

## Epistemological and Ontological Perspectives of Educational Psychology Doctoral Students

**Lia M. Daniels & Lauren Alston**

University of Alberta, Educational Psychology

### Abstract:

As a discipline, educational psychology is somewhat idiosyncratic in terms of content and methodologies. Such idiosyncrasies are likely rooted in the philosophical history of the discipline which involves both the empirical tradition of Thorndike and the contextualized pragmatics of James and Dewey. Despite this, there is little teaching about epistemological and ontological beliefs in most educational psychology doctoral programs. The purpose of this scholarship of teaching and learning was to (a) describe educational psychology doctoral students' epistemological and ontological beliefs and (b) determine the effectiveness of a four-part activity in supporting students' learning about epistemology and ontology. We analyzed 14 doctoral students' responses to a four-part activity to describe their epistemological and ontological beliefs. Second, we used a parallel convergent mixed method design to analyze quantitative and qualitative data describing students' learning from the activity. Students showed eclectic epistemological and ontological beliefs that were overall more epistemologically relativist than realist. For ontology, there was much more variability on the extent to which students believed truth exists and can be known in the discipline. All students, regardless of their epistemological and ontological beliefs, showed growth through the in-class activity. The results of this study and the pedagogical materials on which they are based can help the discipline itself and its students become more aware of its philosophical history and diversity.

**Keywords** epistemology and ontology, doctoral education, educational psychology

*Note: This is a pre-copyedited, author-produced PDF of an article accepted for publication in the International Journal of Teaching and Learning in Higher Education.*

The official citation for this manuscript is: Daniels, L., & Alston, L. (2023). Epistemological and Ontological Beliefs of Educational Psychology Doctoral Students. *International Journal of Teaching and Learning in Higher Education*, 35(2), 17-31.

This paper is not the copy of record and may not exactly replicate the final, authoritative version of the article. The final version will be available, upon publication by the journal.

### **Epistemological and Ontological Perspectives of Educational Psychology Doctoral Students**

In 2002 Hofer and Pintrich wrote the “first book to provide a comprehensive overview of the theoretical and methodological approaches to the study of personal epistemology from a psychological and educational perspective” claiming that it would “define the field for the next 20 years.” It is now 20 years later and educational psychology has made great gains in studying epistemology and ontology as educational constructs, but it has largely done so without bringing clarity to its own beliefs as a discipline (Calfee, 2006). Various writings on the historical and philosophical origins of educational psychology (e.g., Alexander, 2003; Berliner, 2006) reveal the twisting road by which educational psychology came to represent a wide range of students, programs, research interests, methodologies, and career trajectories that originated in and continue to espouse a range of epistemological and ontological beliefs. For doctoral students in educational psychology, this diversity means they hold their own epistemological and ontological beliefs alongside peers who may have different perspectives. Unfortunately, there seems to be few opportunities for doctoral students to learn about their own epistemological and ontological beliefs nevermind those of the discipline. The purpose of this work of scholarship of teaching and learning (SoTL) was twofold: First, we wanted to describe the range of educational psychology doctoral students’ self-reported epistemological and ontological beliefs as measured through a four-part activity. Second, we wanted to measure the effectiveness of the four-part activity in supporting students’ learning about epistemological and ontological beliefs.

### **Epistemology and Ontology**

Ontology and epistemology are philosophical constructs rooted in the nature of reality and how knowledge and knowing come to be. Within psychology, these constructs hold dual roles. On the one hand, researchers can take a “psychological approach to the philosophical field

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

of epistemology” (Hofer, 2008, p. 5) by studying the development and influence of such beliefs on learning and a range of related processes such as self-regulation or meta-cognition (Muis et al., 2006). On the other hand, the philosophical nature of epistemological and ontological beliefs are held by researchers themselves and thus afford an opportunity for examination of the self within the discipline. It is understanding and building awareness of the latter in which we are interested in this study.

Like many other researchers, we view epistemology as a person’s implicit and explicit beliefs about the nature and acquisition of knowledge (Hofer & Pintrich, 1997; Olafson et al., 2010). Epistemology has been of greater research interest than ontology resulting in several models, substantial output, and review papers. For example, Schommer (1990), proposed five dimensions of epistemic beliefs: the certainty of knowledge, simplicity of knowledge, deference to authority, speed of learning, and innate ability. Moreover, she purported that students begin with naive perspectives and then become more mature as they engage with knowledge. These five dimensions are not always supported in factor analysis (e.g., Schraw & Olafson, 2008) leading to alternative models. For example, Hofer (2000) found factor analytic support for four dimensions: certainty/simplicity of knowledge, source of knowledge, justification of knowledge, and attainability of truth.

