The Use of the Epistemic Orientation Survey to Compare Different Grade Level Primary School Pre-service Teachers' Epistemic Orientations towards Teaching Science

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Problem Statement

Epistemic orientation towards teaching science for knowledge generation shows a teacher's combination of the beliefs related to how knowledge is generated, who generates this knowledge, and what process provides this knowledge generation (Lammert et al., 2023). Teacher epistemic orientation is important because it affects whether teachers use knowledge generation approaches (Lammert et al., 2023; Sahin et al., 2023; Suh et al., 2022). Knowledge generation approaches are practiced in knowledge generation environments. Such environments are consistent with constructivist learning, and these classes focus on using epistemic practices like dialogue, argument, and critique. Science practice and knowledge generation are important in science class, and knowledge replication that accounts for students as passive listeners has no place (Lammert et al., 2022). Therefore, a sophisticated epistemic orientation towards teaching science is important to implement knowledge generation approaches in science courses.

Epistemic orientation is a new term and it was constructed on epistemological theories, epistemological understanding, and epistemic beliefs (Lammert et al., 2022). The theoretical framework of this study was constructed on Suh et al.'s (2022) study. According to Suh et al. (2022). Epistemic orientation is comprised of four components, which are epistemic alignment, authority relations in learning, nature of knowledge, and student ability. Epistemic alignment refers to a set of interconnected beliefs about knowing, learning, and teaching. Epistemic alignment is related to the source of knowing, justification of knowing, empirical evidence, evidence-based arguments, how to learn, and how to teach. The second component is authority relations in learning, which is defined as a set of beliefs about authority and power relations between the teacher and students. This component deals with the control of learning and the role of the teacher in teaching. Next, the nature of knowledge concerns whether teachers believe that knowledge is changeable. Changability of knowledge and openness to revision are part of this knowledge. The last belief system is the student's ability, which concerns whether teachers believe that students can generate their own knowledge. The ability to learn is closely linked to this belief (Suh et al., 2022).

Although epistemic orientation is important for high-quality science teaching, previous studies on epistemic orientation were mainly conducted in the United States, and this concept is relatively new for other countries like Türkiye, and research is scarce about teachers' epistemic orientation. To contribute to the literature to close this gap, the current study has two aims. First, this study aims to unveil primary school pre-service teachers' epistemic orientation towards teaching science because science education starts at the primary school level, and pre-service teachers will raise the next generation soon. Therefore, examining their epistemic orientations is important because these orientations are an indicator of whether they will create knowledge knowledge-generative environment in their future science class. Second, the study aims to compare the epistemic orientation of university first-year and third-year students. While first-year pre-service teachers have recently started taking science-related courses, third-year pre-service teachers have completed the science courses. Therefore, this comparison allows feedback regarding how science-related courses affect primary school pre-service teachers' epistemic orientations towards teaching science throughout their undergraduate years.

To sum up, the study has two research questions:

1. What is the level of primary school pre-service teachers' epistemic orientations towards teaching science in terms of epistemic alignment, authority relations in learning, the nature of knowledge, and the students' ability?

2. Are there any significant differences between first-year and third-year primary school pre-service teachers' epistemic orientations towards teaching science in terms of epistemic alignment, authority relations in learning, the nature of knowledge, and the students' ability?

Methodology

The research design of this study is a causal-comparative research design (Fraenkel et al., 2012). Accordingly, two already available groups of pre-service teachers (first year vs. third year) were invited to the study, and their results were compared to see whether group differences affected their epistemic orientations towards science. A total of 58 primary school pre-service teachers (PST) participated in the study. While 34 of them were university first-grade level students, 24 of them were university third-grade level students. Data was collected by use of the epistemic orientations survey developed by Suh et al. (2022). Data collection lasted one hour for each grade level, and data were collected in the spring semester of the 2024-2025 education year. When the study was carried out, first-grade PSTs were taking fundamental science in the primary school course. On the

other hand, third-grade PSTs completed fundamental science in the primary school course and laboratory applications in the science course. Third-year PSTs have been taking the last science course, which was science methods, when the study was conducted. In other words, while first-year PSTs were beginning their science education courses at the university, third-year PSTs were completing their science education courses. Therefore, potential differences in epistemic orientation between the two groups were attributed to their experience in science education courses. The potential difference in the epistemic orientations was also feedback to the science education courses in the program because the results show how science education courses affected PSTs' epistemic orientations towards teaching science.

