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The match matters: Examining student epistemic preferences in relation to epistemic beliefs about chemistry ☆

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ABSTRACT

Student epistemic preferences have been found to be important in student learning and achievement. The present study proposed a new conceptualization of student epistemic preferences in the epistemic match model, assessed the match between student epistemic beliefs about chemistry and their epistemic preferences, and, most importantly, examined how this epistemic match may be associated with chemistry course achievement. We adopted latent class analysis and found three distinct profiles of epistemic preferences based on the dimensions of *simple and certain knowledge*, *attainable truth*, and *alternative knowledge claims*. Students in Latent Class 3 (*Moderate Preferences*) demonstrated the closest match between chemistry epistemic beliefs and epistemic preferences, and had more students who obtained higher grades and fewer students who had lower grades in an introductory chemistry course compared to the other two classes. Students in Latent Classes 1 (*All Preferred*) and 2 (*Alternative-Claim Disliked*), however, demonstrated certain degrees of epistemic mismatch between chemistry epistemic beliefs and epistemic preferences, and had noticeably lower achievement in the chemistry course. The study findings highlight the importance of achieving a close match between epistemic beliefs and epistemic preferences for higher achievement in a subject domain.

1. Introduction

Students develop preferences for various aspects of learning in a subject domain (e.g., a preference for paper-and-pencil exams over online exams). These preferences have been linked to achievement and persistence, suggesting that student preferences at the beginning of an undergraduate course of study might point students away from certain majors, or might be a warning sign about misfit with the major for academic advisors or career counselors (Marsh, Hau, Artelt, Baumert, & Peschar, 2006; Steiner & Sullivan, 1984; Zhang, 2008).

In the present research, we consider an under-researched construct—*student epistemic preferences*, which denotes student preferences for aspects of *subject domain epistemology* (i.e., the characteristics of knowledge and knowing in subject domains, such as simplicity, certainty, and justification of knowledge). Domain epistemology is collectively constructed by all practitioners in a domain and is accepted as a set of basic assumptions on which research, learning, and teaching are built in the subject domain. In the present study, student epistemic preferences are students' preferences specifically for the epistemological characteristics (e.g., knowledge simplicity, certainty, and justification) of a subject domain; similarly, student epistemic beliefs are students' perceptions and beliefs specifically about the epistemological characteristics of a subject domain.

Such preferences are important because a mismatch between student *epistemic preferences* and *epistemic beliefs* at the beginning of college—when students know little about academic domains—could be associated with talent loss from the sciences. If the match matters, and either student epistemic preferences or student epistemic beliefs about the sciences are malleable, then future interventions could be designed to help students better understand the nature of knowledge and of learning in the sciences, and better match students with majors, which may result in better retention in STEM majors.

It has been widely found that students develop *beliefs* with regard to epistemological features of a domain (i.e., *epistemic beliefs* about e.g., simple and certain knowledge), which play an important role in student learning and achievement (see Hofer & Bendixen,

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2012 for a review). There is evidence that students also develop *preferences* for epistemological features of subject domains (Eigenberger, Critchley, & Sealander, 2007; Jacobson & Spiro, 1995). Examining students' epistemic preferences in relation to their epistemic beliefs may shed light on some unanswered questions about learning and achievement in particular academic domains.

Epistemic beliefs are "individuals' beliefs about the nature of knowledge and the process of knowing" (Hofer & Pintrich, 1997, p. 117). Hofer and Pintrich (1997) proposed a multidimensional structure for epistemic beliefs that taps two areas—nature of knowledge (Certainty and Simplicity) and nature of knowing (Justification and Source). Briefly, *certainty* concerns whether knowledge is unchanging vs. evolving over time, and *simplicity* concerns whether knowledge is simple vs. complex in structure. The dimension, *justification*, concerns what an individual believes about justification for knowing and knowledge claims, and *source* concerns individuals' beliefs about where knowledge derives from and how to obtain or construct knowledge. Epistemic beliefs have been found to play an important role in learning and achievement (Greene, Torney-Purta, & Azevedo, 2010; Muis & Franco, 2009; Trautwein & Lüdtke, 2007).