Ontology refers to the way a person views the nature of reality and being. Moore (2005) suggests that ontological beliefs can range from believing that the world is governed by physics to believing that governance is determined by spirits and/or gods, to a mix of both. We agree with Olafson et al. (2010) that more research needs to be conducted that considers both epistemological and ontological beliefs particularly as it pertains to helping novice researchers understand their own way of creating knowledge and being in the discipline of educational

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

psychology. As an example of combined perspectives, Burrell and Morgan (1979) described the assumptions underlying the nature of social science as falling along a subjective-objective continuum in terms of not just epistemology and ontology, but also human nature and methodology. Creswell (2014) takes another approach and offers novice researchers a 2 x 2 matrix that lists words associated with four worldviews that include elements of both epistemology and ontology: positivism, constructivism, transformative, and pragmatism. Creswell (2014) explains that “worldviews arise based on discipline orientations, students’ advisors/mentors inclinations, and past research experiences” (p. 6). Because doctoral students are both generating new knowledge through research and becoming researchers in an established discipline, both epistemological and ontological beliefs are highly relevant to their work in the discipline of educational psychology.

### **Educational Psychology**

The discipline of educational psychology can be defined as “the study of human learning, thinking, and behaving in formal and informal educational contexts” (Vassallo, 2017, p., I). Berliner (2006) explains that the origins of educational psychology stem from the use of psychological concepts and methods to understand four key concepts of education described as the intersection of *teachers x students x task x setting*. Early in the establishment of educational psychology, the complexity of educational problems were met with varying levels of acceptance. On the one hand, scholars following the footsteps of Thorndike became “interested in the laws of learning, not issues of schooling and teaching” and desired a strong empirical controlled approach to educational psychology (Berliner, 2006, p. 18). On the other hand, scholars leaning towards the pragmatics of James and Dewey sought ways to meaningfully “psychologize about the problems and issues of education” and advocated for contextualized and ecological

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

approaches to educational psychology (Berliner, 2006, p. 23). The result is that as an academic discipline educational psychology tends to be viewed as fairly idiosyncratic in terms of both content and methodologies (Muis et al., 2006). By extension, traces of both historical legacies and these idiosyncrasies exist in most departments of educational psychology as evidenced by the types of programs they run and by extension the types of students they recruit and educate.

In terms of programs, most departments of educational psychology offer a wide variety of discrete programs (Table 1). As shown in Table 1, departments of educational psychology at several U15 universities across Canada offer from 1-15 discrete graduate programs. Although each program has some relationship with the broader discipline of educational psychology, it may also have its own epistemological history. For example, school psychology and measurement programs may adhere more closely to post-positivist principles (Elias, 2021) than developmental or counseling psychology programs which may have a more constructivist and humanist perspective (Hanson, 2006; Moore, 2006). Based on publicly available information, all departments listed graduate level research methods courses, but only the University of Ottawa had information available on a course clearly linked to epistemology and ontology.

With such diversity of programming, it is only logical that graduate students come to educational psychology from various academic disciplines, experiences, and training models. Naturally, this range of previous learning experiences yield classrooms full of graduate students with different ontological and epistemological beliefs of which they may be largely unaware. For example, graduate students who enter educational psychology programs through teacher education programs may be more familiar with Dewey and holistic approaches to educational research problems; whereas, students who enter through psychology undergraduate and honor's programs may be more familiar with Thorndike and experimental approaches to research

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

problems. This diversity may help explain why epistemology and ontology appear largely untaught in educational psychology (Pajares, 2003) even though it may be particularly important for graduate students in the field to understand differences between their own epistemologies and ontologies and those of their peers and future colleagues.

Learning about the historical and philosophical foundations of educational psychology may seem unappealing or even unnecessary to doctoral students especially as the priority to publish-or-perish dominates the academy. Few graduate students enter psychology expecting to wrestle with philosophy. Parajes (2003) claims that “[p]sychology departments are infested with eager suitors, most of whom are unlikely ever to take a philosophy course as part of their program. They are also unlikely to be made aware of philosophy’s role in the creation of their discipline” (p. 177). An unspoken extension of Parajes’ argument is that few if any faculty members teach on the philosophical origins of educational psychology. Furthermore, if faculty members were not introduced to the philosophical origins of educational psychology during their own training, there may be a shallow skillset to introduce this content.

