] report excellent internal consistency (Cronbach's $\alpha = 0.90$) and test–retest reliability ($r = 0.85$ over 2 weeks) of the AMAS; they also provide strong evidence of validity through correlation with a well-established math anxiety measure ($r = 0.85$).

To measure math self-efficacy, the Math Self-Efficacy Scale (MSES) [94] was used. The MSES is a nine-item Likert-type scale (1 = not at all confident, 5 = very confident) that prompts participants to estimate their confidence in their ability to complete specific math tasks in the classroom. Example items include confidence in the ability to "work with decimals" or to "determine the degrees of a missing angle". Responses are summed, with total scores ranging from 9 to 45; higher scores indicate higher levels of math self-efficacy. The MSES has been found to have both a strong internal consistency reliability (Cronbach's $\alpha = 0.93$) and validity through relationships with students' past math grades, scores on an established math self-concept measure, and students' expected math grades [94]. Although the MSES was originally created for use with high school students, internal consistency reliability remained very strong with the current sample (Cronbach's $\alpha = 0.94$).

To measure geoscience self-efficacy (GSES), an adapted version of the Patterns of Adaptive Learning Scales [95] was used. This adapted scale was previously used by Pugh et al. [65,69] in a study investigating the factors associated with recruitment and retention of women in geoscience. Participants use a five-point response scale (1 = strongly disagree; 5 = strongly agree) to indicate their confidence in completing the coursework in their geoscience class. Example items include confidence in the ability to "do even the hardest work in my geoscience course(s) if I try" or feeling "certain I can figure out how to do the most difficult class work in my geoscience course(s)". Responses are summed with the total scores ranging from 4 to 20; higher scores indicate higher levels of geoscience self-efficacy. Previous work with this measure found data collected with the scale had an excellent internal consistency ($\alpha = 0.86$) [96].

To measure geoscience interest (GI), an adapted version of Harackiewicz and colleagues' [58] interest scale was used by relating each item to geoscience. Participants respond with a five-point response scale (1 = strongly disagree; 5 = strongly agree) to indicate the extent to which they are interested in geoscience. Example items include agreement with statements like "I enjoy the geosciences" and "I enjoy doing geoscience activities". Responses are summed with the total scores ranging from 9 to 45; higher scores indicate higher levels of geoscience interest. Previous work with this measure found data collected with the scale had an excellent internal consistency ($\alpha = 0.97$) [96].

All measures can be found in the Supplementary Materials.

2.3. Procedure

Participants completed the measures of math anxiety, math efficacy, geoscience efficacy, and geoscience interest as pre-test baseline measures as part of a larger intervention study. Course instructors who agreed to participate in the intervention study, all separate from the research team, received a link to the online survey, which they shared with students through their learning management system and in-class announcements. All instructors required the completion of the survey for course credit, though participation in the research was voluntary and instructors were unaware of which students provided consent. During the first two weeks of each semester, students were either allotted course time or assigned homework to complete the survey, which included informed consent and research participation, the four measures of interest for this study, items related to college major, and a math performance assessment. The survey took approximately 30 min for students to complete. After two weeks, the survey was deactivated to ensure all participants completed it in the same timeframe. Instructors were informed by the research team of their students who completed the survey, though no additional information from the survey was provided to the instructors.

3. Results

3.1. Scale Psychometrics and Descriptive Statistics

All scales used have internal consistency alpha coefficients ranging from 0.82 to 0.93, in this sample, and none showed an increase in reliability if any items were deleted. Therefore, these inferential analyses and subsequent findings are considered robust. See Table 2 for all scale psychometrics. The descriptive statistics for the entire sample, split by gender, are shown in Table 3.

Table 2. Reliability analyses for all study scales.

Measure/Construct	Internal Consistency Alpha
Abbreviated Math Anxiety Scale	0.92
Math Self-Efficacy Scale	0.93
Geoscience Self-Efficacy Scale	0.82
Geoscience Interest measure	0.93

Table 3. Means and standard deviations for all measures.

Measure/Construct	Men [a]		Women [b]		Men and Women [c]	
	Mean	SD	Mean	SD	Mean	SD
Abbreviated Math Anxiety Scale	23.41	9.22	26.79	8.41	25.18	8.95
Math Self-Efficacy Scale	26.52	8.70	24.25	8.75	25.33	8.78
Geoscience Self-Efficacy Scale	15.92	2.56	15.54	2.34	15.72	2.45
Geoscience Interest measure	31.49	6.69	29.42	7.36	30.40	7.11

[a] n = 106; [b] n = 117; [c] n = 223. Note: Only individuals who self-identified their gender identity as "man" or "woman" are included in Table 3.