By *student epistemic preferences* we mean the extent to which students would rather learn subjects or take courses that feature certain epistemological characteristics, such as simple and certain knowledge, attainable truth, and multiple knowledge claims and justifications. Although there is some evidence for the role of epistemic preferences in learning (Eigenberger et al., 2007; Jacobson & Spiro, 1995), we argue that preferences *per se* are unlikely to affect learning. Rather, we draw on literature on vocational characteristics and work preferences to argue that it is the perception-preference match that matters: An employee who seeks great work autonomy but perceives her job as lacking autonomy is more likely to perform poorly and is more likely to intend to leave that job (Kristof-Brown, Zimmerman, & Johnson, 2005). By analogy, a student who *prefers* to "attain truth" and *believes* chemistry as a subject in which one can "attain truth" may be likely to perform better and persist in that major. However, a student who shows a mismatch between what she *prefers* and how she *perceives* the major may be more likely to perform poorly and drop out of the major. Such a student could be a poor fit for the major in the first place, could retain her preferences and drop out of the major, or could adjust her preferences as she comes to understand the discipline at the professional level (as contrasted with how the discipline is presented at the high school level).

The current study employed a person-centered approach—latent class analysis—to understand college students' epistemic preferences. We explored whether there are discrete clusters of students who show different preferences for simple and certain knowledge, attainable truth, and alternative knowledge claims. Based on students' epistemic *preferences* profiles, we examined the extent to which students' epistemic *beliefs* about chemistry match with their epistemic preferences, and the association, if any, between the epistemic beliefs-epistemic preferences match and students' achievement in an introductory chemistry course.

1.1. Student preferences

1.1.1. Importance of student preferences

Why should student preferences matter? After all, beginning freshmen are relatively unused to the demands of undergraduate coursework, the nature of teaching at the undergraduate level (e.g., large lectures with recitations), and the nature of academic disciplines in practice (versus a "high school" version of the disciplines). We base our argument about preferences in a deep and long-standing approach to analyzing preferences-and-beliefs data which is inspired by vocational psychology, namely, the match between an employee's preferences for aspects of jobs and her perception of what the job is actually like. This match has been found to be an important predictor of job performance and intention to remain in a job (Kristof-Brown et al., 2005). Measures of perception-preference match (e.g., comparing perceived job environment to preferred job environment, assessing perceived person-job fit) are used to counsel job-seekers into appropriate jobs, to screen applicants for jobs, and to work with employees as they transition into a new job or to counsel them on performance and retention when they are in a particular job (Gilbert, Sohi, & McEachern, 2008; Kristof-Brown et al., 2005; Van Iddekinge, Roth, Putka, & Lanivich, 2011).

The methodology of this vocational psychology research on perception-preference match can be used by classroom researchers. Specifically, employee self-reported perception of job characteristics, together with employee self-reported preferences for job characteristics, are a much better predictor of performance and retention than are "objective" ratings of job characteristics (Kristof-Brown et al., 2005). By analogy, researchers who are interested in domain characteristics might be able to explain much more variance in course achievement by drawing on student self-report (perceptions or beliefs) of the domain than using "objective" ratings of the domain. This is an important rationale for us to investigate the *epistemic beliefs-epistemic preferences* match, rather than the match between "objective" domain epistemology and student epistemic preferences.

1.1.2. Gaps in preferences research

Student preferences are associated with academic activities and outcomes (Gaynor & Millham, 1975; Jairam & Kiewra, 2010). Marsh et al. (2006) found that learning preferences (i.e., preferences for cooperative learning and competitive learning) had substantial effects on verbal and math achievement in a multi-group path model of high school data from 25 countries. Students' preferences for assessment formats (e.g., traditional writing assessment, closed-ended questions) have an influence on performance in exams (van de Watering, Gijbels, Dochy, & van der Rijt, 2008).

Although student preferences have been found to play a role in learning, the research focus to date has been on student learning environment (SLE) preferences as mentioned above, and there have only been a small number of studies that explored student preferences regarding subject domain epistemology (Eigenberger et al., 2007; Jacobson & Spiro, 1995; Ravert & Evans, 2007). Jacobson and Spiro (1995) explored the special characteristics of learning in a hypertext environment and their effects on learning outcomes. The researchers developed an Epistemic Beliefs and Preferences (EBP) Instrument to assess students' perceptions about the nature of learning and organization of knowledge, and found a significant condition $\times$ EBP interaction: the treatment group (trained on hypertext processing) participants with more complex epistemic beliefs performed better on a problem-solving essay, whereas the control group participants with more complex epistemic beliefs performed significantly worse on the same task. The findings supported the importance of epistemic preferences and beliefs to learning in a computer-based environment. One weakness of the EBP is that the instrument contains both items about preferences and those about beliefs, but the researchers did not conceptualize the measure as differentiating the constructs of epistemic beliefs and epistemic preferences. A more focused measure of epistemic preferences is needed for this line of research.

Eigenberger et al. (2007) explicitly studied *preferences* using their Epistemic Preference Indicator (EPI) scale. The study provided evidence for measure reliability and validity. However, the EPI was designed as a domain-general measure: the items do not tap one subject domain specifically but describe a general "epistemic style"