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Perceptions of Science amongst College Students: An Exploration of Tentativeness and Trust

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Abstract: : In this study, we extend the work of Cobern et al. (2022) by investigating college biology students' trust in science, their recognition of its tentative nature, and their perceptions of its accuracy. Understanding the nature of science (NOS)—its epistemological foundations—has long been assumed to foster confidence in scientific knowledge. However, recent discourse, particularly in the wake of the COVID-19 pandemic, raises questions about whether emphasizing the tentativeness of science might undermine trust rather than strengthen it. Our findings suggest a more nuanced perspective: while this ethnically diverse cohort of science majors affirms core scientific principles, including those contentious in public discourse (e.g., human evolution), trust in science is more closely tied to perceptions of its accuracy than to NOS understanding alone. Notably, students who perceive science as highly accurate exhibit significantly greater trust, whereas those with lower accuracy perceptions express greater skepticism. These findings suggest that trust in science is not merely a function of knowledge but is mediated by accuracy judgments, highlighting the need for instructional approaches that balance NOS concepts with clear communication of scientific reliability. The results underscore the complexity of fostering both scientific literacy and trust, with implications for education and future research.

Keywords: accuracy; certainty; durability; nature of science; public understanding of science; tentativeness; trust.
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Introduction

Scientific and technological advancements have transformed modern life, benefiting nearly everyone. Yet, despite these achievements, questions about trust in science have become increasingly pressing. This concern is evident in Naomi Oreskes' (2019) book, Why Trust Science?, which directly engages with skepticism toward scientific claims. The urgency of this issue intensified in the wake of the COVID-19 pandemic, as public confidence in science faced heightened scrutiny.

Among the many hypotheses regarding this decline in trust, the prestigious journal Nature (2017) raised a pointed critique of science education. The journal suggested that the way the nature of science (NOS) is taught in schools might actually encourage excessive doubt rather than confidence in scientific knowledge. This claim challenges a long-standing assumption in science education: that teaching NOS—including the tentative nature of scientific knowledge—fosters trust in scientific claims. Schwartz (2024) echoes this view, arguing that understanding the evolving nature of scientific knowledge builds trust by demonstrating that scientific claims represent the best available explanations to date.

However, empirical data suggests otherwise. A recent study by Cobern et al. (2022) found that many preservice elementary and middle school teachers hesitated to express trust in scientific knowledge, often citing its tentative nature as the reason. Given the lack of data supporting Schwartz's contention, we sought to expand the Cobern et al. study.

Thus, the purpose of this research is to further investigate the relationship between students' trust in science and their understanding of its tentative nature, examining whether an emphasis on scientific tentativeness strengthens or weakens confidence in scientific knowledge.

Research Background and Conceptual Framework:

Scientific knowledge is characterized by both durability and tentativeness. This duality forms the foundation of science education, shaping how students perceive the reliability of scientific claims. Two key theoretical perspectives inform our study: the nature of science (NOS) and the concept of trust. Understanding how these frameworks intersect is essential for designing effective science education strategies that foster both comprehension and confidence in scientific principles.

The nature of science has been a focal point of science education since the curriculum innovations of the 1960s. Among these innovations, Showalter (1974) outlined seven key dimensions of scientific literacy: understanding the nature of science, applying scientific concepts, using scientific processes, fostering critical thinking, evaluating scientific information, recognizing the societal implications of science, and appreciating the excitement of scientific discovery. These dimensions collectively aim to cultivate a well-rounded scientific perspective among students, ensuring that they not only acquire knowledge but also develop the ability to engage with science in meaningful ways.

Of particular relevance to our study is the dimension of understanding the nature of science, which directly informs how students perceive scientific knowledge and its development. This emphasis on NOS has shaped educational policies for decades. Efforts to improve science instruction have consistently highlighted the importance of scientific inquiry and the development of scientific knowledge. By the mid-1970s, NOS had become deeply embedded in science education policy, as exemplified by Showalter (1974) and later reaffirmed in national frameworks such as the National Science Education Standards (National Research Council, 1996) and the Next Generation Science Standards (NGSS Lead States, 2013).