In 2004, Alexander envisioned that the educational psychology of 2020 would be characterized by “studies of epistemology joined by systemic explorations of ontology, ethics, and aesthetics and their role in learning and teaching. That distant philosophical legacy, reflected in the works of James, Dewey, Peirce, and Hall, will not only be invigorated, but also fused with established empirical traditions” (p. 155). Indeed, educational psychologists have made impressive gains in studying epistemic constructs such as personal epistemology (Hofer & Bendixen, 2012), epistemic cognition (Greene et al., 2016), and epistemic emotions (Pekrun et al., 2017) and their development in and implications for education (Khine, 2008). Indeed, epistemic beliefs have found their way into some of the central foci of educational psychology

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

including self-regulated learning (e.g., Muis, 2007) and metacognition (Hofer, 2004). Despite the progress educational psychologists have made in understanding the epistemological beliefs of students, teachers, and lay people (Muis et al., 2006), there is less documentation of gains made in understanding themselves or the breadth of beliefs that characterize the discipline.

### ***Research on Epistemology and Ontology in University Students***

Most research on epistemic beliefs in college students has focused on either the epistemic beliefs of students from different academic disciplines in a between-group manner or the epistemic beliefs of students thinking about different academic disciplines in a within-group manner (see Muis, 2006 for a review). In doing so, researchers use some combination of self-report scales to measure epistemological dimensions such as certainty, complexity, and source of knowledge or interview techniques that produce a more holistic description (see Schraw, 2013 for a review of measurement). We identified no study about epistemology or ontology that focused on doctoral<sup>1</sup> students in educational psychology specifically and thus we reviewed research that included students in either education or psychology more broadly.

Hofer (2000) recruited 326 1st year college students from introductory psychology classes to examine domain differences in beliefs about science and psychology. All participants responded to questions about the certainty, justification, authority, and notion of truth for both science and psychology (counterbalanced). Based on a series of *t*-tests, Hofer showed that students believed knowledge in science was more certain, justified by expertise, rooted in authority, and focused on truth than psychology. Although Hofer's concern was not for psychology itself, it is interesting to note that students were least likely to perceive that within psychology knowledge is certain and simple and most likely to perceive that knowledge could be justified by personal experience. More recently, Rosman et al., (2020) asked 938 German

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

undergraduate students to indicate the extent to which they considered biology compared to psychology to be rooted in “absolute” facts and truth or multiplistic subjective beliefs. Using Bayesian paired samples *t*-tests, they found very strong evidence that students viewed biology as more absolutist than psychology and psychology as more multiplistic than biology. Moreover, these results did not differ by whether the participants themselves were studying in a hard or soft science discipline.

In 2008, Schraw and Olafson piloted a four-quadrant measurement tool that crossed epistemological and ontological beliefs along two axis anchored by ontological-relativist vs. ontological-realist and epistemological-realist and epistemological-relativist. They found that the majority of teachers enrolled in an education graduate program (58%) positioned themselves within the quadrant that reflects higher ontological and epistemological relativism. Next, students were likely to hold beliefs characterized as ontological-relativism and epistemological-realism (41%). No students were located in the quadrant defined as epistemological-relativist and ontological-realist and only two participants indicated beliefs characterized by both ontological and epistemological-realism. A slightly different pattern emerged in Olafson & Schraw (2010). Although most participants again identified as ontological and epistemological relativists (60%) and no participants identified as epistemological relativists and ontological realists, more participants (33%) indicated beliefs aligned with epistemological realism and ontological realism (i.e., traditional views) than epistemological realism paired with ontological relativism (6%). Olafson and Schraw (2010) additionally found that nine participants had consistent beliefs that did not change over the course of the semester; whereas, seven students showed some sort of change in their beliefs. In terms of change, Olafson and Schraw



## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

explain that “the most common movement pattern involved becoming more closely aligned to a single world view or a hybrid world view” (p. 258).