3.2. Main Inferential Analyses

To answer research question 1 (What are the relationships among math anxiety, math self-efficacy, geoscience self-efficacy, and geoscience interest in a sample of undergraduate students in introductory geoscience courses?), Pearson's correlations were conducted with total scores for the entire sample on scales measuring math anxiety, math self-efficacy, geoscience self-efficacy, and geoscience interest. The results of these correlation analyses reveal that all variables are statistically significantly related to one another. Students with high math anxiety are likely to report low math self-efficacy, low geoscience self-efficacy, and low geoscience interest. Students with high math self-efficacy are likely to report high geoscience self-efficacy and geoscience interest. See Table 4 for full correlations.

Table 4. Correlations between all study variables.

	Math Anxiety	Math Self-Efficacy	Geoscience Self-Efficacy	Geoscience Interest
Math Anxiety	–	–	–	–
Math Self-Efficacy	−0.408 *	–	–	–
Geoscience Self-Efficacy	−0.382 *	0.413 *	–	–
Geoscience Interest	−0.207 *	0.269 *	0.389 *	–

Note. * significant at $p < 0.01$.

To answer research question 2 (Is students' geoscience interest predicted by math anxiety, math self-efficacy, and geoscience self-efficacy?), hierarchical regression was conducted with total geoscience interest scores as the outcome variable and geoscience self-efficacy, math self-efficacy, and math anxiety entered as predictor variables in individual blocks in the stated order on the entire sample. This analysis allows us to explore which of the entered variables (i.e., geoscience self-efficacy, math self-efficacy, and/or math anxiety) significantly contributes to students' levels of geoscience interest entered by strength of correlation in RQ1. This regression analysis shows that geoscience self-efficacy is the strongest predictor of geoscience interest, accounting for 14.8% of the variance. Math self-efficacy increases the prediction of geoscience interest to 15.9%. Both of these variables are significant predictors of geoscience interest. Math anxiety, however, does not significantly add to the prediction of interest; in fact, when math anxiety is added to the regression analysis, the amount of variance in interest scores decreases to 15.6%. See Table 5 for regression analysis information.

Table 5. Hierarchical regression analysis summary table with geoscience interest as outcome variable.

Variable	Standardized Beta Coefficient	t	*p*	Adjusted R^2
	Block 1			0.148
Geoscience self-efficacy	0.389	6.583	<0.001	
	Block 2			0.159
Geoscience self-efficacy [a]	0.335	5.194	<0.001	
Math self-efficacy [a]	0.131	2.034	0.043	
	Block 3			0.156
Geoscience self-efficacy [a]	0.327	4.887	<0.001	
Math self-efficacy	0.121	1.794	0.074	
Math anxiety	−0.032	−0.487	0.627	

[a] Significant predictor of geoscience interest.

To answer research question 3 (Are there gender differences in the relationships between the study variables or in how the study variables predict interest?), gender differences were examined. To determine whether gender differences exist, the data file was split according to participants' self-reported gender identity and both correlation and regression analyses were run with this gender split. Because the sample size for gender minority participants was quite low compared to gender binary participants, we conducted these statistical analyses on gender differences for the 223 participants who identified as either male or female. While math attitudes and geoscience attitudes are significantly correlated in both men and women, they are significantly more strongly correlated in women. See Table 6 for gender comparisons in the correlational analysis.

Table 6. Comparison of correlations between all study variables by gender.

	Math Anxiety	Math Self-Efficacy	Geoscience Self-Efficacy	Geoscience Interest
Math Anxiety		−0.306 *	−0.407 **	−0.174
Math Self-Efficacy	−0.517 **	-	0.356 **	0.128
Geoscience Self-Efficacy	−0.452 **	0.470 **	-	0.335 **
Geoscience Interest	−0.249	0.349 **	0.437 **	-

Note. The results for women are shown with the shaded cells. The results for men are shown with the unshaded cells. * significant at $p = 0.001$; ** significant at $p < 0.001$.

According to the results of the regression analysis, geoscience self-efficacy is the strongest predictor of interest for both men and women; however, the addition of math self-efficacy decreases the predictive value of interest for men, but increases it for women. In other words, men's math self-efficacy is unimportant for their interest in geoscience but women's math self-efficacy is significantly important for their geoscience interest. See Table 7 for these results.

Table 7. Hierarchical regression analysis summary table comparing gender with geoscience interest as outcome variable.

Variable	Men				Women			
	Standardized Beta Coefficient	t	*p*	Adjusted R^2	Standardized Beta Coefficient	t	*p*	Adjusted R^2
Block 1				0.104				0.184
Geoscience self-efficacy	0.335	3.630	<0.001		0.437	5.215	<0.001	
Block 2				0.095				0.204
Geoscience self-efficacy [a]	0.332	3.342	0.001		0.351	3.738	<0.001	
Math self-efficacy [a]	0.010	0.098	0.922		0.184	1.956	0.053	
Block 3				0.088				0.197
Geoscience self-efficacy [a]	0.317	2.991	0.003		0.353	3.594	<0.001	
Math self-efficacy	0.001	0.014	0.989		0.186	1.821	0.071	
Math anxiety	−0.045	−0.434	0.665		0.007	0.065	0.948	

[a] Significant predictor of geoscience interest.