Building upon these foundations, scholars have articulated seven core aspects of NOS, including its empirical basis, the distinction between theories and laws, and its creative and socially embedded nature (Matthews, 2012). These aspects illustrate that scientific knowledge is not static but is continually refined through observation, experimentation, and peer review. Central to this framework is the principle that scientific knowledge is both durable and tentative (Lederman & Lederman, 2014; McComas, 2020). While scientific claims evolve with new evidence, they also represent the best available explanations at any given time, allowing science to advance through a process of refinement and revision.

Despite the longstanding emphasis on tentativeness in science education, the concept of trust has only recently gained attention in this field (see e.g., Science & Education 31:5). Historically, educators have assumed that understanding the nature of science naturally fosters trust in its conclusions, leading students to accept scientific findings as both reliable and credible. However, there is little empirical support for this assumption. The claim that teaching NOS enhances trust is often asserted (Schwartz, 2024) but remains unverified. On the contrary, some research suggests that emphasizing the tentativeness of scientific knowledge may inadvertently undermine trust (Cobern et al., 2022). The absence of the term "trust" in key NOS literature further underscores its limited exploration within science education. Without a structured effort to integrate trust into NOS instruction, students may develop skepticism rather than confidence in scientific knowledge. This highlights the need for deliberate instructional strategies that reinforce both the reliability and the evolving nature of scientific knowledge.

Defining Trust and Its Role in Science

Trust is a common human experience, so much so that people seldom feel the need to define it explicitly. When asked, individuals typically describe trust in simple terms, such as having confidence in someone or something or relying on a person or system to act predictably and dependably. This intuitive understanding, while useful in daily interactions, does not fully capture the complexities of trust in scientific contexts.

From a more technical perspective, trust is a heuristic people use to simplify decision-making in situations involving complex or uncertain information (Siegrist & Cvetkovich, 2000). When individuals lack sufficient knowledge or face ambiguity, trust plays an amplified role in shaping their judgments. It influences behavior in profound ways and is a key factor in consumer decision-making, political attitudes, and public acceptance of science. Businesses, for instance, invest heavily in public opinion research—such as the Edelman Trust Barometer (2025)—to gauge and manage consumer trust in their products and services. In the context of risk analysis, trust is a crucial determinant of how people evaluate the benefits and risks associated with science and technology (Siegrist & Cvetkovich, 2000). The same principle applies to scientific knowledge: if the public does not trust science, even a robust scientific consensus may fail to motivate policy change or behavioral shifts. This has significant implications for public attitudes toward urgent issues such as climate change, vaccinations, and genetically modified organisms (Oreskes, 2019; Dunlap & McCright, 2011).Science education faces the same challenges as other domains where trust plays a crucial role, necessitating careful pedagogical approaches to maintain confidence in scientific claims. However, in order that pedagogy be grounded in evidence, it is important that the science education community develop a better understanding of how students perceive the trustworthiness of science, which is what our research is about.

Following Cobern et al. (2022), we approach trust through the lens of basic emotion theory. Emotions, as Ekman (1992) describes, have "evolved through their adaptive value in dealing with fundamental life-tasks" (p. 169). Trust, like other emotions, has deep evolutionary roots. It has historically played a vital role in human survival by allowing individuals to navigate complex social relationships and cooperative systems. This perspective suggests that trust is not simply a rational calculation but also an instinctive, deeply ingrained response to perceived reliability and credibility. Hence, it is reasonable to ask people if they trust someone or something, which is what agencies such as Edelman Trust Barometer (2025) do.We tested three hypotheses using a survey method. The first two reflect our expectations that students support established scientific claims and perceive science as both accurate and trustworthy despite its tentativeness. The sub-hypothesis and Hypothesis 3 explore the relationship between students' confidence in scientific claims and their understanding of science's nature.

Hypothesis 1: Students express confidence in established scientific claims, regardless of controversy.

Sub-hypothesis: Students with low confidence in controversial scientific claims are also likely to have low confidence in the accuracy and trustworthiness of science but higher confidence in its tentativeness.

Hypothesis 2: Students perceive science as accurate and trustworthy while recognizing its tentative nature.

Hypothesis 3: A positive correlation exists between students' confidence in scientific claims and their confidence in science's accuracy and trustworthiness.