### **The Current Study**

Although educational psychology researchers have made substantial progress in understanding epistemological and ontological beliefs and their associations across different academic domains, there has been almost no empirical study of the epistemology and ontology of graduate students themselves in educational psychology. Particularly because educational psychology has philosophical roots that are meandering and somewhat idiosyncratic (Berliner, 2006), it is important to understand how educational psychology doctoral students understand their own beliefs and how they fit with the knowledge they create through research. Nist and Holschuh (2005) offer five suggestions for helping students develop mature epistemological beliefs; however, aside from suggesting students undertake self-assessment none of their recommendations draw on the contemporary tools that are used in research to measure epistemological and ontological beliefs (see Olafson & Schraw, 2008 for a review). We believe the pedagogical value of the existing tools is under-realized and thus these tools guide the instructional decisions in the current research. We had two overarching purposes. First, because the discipline of educational psychology is so diverse (Pajares, 2003), we describe doctoral students’ self-reported epistemological and ontological beliefs. To do this the first author designed a four-part in-class activity based on existing resources in the literature. Second, we wanted to measure the effectiveness of the activity in increasing students’ self-reported understanding and consideration of epistemological and ontological beliefs as they pertain to conducting research in educational psychology.

### **Method**

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

We view this work as a scholarship of teaching learning (SoTL) in its intention to “make transparent, for public scrutiny, how learning has been made possible” (Trigwell, 2021, p. 287). Data came from two sources: the four-part in-class activity and a brief self-report follow-up survey that was distributed after the course was completed and final grades had been assigned. The in-class activity was subjected to secondary descriptive analyses to answer the research question: What are the epistemological and ontological beliefs of a sample of doctoral students in educational psychology? We used the self-report follow-up survey to collect data following a convergent mixed methods design that equally weighted quantitative and qualitative data and intentionally integrated the two data sources to bring about mixed insights (Fetters & Freshwater, 2015). The mixed method question was: What quantitative and qualitative changes in epistemological and ontological beliefs did doctoral students in educational psychology report following a four-part in-class activity?

### **Procedure**

As part of a doctoral research seminar, students ( $n = 19$ ) completed a four-part in-class activity related to epistemological and ontological beliefs. At the conclusion of the course, the course instructor (who is the lead author) gained ethics approval to undertake secondary data analysis of the in-class activity and distribute a survey. A research assistant with no connection to the course emailed all students requesting they consent (a) to their in-class activity responses being anonymized and analyzed for research purposes and (b) to completing a brief five question follow-up survey.

### **Participants**

Fourteen women of the 19 students consented to have their data included for analysis. All students were in the first or second year of a doctoral program in the Department of Educational

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

Psychology at a Canadian Research-intensive University. For all but one student, this was a required course. In a forced-choice question, five participants identified their most common methodological approach broadly characterized as qualitative (~33%) and the remaining nine participants selected quantitative (~66%).

### **Materials**

#### ***In-class Activity***

The in-class activity consisted of four parts, each adapted from existing sources. First, students were asked to rate themselves on four semantic differential scales representing continuums related to the nature of social sciences. The word pairs were taken from Burrell and Morgan's (1979) subjective-objective perspectives on assumptions underlying the nature of social science in regards to ontology, epistemology, human nature, and methodology. We used a 7-point scale with the objectivist descriptor = 1 and the subjectivist descriptor = 7. Second, students used a 1 = strongly disagree to 5 = strongly agree likert scale to respond to 18-items used in Hofter (2000) to measure discipline-focused epistemological beliefs regarding the certainty of knowledge (8 items), justification of knowledge as personal (4 items), authority of source (4 items), and attainment of truth (2 items) in their discipline of educational psychology. Third, students examined a 2 x 2 matrix from Creswell (2014) that lists words associated with four major worldviews: positivism, constructivism, transformative, and pragmatism. Students were instructed to select all the words that resonated with their approach to research even if they came from more than one cell in the matrix. Finally, students plotted themselves on a four-quadrant plane adapted from Schraw and Olafson (2008) defined by epistemological realist,positivist/relativist,constructivist on the x-axis and ontological realist/relativist on the y-axis.

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

### ***Follow-up Survey***

As an indication of whether participants changed their understanding of epistemology and ontology, participants answered two paired questions on a four-point scale (1=not at all, 2=a little bit, 3=somewhat 4=very much). The first question asked students to retrospectively report their familiarity with epistemology and ontology prior to the course and the matched question asked about their current understanding having completed the course. The second set of questions asked students about how much they considered epistemology and ontology in their research before and after the course. Then participants were asked to write an open-ended reflection about their learning based on the in-class activity as the qualitative data.