4. Discussion

While geoscience education researchers have long recognized the importance of affective variables in student learning [10–18], the role of math attitudes in geoscience learning has, historically, been overlooked. This project provides initial evidence for the relationship between math attitudes and geoscience attitudes. The current research results suggest that math attitudes are especially important for women, for whom math efficacy predicts geoscience interest above and beyond geoscience efficacy. For men, however, only geoscience efficacy predicts geoscience interest. Student self-efficacy has previously been related to science identity [97,98] and persistence in STEM [99,100]. Because of the importance of self-efficacy in science overall, and the findings in the current study regarding the importance of math self-efficacy for women, it is possible that math self-efficacy specifically plays a role in womens' geoscience identity and subsequent persistence. While that was not the focus of the current project, our findings on the role of math self-efficacy create avenues for additional work in this area.

While math anxiety was not a significant predictor of geoscience interest, it was significantly related to geoscience interest and efficacy, again more strongly in women. This result suggests that math anxiety is a relevant factor in students' geoscience attitudes. Previous research has shown that math anxiety has a direct effect on math and science career interests for women, but not men [63,87]. These findings suggest that math attitudes are particularly important in women's attitudes in geosciences.

Geoscience majors or students in upper-division courses are likely to be less impacted by negative math attitudes. Because introductory geoscience courses draw from the general education student population, the students' attitudes toward math may differ from the instructors' and/or majors'. It is therefore important to understand introductory geoscience students' math attitudes and how they are related to geoscience attitudes. Introductory geoscience courses are a place to attract and recruit majors [64]. Instructor awareness of math attitudes could result in implementation of interventions to increase student math self-efficacy, to increase geoscience efficacy and interest. These efforts could be especially important for women in introductory geoscience courses who may successfully pass the course, but are unlikely to continue in geoscience, without interventions to mitigate low math self-efficacy and/or high math anxiety. By recognizing and attending to introductory geoscience students' math attitudes, it is more likely they will experience increased interest in geoscience.

Interest is an important predictor of both declaring a geoscience major and retention in that major [12,59,65,66]. Interest is extremely complex and influenced by many factors. The current study adds to our understanding of the interest in geoscience by providing evidence that while geoscience self-efficacy most strongly predicted geoscience interest, importantly, for female students, math self-efficacy is an important predictor of their interest in geoscience. This clearly suggests that improving female students' math self-efficacy should increase their geoscience interest; the increase in interest should attract more women to a major, degree, and career in geoscience.

5. Limitations and Future Research

Because students are typically introduced to math as a formal discipline well before being introduced to the geosciences, it is tempting to use these findings to suggest a causal influence of math attitudes on geoscience attitudes for introductory geoscience students. However, we emphasize that the study was exploratory and correlational in nature. Additional research should explore math attitudes' direct and indirect effects on geoscience attitudes to better understand the causal impact. Despite this limitation, there is a clear relevance of math attitudes in geoscience attitudes. Intervention research with math skills (e.g., The Math You Need, When You Need It, available at https://serc.carleton.edu/mathyouneed/) has shown success in introductory geoscience courses [8,9], and math attitude interventions may improve student learning and success in geoscience. In fact, Headley's [47] recent work showed that a specific intervention, which rephrased geoscience math problems, decreased geoscience students' math anxiety. Headley's work and recent work by our team [101] reveal the importance of math attitudes in geoscience. Future work should continue to explore math attitudes in geoscience and how this knowledge can be used to improve student learning.

We also acknowledge that combining multiple classes of students over multiple academic years across multiple universities may introduce noise or error to the data. However, given the impact of the pandemic on class enrollment sizes, this was necessary for sufficient sample size. All statistical assumptions were checked before main analyses and, because no assumptions were violated, we believe error to be minimized in the project. Additionally, the measures used in the research were previously used scales and we analyzed the internal consistency of each measure; all were found to surpass the generally agreed-upon cutoff for strong internal consistency (alpha = 0.80).

Only 11 participants were declared geoscience majors, limiting our ability to discern how majors' math and geoscience attitudes are different from those of non-majors. Replicating this research in introductory geoscience classes that only consist of geoscience majors would help to understand how math attitudes contribute to geoscience attitudes, thus contributing to better student support and recruitment efforts.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/educsci14040426/s1, all quantitative measures used.

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Data Availability Statement: Due to the nature of our research and participants not providing consent for their data to be shared, data are unavailable.

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