In this study, we widen the scope of inquiry by addressing a population different from Cobern et al. (2022). Our subjects came from a college level, introductory biology course, taught by this paper's primary author. The syllabus for this course does not include explicit instruction on NOS. The data was collected toward the middle of the semester.

By widening the scope of our study population and addressing gaps in existing research, we aim to provide a deeper understanding of how science education influences confidence in scientific knowledge. The findings will offer valuable insights for educators seeking to balance the teaching of the tentative nature of science with the need to foster trust in science.

Methods

Extension Strategy

This study employs a conceptual replication approach to extend prior research on students' trust in science. Replication studies remain rare in education research, comprising only 0.13% of published studies (Makel & Plucker, 2014). Yet, replication is essential for establishing the reliability and generalizability of findings. Given the significance of public trust in science, our study addresses this gap by replicating and expanding upon the work of Cobern et al. (2022) and Mueller and Reiners (2022).

We adopt a conceptual replication strategy, which allows modifications to key study dimensions such as participant demographics and research settings (Chhin, Taylor, & Wei, 2018; Schmidt, 2009). Unlike prior studies that focused on homogenous pre-service teacher education majors, our research examines a broader sample of science majors at a diverse Midwestern university. This methodological variation enhances external validity and provides new insights into the relationship between students' trust in science and their perceptions of its tentativeness. By testing these relationships in a different population and setting, we aim to determine whether previous findings hold or if additional factors influence students' confidence in science.

Study Design

Cobern et al. (2022) employed a survey-based design to investigate preservice K–8 teacher education students' confidence in scientific concepts (both controversial and non-controversial) as well as their views on the nature of science (NOS) as tentative. The instrument avoided testing knowledge directly; instead, all items were framed as "according to the scientific community…" and presented in Likert format with optional comment sections. The items focused on accepted scientific statements (settled science) and were vetted by experienced college science instructors.

Data were collected in 2015 over a three-week period from 305 students enrolled in science content courses at a large Midwestern public university. During the first two weeks, students responded in-class to non-controversial and controversial science items (one set per session). In the third week, NOS items and demographic questions were administered. This spacing was used to reduce carryover effects.

A conceptual replication was carried out in 2017 with a new group of 202 students. Two items from the 2015 survey were revised for the replication due to findings from the initial study:

1. The circulation item, originally intended as a non-controversial concept, produced unexpectedly low confidence ratings. Student comments suggested confusion over phrasing. A reworded item with "face equivalency" was introduced to better capture student understanding.
2. The nature of science (NOS) item, which combined two clauses (durability and tentativeness), was split into two separate items in 2017. This decision was based on analysis showing that students overwhelmingly focused on tentativeness in their written responses. The new items introduced more accessible terms (accuracy and trust) to capture the durable nature of science. See Table 1.

Table 1

Durable and Tentative NOS Statements For 2015 and 2017 (Cobern et al., 2020, p. 1216)

Durable and Tentative NOS Statements for 2015 and 2017

2015	According to the science community, scientific knowledge is durable, but can change in light of new evidence or changes in perspective.
2017	a) According to the science community, scientific knowledge is accurate and can be trusted.
	b) According to the science community, scientific knowledge can change in the light of new evidence.

Comparative statistical tests showed the samples were demographically similar, with only modest shifts in item responses between years. The updated items maintained conceptual continuity with the original survey while improving clarity and interpretability.

Our extension of Cobern et al. (2022), in the form of a conceptual replication, used a study design that mirrored that of Cobern et al. (2022), as described above, assessing students' confidence levels in scientific concepts categorized as non-controversial (e.g., Newton's laws, human physiology) and controversial (e.g., evolution, climate change). We framed the content questions the same way using the introductory phrase: "according to the scientific community." See example in Table 2.

Table 2

Example Of Item Format

Please read the following scientific statement. Then circle a number on the scale to indicate how confident you are that the scientific statement is true. In the box below, briefly explain your choice of confidence level.