### **Rationale for Analysis**

Each part of the in-class activity was analyzed separately in order to describe the epistemological and ontological beliefs of educational psychology doctoral students. First, for the two likert-scale activities, we examined descriptive statistics and correlations. Second, for the word selection activity, we calculated frequencies of each word and described patterns. Third, for the matrix plot we combined responses into a single visual representation that also included the primary quantitative/qualitative distinction indicated by participants.

For the follow-up survey we began with quantitative analyses in which we looked at frequencies and change-scores on average through paired-samples *t*-tests. Next, we used a deductive analysis to identify ways students' described changes related to epistemology and ontology in their open-ended reflections. Finally, through an intentional mixing strategy we created a joint display (Fetters & Guetterman, 2021) that provides a holistic perspective of learning based on the activities at the individual level. The two authors undertook these analyses as a team and worked to share understanding and agreement on all elements.

## Results

### Description of Epistemological and Ontological Beliefs from in-class Activity

#### *Likert-scale Questions*

Participants' responses to the in-class activity revealed both similarities amongst the students and diversity in terms of their self-reported epistemological and ontological beliefs (see Table 2). The mean score for each of Burrell & Morgan's items was above the midpoint score of 3.5 and the lower end of the response scale was selected only three times. No participant responded with a score of 1 that would be most strongly associated with the objectivist belief. The scores on Hofer's scales also revealed more complex than simple beliefs. For example, the mean score for certainty was 1.83 and responses 3 or higher on the five-point likert scale were selected less than 10% of the time. The mean scores for the remaining three scales were right around the scale midpoint of 2.5. It should be noted that the reliability coefficients of the other Hofer scales were lower than desirable and thus we interpret them cautiously.

In looking at the correlations (Table 2), there were few significant associations amongst the measures of epistemology and ontology, which suggests that these beliefs are somewhat distinct for this sample of doctoral students. For example, although relativism and constructivism were strongly positively correlated as would be expected, there were no corresponding associations with voluntarism or idiographic beliefs even though they represent objectivist beliefs. From Hofer, the attainment of truth subscale was negatively correlated with personal justification, but none of the other scales were significantly correlated with each other. Relativism had the most statistically significant associations with other variables: Students who reported high levels of relativism were less likely to see educational psychology as characterized

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

by certainty, more likely to agree that personal justification is a valid way to know in the discipline, and less likely to expect truth to be obtained in the discipline.

### ***Word Selection Results***

Participants also showed an eclectic approach to epistemological and ontological beliefs in the word selection activity based on Creswell. Participants made in total 86 selections from the word options with each participant picking on average 6 words (range 3-11). Six out of 14 participants (43%) selected words from all four quadrants and five participants chose words from all but Quadrant A. Indeed, Quadrant A words representing postpositivism were selected least often; whereas, only one participant did not pick any words from Quadrant D representing pragmatism (see Figure 1). The words selected with the highest frequency were: understanding (12), collaborative (11), and real-world practice oriented (11). Interestingly, these three words all reside in separate quadrants.

### ***Matrix Location Results***

For the final part of the in-class activity, students were asked to locate themselves on Olafson and Schraw's (2008) 2 x 2 matrix defined by epistemological and ontological anchors (see Figure 2). In keeping with the likert-scale responses, all but two participants considered themselves more relativist/constructivist than realist/positivist epistemologically. In contrast, participants used the full range of the ontological axis and were evenly divided between the two sides of the midpoint regardless of their epistemological position. No participant indicated they felt they belonged in Quadrant 4 characterized as an ontological-relativist and an epistemological-realist.

### **Effectiveness of in-class Activity**

### ***Quantitative Results***

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

On average, participants increased their understanding ( $M = 3.64$ ,  $SD = .50$ ) of epistemology and ontology relative to their original familiarity ( $M = 2.00$ ,  $SD = .88$ ) by 1.64 points on the four point scale. This change represented a statistically significant increase in students' understanding of epistemology and ontological beliefs,  $t(13) = -6.62$ ,  $p < .001$ , CI  $[-2.18, -1.11]$ . Similarly, students also reported statistically significant increases in their consideration of epistemological and ontological beliefs after ( $M = 3.71$ ,  $SD = .47$ ) compared to before the course ( $M = 1.79$ ,  $SD = .70$ ),  $t(13) = -7.81$ ,  $p < .001$ , CI  $[-2.46, -1.40]$ .