Frequency analysis was used to answer the first research question that addresses the level of participants' epistemic orientation. Accordingly, the Epistemic orientation survey (Suh et al., 2022) was prepared in a 5-point Likert-type form. Therefore, the mean scores close to 5 were accepted as high epistemic orientations, the mean scores around 3 were at a moderate level, and the scores closer to 1 represented the low epistemic orientations.

To answer the second research question, independent sample t-tests were conducted to see whether there is a difference between first-year and third-year level PSTs' epistemic orientations in four components (e.g., epistemic alignment). Before the independent sample test, the assumptions of the test were checked, and no serious violation was observed. Reliability analysis showed that Cronbach's alpha was 0.71 for the whole scale.

Results

The frequency analysis showed that primary school PSTs' epistemic orientation towards teaching science mean score was 3.58 out of 5.00, which shows a moderate level of orientation. These results show that participants' orientation leads neither to knowledge generation nor to a knowledge replication approach. Specifically, the epistemic alignment result was similar to the general epistemic orientation result. The mean score for the epistemic alignment was found as 3.61. This result shows participants are undecided in epistemic alignment (e.g., justification of knowledge). Participants' beliefs about the nature of knowledge were relatively better, and the mean score of this component was 3.92, which shows that participants mainly believed scientific knowledge is open to revision and change. On the other hand, the mean score for the class authority was the component that was closer to the knowledge replicative approaches. The mean score for the class authority was 2.90. The component that was closest to the knowledge generative approach was student ability, and the mean score for this component was 4.06 out of 5.00. These results show PSTs mainly believe that every student can learn with effort, regardless of their individual differences. To sum up, descriptive statistics show that participants' epistemic orientation changes from one component to another. However, overall epistemological orientation results show participants have a moderate level of epistemic orientation towards teaching science.

For the second research question, a series of independent sample tests were carried out to see whether different grade levels in the primary school education program differ in terms of epistemological orientations. For the overall epistemic orientation score, an independent-sample t-test was carried out to compare first-grade and third-grade PSTs. No significant difference was found for first-class (M=3.55, SD = 0.23) and third-class (M=3.63, SD = 0.30; t(56)=1.09, p= .28, two-tailed). When specifically, epistemic alignment scores were compared, again the results showed no significant differences for first-class (M=3.61, SD = 0.30) and third-class (M=3.63, SD = 0.31; t(56)=0.35, p=.73, two-tailed). The epistemic nature of knowledge yielded similar results too. There was no significant difference between first-class (M=3.86, SD = 0.51) and third-class (M=4.02, SD = 0.46; t(56)=1.26, p=.21, two-tailed). No significant difference was also observed for student ability for first-class (M=4.12, SD = 0.61) and third-class (M=3.98, SD = 0.58; t(56)=0.92, p=.36, two-tailed). The only significant difference was found for the class authority component between first-class (M=2.81, SD = 0.28) and third-class (M=3.05, SD = 0.36; t(56)=2.90, p=.005, two-tailed) in favor of third-class. The effect size was moderate and calculated as 0.13. Overall, these findings show that participants' epistemic orientation is mainly stable in their undergraduate career, and science-related courses do not affect their epistemic orientation so much. Furthermore, participants' epistemic orientation is mainly at the moderate level, which does not lead them to create knowledge generation environments. The only difference between the two groups was the class authority; therefore, formal science-education courses might positively affect primary school PSTs' beliefs about who controls the class and power relations. While PSTs who started taking science courses recently mainly believed that the teacher controls the science class, the PSTs who completed science-education courses were closer to the belief that student and teacher share the power in science classes. Previous research suggested and found evidence that argumentation, discourse, and science writing heuristics (SWH) centred professional development programs lasting more than one year improve teachers' epistemic orientations and facilitate their implementation of knowledge generation approaches (Lammert et al., 2023; Morandi et al., 2025; Sahin et al., 2023; Suh et al., 2023). Therefore, these practices are advised to be integrated into the science-education courses to improve primary school PSTs' epistemic orientations towards teaching.

Keywords: Epistemic Orientations, Pre-service teachers, Primary School, Science Courses, Science Education

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