Q1 – According to the science community, an object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

1	2	3	4	5
Not at all confident				Very confident

To assess perceptions of the tentative nature of science, we incorporated items from Cobern et al. (2022) while refining measurements of accuracy and trustworthiness. Drawing from Gill et al. (2023a & 2023b), we separated these constructs into distinct survey items to enhance clarity. Prior research has validated the reliability of these measures, and our study continues this validation process. Using a Likert format, we asked, "To what extent do you agree or disagree with the following statements" with the statements being:

Scientific knowledge is accurate

Scientific knowledge can be trusted

Scientific knowledge can change in light of new evidence

Data collection occurred over three weeks in an undergraduate biology course. During the first two weeks, students responded to one question per class session. In the third week, they answered the nature of science (NOS) questions and provided demographic information. This staggered approach minimized response bias from prior items. See Table 3.

A copy of the 7-item instrument (plus demographic questions) is available in the supplemental materials. This ensures transparency and allows for replication in future studies, further validating our approach. Ethical approval was obtained from the Institutional Review Board at the University of Detroit Mercy and Western Michigan University. All participants provided informed consent prior to participation.

Table 3

Data Collection Schedule

Week 1	1st day	Noncontroversial scientific statement: Newton's First Law	(Abbreviated as Motion)
	2nd day	Controversial scientific statement: anthropogenic climate change	(Abbreviated as Warming)
Week 2	3rd day	Controversial scientific statement: biological evolution	(Abbreviated as Evolution)
	4th day	Noncontroversial scientific statement: heart/lung function	(Abbreviated as Circulation)
Week 3	5th day	Statement on the Nature of Science & demographic covariables: religiosity, science courses, politics, age, gender	(Abbreviated as Durable/Tentative)

Sample

This exploratory study recruited 167 undergraduate students from an introductory biology course. Participants included science majors (e.g., chemistry, physics, biology, engineering, and pre-professional programs such as medical, nursing, physician assistant, dental, and veterinary school) and a smaller group of non-science majors (e.g., humanities, arts, social sciences, journalism, and law). The sample consisted of both first-year and transfer students.

Many participants likely encountered NOS instruction in high school as nearly all attended schools in a state where such content is included in the official science curriculum. Additionally, their digital literacy may have exposed them to NOS concepts online. A preliminary search using terms like "tentative nature of science" and "nature of science" yielded numerous online resources.

The sample was ethnically diverse: 44% Middle Eastern, 32% white, 14% Asian, 9% African American, and 1% mixed ethnicity. Gender distribution included 63% female and 37% male. In contrast, previous studies (Cobern et al., 2022) featured lower male (not exceeding 12%) and minority (not exceeding 10%) representation.

Quantitative Analysis

We conducted the quantitative analysis using SPSS Version 27, performing descriptive and correlation analyses. Before testing our three hypotheses, we disaggregated data to examine variations by gender, ethnicity, and major. Gender analysis revealed no significant differences across the seven survey items. To assess differences among majors, we categorized students into three groups: life science majors, physical science majors, and non-science majors. Regarding these three groups, notable differences emerged in three survey items:

- Q4 (Human Evolution): Non-science majors reported significantly lower confidence than science majors.
- Q5 (Accuracy of Science): Surprisingly, non-science majors exhibited higher confidence than science majors.
- Q6 (Trustworthiness of Science): Life science majors reported lower trust in science than physical science and non-science majors.

These findings will be further examined in the Implications and Limitations section.
Although some ethnic variations were observed, none were significant enough to warrant further analysis. Consequently, ethnicity was excluded as a variable in subsequent analyses. Following Cobern et al. (2022), we considered dividing participants based on science content scores. However, due to a limited number of low-scoring participants (only four), this approach was not feasible and was excluded from further analysis. Given that most participants were science majors, this was not unexpected.

Results

Hypothesis 1: Undergraduate science students express confidence in established scientific claims regardless of their public controversy.
Sub-hypothesis: Students with low confidence in controversial scientific claims are also likely to have low confidence in the accuracy and trustworthiness of science but higher confidence in its tentativeness.
Descriptive data for our students are presented in Table 4, with comparative data from Cobern et al. (2022) included in the last two columns. The data strongly support Hypothesis 1. As shown in Table 4, all of the means for the content items indicate high confidence levels among students. The absence of a statistically significant difference between mean scores for controversial items (4.90) and non-controversial items (4.39). To provide further evidence that students were strong across all four content items, we calculated Cronbach's alpha for the four content items, incorporating responses from all students. The resulting coefficient of 0.852 indicates strong internal reliability, confirming that students performed consistently well across all items. Additionally, the data shown in Table 4 (see the sixth column) indicate that the means for the four content items are all higher for the current group of students compared to the preservice teachers in the Cobern et al. (2022) study.