### ***Qualitative Results***

The deductive qualitative analysis of participants' open-ended reflections revealed two ways that students described the change that we captured numerically. In 92% of the responses, students described a change in their understanding of ontology and epistemology using words like "realized", "my worldview shifted", "something clicked", "changed my thinking", and "started reflecting". Within these, 46% of the responses included reflection on the ways students' understanding of epistemology and ontology changed as *scholarly philosophical constructs*. For example, five participants described being surprised when discussing the process of reflecting upon their own ontology and epistemology and what that means for their research practice. Additionally, 4 participants reflected on being more intentional regarding their research practices based on their learning. The other 54% of responses described changes in students' understanding of their *actual epistemological and/or ontological beliefs* as a result of the activities and learning in the course. Interestingly, there are both examples of students who report becoming more constructivist/relativist compared to earlier positivist/realist training and one student who assumed they were relativist and as they learned about what that actually means were better able to identify and defend their realist perspective. One student elaborated that they

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

now understand how their epistemological and ontological beliefs confirm their stance on embracing anti-racist and de-colonial practices into their research and personal life.

### *Mixed Results*

We represented the quantitative and qualitative data for each participant individually in a joint display together in Figure 3. An illustrative quote for each of the 14 participants emanates from the quantitative scores to give words to the quantitative data. Overwhelmingly, the visualization portrays individual change and growth based on the four-part in class learning activity. Eight participants (57%) increased from an original “not at all” or “a little bit” to the maximum “very much” on the familiarity/understanding questions. We found a similar pattern for the consideration items with all but one participant moving up at least 1 response level and a total of 10 participants (71%) increasing to the maximum “very much” response. There were two exceptions to growth in the individual quantitative scores: One participant indicated a “somewhat (3)” for both familiarity before and understanding after the course, while another participant did the same for the consideration items. This latter participant also chose the top category for familiarity before the course and therefore had no room to show growth in a quantitative fashion. Nonetheless, both of these students qualitatively described ways in which the activities helped them become more intentional or understand their original perspectives thus showing the importance of mixing the two forms of data.

### **Discussion**

The purpose of this scholarship of teaching and learning was to both describe the ontological and epistemological beliefs of doctoral students in educational psychology and to determine the effectiveness of the in-class activity in supporting their learning. We focus our discussion on three main findings before turning our attention to limitations, implications, and



## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

directions for future research. First, we discuss the finding that doctoral students hold a wide range of ontological and epistemological beliefs. Second, we touch on the effectiveness of the in-class activity in supporting student learning. Third, we discuss the different starting points for students and how that may interact with both their personal learning about ontology and epistemology and their understanding of their peers.

### **Eclectic Philosophical Beliefs**

Students showed eclectic philosophical beliefs as they completed the four parts of the in-class activity. Although all participants generally tended to respond on the subjectivist end of responses and had low certainty, scores at the midpoint on items related to how much educational psychology is based on personal justification, authority, or if truth can be obtained imply no strong belief in either direction. Furthermore, participants' word selections were not constrained to a single quadrant of Creswell's word lists, implying that students felt able to pick and choose different elements of worldviews.

Two explanations seem plausible for this finding. First, it is possible that these doctoral students have had little attention to the philosophical underpinnings of research and thus have not yet consolidated their ontological and epistemological beliefs. The follow-up survey points to this possibility with five respondents answering that they had "not at all" considered the role of ontology and epistemology before this course. This would align with Olafson and Schraw (2010) who found that novice students had a wider belief set than more experienced students. In this case although doctoral students are senior students, they remain novice in regards to philosophical beliefs. Second, it is possible that the eclectic approach is actually representative of doctoral students in educational psychology as a diverse discipline. Indeed Hofer and Bendixen (2012) suggest that ontological and epistemological beliefs are particular to certain disciplines

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

and, as described in the literature review, doctoral students in educational psychology may be less homogenous than other areas of psychology given the conflicting roots of the field (Alexander, 2003). While twenty years ago Hofer (2000) showed that 1st year college students perceived psychology as having a single authority, the same does not seem to be true for students in educational psychology specifically who may have very divergent areas of expertise, audiences, and professional ambitions.

