Differential Impact of Science Instruction on Paranormal Beliefs Among College Students: A Three-Semester Investigation

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Abstract. This study explores the impact of epistemic-focused science instruction on college students' paranormal beliefs and physics understanding. Despite lacking scientific validation, paranormal beliefs persist. The intervention, extending over three semesters, included epistemic and ontological training to counteract intuitive biases and encourage empirical evidence-based hypothesis formation. Results indicated a slight decrease in paranormal beliefs and a notable enhancement in physics comprehension. K-means clustering showed diverse student reactions to the intervention, while qualitative analyses identified misconceptions reinforcing paranormal beliefs, underscoring the importance of scientific epistemology in reshaping student perspectives.

Introduction

During the 18th-century Enlightenment, science emerged as a fundamental way of knowing, sparking a significant scientific revolution and emphasizing the critical role of science education today. Effective science instruction should enable students to apply science epistemic practices (SEPs) to understand everyday phenomena, recognizing that these practices vary and are context-dependent [1]. Despite the persistence of paranormal beliefs (PBs) unsupported by empirical evidence [2;3], integrating SEPs into education could shift students' perspectives away from PBs [4;5]. This underscores the importance of a physics instruction designed to influence students' epistemic practices and PBs, leveraging the interconnectedness of science, student practices, PBs, and instruction to foster a scientific approach to interpreting phenomena.

Theoretical Framework

This study addresses the persistence of non-scientific thinking, such as paranormal beliefs, in our science-intensive society, despite the Enlightenment era's emphasis on scientific reasoning. Focusing on a general education physics course using the Next Generation Physics of Everyday Thinking (NGPET) curriculum [6], this research investigates the impact of integrating models and evidence in scientific explanations on students' epistemic practices and beliefs. Drawing on literature across disciplines, it constructs a theoretical model based on the influence of intuitive thinking and core knowledge on paranormal beliefs [5;7;8] and explores the effectiveness of ontological and epistemic training in reducing such beliefs [9;10]. By implementing a targeted instruction within the NGPET framework, enriched by an online learning community that focuses on paranormal phenomena, the study aims to reduce paranormal beliefs, enhance conceptual physics understanding, and establish a correlation between participation in this community and improvements in both areas. This investigation not only seeks to evaluate the proposed solution over three semesters but also to understand how targeted science instruction focusing on scientific epistemic practices and paranormal phenomena can influence college students' beliefs and understanding, presenting a nuanced approach to science education in the context of modern challenges.

Methods and Founding

The study utilized a comprehensive three-tiered mixed-methods approach to evaluate the intervention's effectiveness, beginning with whole-class assessments through pre- and post-surveys, which measured changes in paranormal beliefs and physics understanding among the students. At this level, data from 137 participants across three phases showed a notable decrease in paranormal belief scores, from an average of 2.9 to 2.6 in phase I, 3.5 to 3.3 in phase II, and 3.2 to 2.9 in phase III. Additionally, improvements in physics test scores were observed, with

averages rising from 23.3 to 31.0 in phase I, 23.3 to 29.1 in phase II, and 21.8 to 26.7 in phase III, indicating significant learning gains.

Subgroup analysis through k-means clustering revealed four distinct clusters based on changes in paranormal beliefs and physics understanding. This nuanced analysis highlighted an unexpected increase in paranormal beliefs for certain subgroups, contrary to the overall trend. For instance, in phase I, 14 students exhibited a significant rise in paranormal belief scores from 2.51 to 3.08. The relationship between online learning community (OLC) participation and educational outcomes was also scrutinized, revealing that engagement levels in the OLC significantly influenced the shifts in paranormal beliefs and conceptual physics understanding. This detailed examination underscores the complexity of changing paranormal beliefs and enhancing physics understanding, illustrating the varied impact of educational interventions across different student groups.

Discussion and Conclusion

This study evaluated an educational intervention's effect on college students' paranormal beliefs and conceptual physics understanding, employing a theoretical model that links intuitive thinking and complex foundational knowledge to paranormal and alternative scientific beliefs [5;7;8]. The intervention, which included epistemic and ontological training focused on paranormal phenomena, aimed to reduce paranormal beliefs and enhance physics understanding. Data analysis from three phases showed a significant decrease in paranormal beliefs and improved physics understanding, although isolating the effect of the specific training without a control group was challenging. Participation in an online learning community (OLC) correlated with these outcomes, with k-means clustering revealing diverse student responses, including a subgroup whose paranormal beliefs increased post-intervention.

The study's multi-level analysis highlighted how different students interacted with the intervention, with some misapplying epistemic tools to support rather than challenge their paranormal beliefs. This suggests that while the intervention could reduce paranormal beliefs broadly, individual responses varied significantly, pointing to the complex nature of changing epistemic practices. The findings underscore the necessity of considering diverse student reactions when designing and implementing educational interventions aimed at shifting deeply held beliefs and underscore the importance of a nuanced approach to science education that recognizes the individuality of student learning and belief systems.

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