Table 4

Means and Standard Deviation of Trust Survey

Topic	N	Mean	Std Dev	Cobern et al.	Δ
1) Motion	167	4.81	0.61	4.49	0.32
2) Warming	167	4.86	0.53	3.89	0.97
3) Circulation	167	4.63	0.86	3.67	0.96
4) Evolution	167	4.76	0.68	4.11	0.65
5) Accurate.	167	3.69	0.82		
6) Trusted	167	3.82	0.78	3.37	0.15
7) Tentative	167	4.51	0.65	4.73	-0.22

The fifth, sixth, and seventh items in Table 4 provide a basis for addressing Hypothesis 2 in the following section.

Hypothesis 2: Students perceive science as accurate and trustworthy while recognizing its tentative nature.
Supporting Hypothesis 2, analysis of our data (Table 4) indicates that students strongly recognized science's tentative nature, with a mean score of 4.51. However, their trust in science was notably lower (mean = 3.82), and their perception of scientific accuracy was even lower (mean = 3.68). Despite their strong scientific backgrounds and confidence in scientific knowledge (items 1-4), students did not exhibit correspondingly high trust in science or strong perceptions of its accuracy.

Hypothesis 3: There exists a positive correlation between students' confidence in scientific claims and their confidence in the accuracy and trustworthiness of science.
To test this hypothesis, we aggregated the four science content items into a single variable (content score), justified by the high item means, strong internal consistency (Cronbach's alpha = 0.852), and the lack of significant differences between controversial and non-controversial items. We then analyzed the relationships between content score, perceptions of scientific accuracy, trust in science, and recognition of science's tentative nature. See Table 5.

Among these comparisons, only two correlations reached statistical significance, and only one of these was strong enough to be practically meaningful. The aggregate content score was not significantly related to perceptions of accuracy, trust, or tentativeness, suggesting that confidence in scientific knowledge does not directly translate into greater trust in science or perceptions of its accuracy. However, we did find a strong positive correlation between students' perceived accuracy of science and their trust in science ($r = 0.630$; $p < 0.001$). Contrary to our expectations, trust in science was positively, though weakly, correlated with recognition of its tentative nature ($r = 0.183$; $p < 0.018$).

Table 5

Correlations Between Students' Confidence On Tentative, Accurate, and Trustworthy Items

		Content score	Accuracy	Trust	Tentative
Content score	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	167			
Accuracy	Pearson Correlation	-.109	1		
	Sig. (2-tailed)	.161			
	N	167	167		
Trust	Pearson Correlation	-.032	**.630****	1	
	Sig. (2-tailed)	.677	<.001		
	N	167	167	167	
Tentative	Pearson Correlation	-.027	.139	**.183***	1
	Sig. (2-tailed)	.732	.073	.018	
	N	167	167	167	167

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

*. Correlation is significant at the 0.05 level (2-tailed).

To further explore the strong correlation between trust and accuracy, we divided students into low- and high-accuracy groups. The low-accuracy group (n = 52) rated accuracy as 3 or less, while the high-accuracy group (n = 115) rated it as 4 or 5. The overall mean trust score was 3.91, but when disaggregated, the low-accuracy group had a trust mean of 2.94, whereas the high-accuracy group had a mean of 4.44. This difference explains the strong correlation (0.630) between trust and accuracy.

Finally, the mean score for recognizing science's tentative nature was 4.57 across all students. The low-accuracy group had a tentative nature mean of 4.43, while the high-accuracy group had a mean of 4.64. This minor difference aligns with the weak correlation (0.183) between trust in science and its perceived tentativeness.

Discussion

Hypothesis 1: Undergraduate science students' express confidence in established scientific claims regardless of their public controversy.