In the 2 x 2 matrix portion of the activity, our results were quite different from those of Schraw and Olafson (2008) and Olafson et al. (2010). In their samples of education graduate students in curriculum and instruction, all of whom were also practicing teachers, no participants placed themselves in the quadrant defined as epistemological relativist and ontological realist and about half of participants viewed themselves as epistemological realists and ontological relativist. Our results are the inverse of this pattern perhaps highlighting the influence of psychology on these students. Specifically, none of our participants indicated they held beliefs characterized by epistemological realism and ontological relativism and five participants saw their beliefs as fitting with epistemological relativism and ontological realism. This difference may also be attributed to the differences in the work of teaching compared to the work of research. Regardless, it shows that doctoral students in educational psychology differ from graduate students in education more broadly.

### **Effectiveness of Learning Activity**

Overall, the four-part in-class activity was well received by students and both the self-report survey and open-ended responses suggest it was largely effective in increasing students' understanding and consideration of ontology and epistemology. Regardless of their starting point, all but one student indicated an increase in their understanding and/or

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

consideration of ontology and epistemology in light of the in-class activity. Moreover, every student made some comment alluding to ways in which their understanding shifted and even led to surprise by their own personal epistemology and ontology. Participants also linked their gain in ontological and epistemological understanding to becoming more intentional about questioning where their knowledge comes from, how their research practices are informed by their beliefs, and what the implications are for their studies and/or practice. Such an approach compliments researcher recommendations that in order to conduct ethical intersectional research and counseling in psychology it is important to explicitly reflect on one's values in knowledge production (Moradi & Grzanka, 2017). In their literature review on counseling theories, Hansen (2006) notes that cross-cultural studies have demonstrated a wide range of worldviews and theoretical perspectives that effectively address healing for example.

Participants' written reflections also described an increase in intentionality as a result of the in-class activity. Mason (2003) described student intentionality as an investment in reflecting on the state of their own understanding of knowledge. Such a reflection challenges students to evaluate their previous knowledge while also examining the roots of their beliefs and why they have certain beliefs (Mason, 2003). Through the in-class activity, participants were given the opportunity to engage in self-reflective and motivational forms of learning, which Mason (2003) describes as an "intentional level of cognition" (p. 220) leading to change.

### **Different Starting Points**

The strong positive correlation between the ontology scale (realism-relativism) and the epistemology scale (positivism-constructivism) is a good indication of the validity of the measures as well as an indication that students responded consistently to different items measuring ontological and epistemological concepts. Although the vast majority of students

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

indicated some amount of increased learning during the course, it was clear students varied in the extent to which ontology and epistemology had been part of their education thus far. For example, students who had considered their beliefs prior to the class reported lower beliefs about the certainty and reliance on experts as the authority over knowledge at the very outset of the course. The process of examining one's understanding of knowledge and how to assess what one knows may yield a greater degree of uncertainty regarding the nature of knowledge. Our study participants demonstrated ontological and epistemological beliefs that leaned towards relativism and constructivism, which involves a worldview of multiple truths, therefore it makes sense that they would also express uncertainty in knowledge. If students' worldviews involve multiple perspectives and various ways of understanding each perspective, then it becomes difficult to be certain of any knowledge that is gained even through structured learning activities.

Additionally, these students may also practice reflexivity in a way that constructively challenges experts in the discipline thereby becoming the worldviews they perceive. Moore (2005) argues that reciprocal exchanges of knowledge within the practice of psychology leads to a more ethical and practical approach which moves away from relying on expert handbooks and rigid techniques. Furthermore, Moradi & Grzanka (2017) developed guidelines that specifically call for critical approaches to epistemology and urge people within the field of psychology broadly to integrate multiple theories and existing measures to develop innovative measures that accurately capture the variety in human experience. For other students, these ideas were brand new and more difficult to reconcile with a narrower perspective that had not previously been challenged or stretched. Regardless, for the teaching and learning of ontology and epistemology, it will be important to recognize that doctoral students in educational psychology are starting at

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

different points of familiarity and that can influence the way they engage with the constructs themselves.

### **Limitations**

The results described herein need to be considered in light of three limitations. The participants for this study came from one Department of Educational Psychology at a Mid-western Canadian university and their responses may not be representative. Indeed, it seems that across Canada there is a wide range of attention (or inattention) paid to coursework related to epistemology and ontology. Future research may want to consider a Canada-wide baseline survey of educational psychology graduate students' understanding and consideration of ontology and epistemology. Second, although students in educational psychology can take a wide range of specific programs, the vast majority of students in this course are part of a program in which students are training to become licensed psychologists. Students in other programs are able to take the course, but it is not required. This in and of itself is interesting, but in terms of the results it means that further broadening of scope may be required within even this single department. Finally, participants retrospectively indicated their understanding and consideration of epistemology and ontology at the conclusion of the course. Because we did not anticipate the learning activity being so impactful there was no intentional pre-test. Although this may have been more desirable empirically, the evolving nature of SoTL sometimes makes it difficult to know in advance how to measure the impact of the learning activity.