Sub-hypothesis: Students with low confidence in controversial scientific claims are also likely to have low confidence in the accuracy and trustworthiness of science but higher confidence in its tentativeness.

The absence of a statistically significant difference between mean scores for controversial items and non-controversial items further reinforces this conclusion, demonstrating that students exhibit confidence in scientific claims regardless of their level of public controversy. Additionally, since the means for the four content items were all higher for the current group of students this suggests that our students exhibit a higher level of confidence in established scientific claims

A key difference between our study and the Cobern et al. (2022) study is the composition of the student samples. The Cobern et al. study included a substantial number of students with weaker scientific knowledge, allowing them to categorize students into strong and weak groups and analyze their perceptions of scientific accuracy and trustworthiness accordingly. In contrast, nearly all students in our sample exhibited high science scores, leaving little variation in responses. Without a range of perspectives, particularly from those skeptical of controversial claims, statistical analysis of this relationship was not possible.

Regarding the sub-hypothesis, our findings do not provide direct support, as nearly all students demonstrated high confidence in both controversial and non-controversial scientific claims. Given that our sample consisted predominantly of science majors, their consistently high scores contrast with the more varied confidence levels observed in Cobern et al.'s (2022) study, which included a significant number of preservice K-8 teacher education students. This difference in sample composition likely contributed to the lack of variation necessary to test the sub-hypothesis effectively. Overall, these findings confirm that students exhibit high confidence in scientific claims, irrespective of public controversy, highlighting a strong grasp of established scientific knowledge. Students had the opportunity to comment after each item, however very few did. The fewest comments were about the content items. When students did comment on content it was basically to affirm science.

Hypothesis 2: Students perceive science as accurate and trustworthy while recognizing its tentative nature.
Building on previous research (Gill et al., 2023a & 2023b), we explored students' perceptions of scientific accuracy and trustworthiness while considering their recognition of its tentative nature. Notably, our students, most of whom are science majors, were only slightly more trusting of science than the K-8 preservice teachers in the Cobern et al. (2022) study. However, they were just as likely to recognize the tentative nature of science. This contrast suggests that confidence in scientific claims does not necessarily translate into perceived trustworthiness or reliability. A similar trend was observed in Cobern et al. (2022), where preservice elementary teachers exhibited even lower trust in science while strongly affirming its tentative nature. These findings indicate that acknowledging the evolving nature of science does not inherently lead to increased trust in its conclusions.

Additionally, the gap between students' recognition of science's tentativeness and their lower levels of trust and perceived accuracy suggests a more complex relationship between these factors. It remains unclear whether students view tentativeness as a strength of science, demonstrating its self-correcting nature, or whether they associate it with uncertainty, thereby diminishing trust. The findings highlight the need for further exploration into how science education can reinforce the reliability of scientific claims while still emphasizing their evolving nature. Based on these results, our data do not support Hypothesis 2.

Hypothesis 3: There exists a positive correlation between students' confidence in scientific claims and their confidence in the accuracy and trustworthiness of science.

The results showed a strong positive correlation between students' perceived accuracy of science and their trust in science which suggests that students who perceive science as accurate are significantly more likely to trust it. However, , trust in science was positively, though weakly, correlated with recognition of its tentative nature but the effect size was too small to be practically meaningful. While this finding challenges initial assumptions that trust would decline with greater recognition of scientific tentativeness, the weak correlation does not provide strong evidence for a meaningful connection.

We found a strong correlation between trust and accuracy, indicating that perceptions of scientific accuracy significantly mediate trust in science. These findings indicate that students with less confidence in the accuracy of scientific knowledge were also less trusting of scientific knowledge, whereas students with more confidence in the accuracy of scientific knowledge were also more trusting of scientific knowledge. We also found a weak correlation between trust in science and its perceived tentativeness. Bifurcating students based on how strongly they perceived the tentative nature of science had little effect on their trust in science, as trust levels remained similar across groups. Ultimately, these results do not support the hypothesis that confidence in scientific knowledge correlates with trust in science or perceptions of accuracy. However, the strong association between trust and accuracy suggests that trust in science is shaped less by scientific knowledge itself and more by how accurate students perceive science to be.

Regarding qualitative data, as noted above, few students left comments, but those who did primarily commented on the nature of science items (see the last three rows in Table 5). Most of the comments regarding accuracy were that science was for the most part accurate. Equivocations had to do with the possibility of new discoveries. For example, one student wrote "Scientific knowledge is accurate to our understanding, but science is constantly changing as new discoveries/advances are constantly being made." Student responses about the trustworthiness of science were similar. Most of the comments indicated that science can be trusted but within limits. For example, one student said, "Yes we can trust it but human knowledge about most topics is ever evolving as new ideas are being proven." The fewest comments were about the tentative nature of science. Three students wrote comments essentially affirming the tentative nature of science while two students merely pleaded ignorance. Overall, what few comments the student left were consistent with the quantitative data.

Conclusion and Limitations

Central to this study is the recognition of the pivotal role trust plays in the acceptance and utilization of scientific knowledge within society. Trust, as highlighted by Evans and Schairer (2024), is instrumental in garnering support for scientific advancements, such as gene drive innovations aimed at combating diseases like malaria. However, as Oreskes (2019) has emphasized and as our findings corroborate, trust in science remains vulnerable to skepticism, often stemming from misconceptions about the nature of scientific inquiry. These misconceptions present a significant challenge, as trust in science is not merely a function of knowledge but is also influenced by perceptions of its accuracy and reliability.

One of the critical aspects of our study was the challenge posed by the dynamic and evolving nature of scientific knowledge. While scientific facts are subject to revision and refinement, such changeability does not necessarily diminish the trustworthiness or accuracy of science. However, our findings suggest that communicating the tentativeness of scientific knowledge requires a delicate balance. Acknowledging the provisional nature of scientific understanding is essential for cultivating critical thinking skills and fostering a deeper appreciation for the scientific process. Yet, overemphasizing scientific uncertainty may inadvertently erode trust in science among students, reinforcing concerns raised by Nature (2017) and Cobern et al. (2022). Our findings suggest that some students interpret tentativeness as a strength that aligns with the self-correcting nature of science, whereas others perceive it as a source of uncertainty that weakens confidence in scientific claims.

Our study also highlights the complexity of the relationship between confidence in scientific claims, perceptions of science's accuracy, and trust in science. Contrary to our initial hypotheses, confidence in scientific claims did not correlate with perceptions of science's accuracy or trustworthiness. This suggests that confidence in specific scientific assertions may not necessarily translate into broader trust in the scientific enterprise itself. However, the significant correlation between trust in science and perceptions of its accuracy suggests that trust may be more closely tied to views on correctness than to general scientific literacy. This finding underscores the importance of addressing how students conceptualize accuracy in the context of scientific uncertainty (also see Covitt and Anderson, 2022).

The demographic composition of our sample provides an additional dimension to our findings. Unlike previous studies (Cobern et al., 2022; Mueller & Reiners, 2022), which focused on pre-service teachers, our study predominantly featured science majors. Despite this distinction, we found that science majors exhibited similar doubts about trust in science, suggesting that skepticism is not limited to non-science majors. While it is well-documented that non-science majors exhibit varying degrees of acceptance toward certain scientific concepts, such as evolution, the unexpected disparities in confidence levels between science and non-science majors warrant further investigation.

Our findings also contribute to ongoing discussions about the teaching of the nature of science (NOS). In response to Schwartz (2024), who argues that mistrust in science arises from inadequate NOS instruction, we acknowledge the importance of effective pedagogy. However, Schwartz's argument does not account for trust as an explicit factor within NOS instruction, nor does it incorporate the role of accuracy in shaping trust. Like trust, accuracy is often assumed rather than examined, yet our findings indicate that perceptions of accuracy play a crucial role in shaping students' trust in science. The assumption that properly teaching NOS will naturally foster trust may overlook the reality that students interpret tentativeness in different ways—some viewing it as a hallmark of scientific progress, while others see it as a reason for skepticism. Our study suggests that simply reinforcing the concept of scientific tentativeness may not be sufficient; rather, science education should also address how accuracy is communicated to students in order to strengthen trust.

Implications and Limitations

Given these insights, several implications for both educational practice and future research emerge. Educators must navigate the challenge of instilling confidence in scientific claims while fostering an appreciation for the evolving nature of scientific knowledge. Emphasizing the criteria for scientific accuracy and trustworthiness—rather than merely highlighting science's tentativeness—may serve as a more effective approach for strengthening trust in science. Furthermore, our study highlights the need for longitudinal research to explore the long-term effects of science education on students' trust in science.

As with any study, our research has limitations that must be acknowledged. We used a convenience sampling approach, selecting participants based on accessibility, which may not accurately represent the wider population. Additionally, data collection was limited to a single semester, potentially restricting the depth of our analysis. Furthermore, our research questions focused on a specific aspect of trust in science, which may limit the generalizability of our findings. Future studies should seek to explore trust in science across broader populations, including non-science majors and diverse educational settings.

In addition to these methodological constraints, we also noted some demographic differences that warrant further investigation. As previously mentioned, our analysis revealed three notable variations based on academic major: non-science majors exhibited lower confidence in human evolution (Q4), non-science majors paradoxically rated science as more accurate than science majors (Q5), and life science majors reported lower trust in science compared to both physical science and non-science majors (Q6). While these differences were not statistically significant, two of the three findings—higher accuracy ratings among non-science majors and lower trust levels among life science majors—are particularly puzzling. Because our sample size for these subgroups was relatively small, these results may be spurious. However, we consider it a limitation of our study that we are unable to determine whether these patterns reflect meaningful trends or random variation. Addressing this question would require replication of our study, ideally with a larger and more demographically diverse sample to assess whether these differences persist and, if so, what underlying factors contribute to them.

Ultimately, trust in science is a multifaceted construct shaped by numerous factors, both within and beyond the classroom. While our study provides valuable insights into the interplay between education, confidence, and trust in science, it represents only a stepping stone toward a more comprehensive understanding of this complex phenomenon. By continuing to unravel the intricacies of trust in science, educators and researchers can work toward fostering a more informed and scientifically literate society.

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Appendix

Please read the following scientific statement. Then circle a number on the scale to indicate how confident you are that the scientific statement is true. In the box below, briefly explain your choice of confidence level.

Q1 – According to the science community, an object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

1 2 3 4 5

Not at all confident Very confident

Q2 – According to the science community, human activities are responsible for the recent rapid increase of Earth's average atmospheric and oceanic temperatures.

1 2 3 4 5

Not at all confident Very confident

the lungs.

1 2 3 4 5

Not at all confident Very confident

Q4 – According to the science community, all biological organisms, including humans, have evolved over time from common ancestors.

1	2	3	4	5
Not at all confident				Very confident

Q5 – Scientific knowledge is accurate.

a) Strongly disagree b) Disagree c) Neutral d) Agree e) Strongly agree

Q6 – Scientific knowledge can be trusted.

a) Strongly disagree b) Disagree c) Neutral d) Agree e) Strongly agree

Q7 – Scientific knowledge can change in light of new evidence.

a) Strongly disagree b) Disagree c) Neutral d) Agree e) Strongly agree

8 – What is your gender?

a)Woman b) Man c) Non-binary d) Prefer not to say

9.What is your year of study?

a)Freshman b) Sophomore c) Junior d) Senior

10.What is your race/ethnicity

- White – For example, German, Irish, English, Italian, Polish, French, etc.
- Hispanic, Latino/a, or Spanish Origin – For example, Mexican or Mexican American, Puerto Rican, Dominican, Salvadoran, Peruvian, Mestizo, Chicano, etc.
- Black or African American – For example, Jamaican, Haitian, Nigerian, Ethiopian, Somali, Creole, Caribbean, etc
- American Indian or Alaska Native – For example, Navajo Nation, Blackfeet Tribe, Mayan, Aztec, Quechua, Native Village of Barrow Inupiat Traditional Government, Nome Eskimo Community, etc.
- Asian – For example, Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese, etc. Native Hawaiian or Other Pacific Islander – For example, Native Hawaiian, Samoan, Guamanian or Chamorro, Tongan, Fijian, Marshallese, etc.
- Middle Eastern or North African – For example, Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, Armenian, etc.

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