### **Implications and Directions for Future Research**

The results of the SoTL presented herein have important implications for students, instructors, and the discipline of educational psychology as a whole. First, students who wrestle with epistemology and ontology as constructs, need to be expected and empowered to understand

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

these constructs and their role in their research. Likewise, students need to be aware that their peers in educational psychology can have a range of beliefs that may be very different from their own. Acknowledgement of these differences can help students appreciate the diversity of research that is undertaken in educational psychology as they recognize the benefit of multiple approaches to dealing with current research topics (Johnson & Cassell, 2001).

Second, instructors of educational psychology graduate research seminars need to acknowledge that epistemology and ontology are complex topics for students that may require direct instruction paired with active learning activities for students to meaningfully grasp the concepts and their personal relevance. The materials used in this four-part learning activity are available as supplementary materials and instructors are welcome to use and adapt them to their own research seminars. Instructors will need to approach this learning with an open mind recognizing a wide range of starting points and tensions in students who may not be accustomed to sharing their beliefs. Although many instructors note the importance of a safe and respectful class climate in supporting learning especially when opinions may differ, a more explicit attention to creating a classroom that affords open discussion about beliefs may help instructors in this regard. For example, because a course syllabus can be viewed as a socializing mechanism (Sulik & Keys, 2014), instructors could include direct statements to set expectations for the “classroom’s interactional and socio-emotional landscape” (Valentin & Grauerholz, 2019, p. 220). In addition, instructors will require a thorough understanding of their own beliefs and an expertise that allows them to either put their personal beliefs aside or bring them fully to bear on their instruction of philosophical implications for research.

Third, the discipline of educational psychology itself must recognize a diversifying of epistemological and ontological beliefs that is likely rooted in its longstanding history of

## EPISTEMOLOGY & ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

pragmatics versus empiricism (Berliner, 2006). This will become even more important as the graduate student population further broadens. For example, more graduate students are entering programs from marginalized groups and taking up the call for advocacy. As one example, gay-straight alliance (GSA) research involves many complex intersections of gender identity/expression, sexual orientation, race, class, and culture. Some researchers may pragmatically take a relatively direct post-positivist approach to simplify the issue for the public or bring large-scale data to bear on the decisions of policy-makers, government entities, and funding agencies in order to increase resources toward improving the lives of LGBTQ2S+ youth in schools (e.g., Baams et al., 2018; Day et al., 2019; Poteat et al., 2020). Other researchers such as Poteat et al. (2017) recommended that the study of GSAs requires a more constructivist and transformative worldview that highlights the complexity of multiple truths within youth activism in the LGBTQ2S+ community (Bain & Podmore, 2019). As the discipline of educational psychology responds to calls for meaningful solutions to educational problems (Alexander, 2004), it will need to actively and intentionally bring language to epistemological and ontological beliefs in order to see the value in all contributions.

### **Conclusion**

Educational psychology has a long philosophical history rooted in both pure and applied research (Berliner, 2006) on a wide range of topics pertinent to education. Our results suggest that doctoral students in educational psychology neither fully understood their own epistemological and ontological beliefs nor the possible range of beliefs held by their peers before participating in the four-part in class activity. As educational psychology researchers become increasingly required to disclose their biases, assumptions, and conflicts of interest, a critical starting point will be for scholars to articulate the beliefs that underlie their research

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

questions and approaches. The learning activity described in this SoTL appears to be one way to help doctoral students in educational psychology achieve this goal.



**Footnote**

<sup>1</sup>Muis and Franco (2010) examined epistemological beliefs in a sample of undergraduate students enrolled in an educational psychology course. They found 54% of students held epistemological beliefs that would be considered both rational and empirical, 24% predominantly rational, and 22% predominantly empirical. We have not reviewed this study because the focus was on the relationship amongst beliefs and self-regulation not the nature of beliefs themselves.

### References

- Alexander, P. A. (2003) Coming Home: Educational Psychology's Philosophical Pilgrimage. *Educational Psychologist*, 38(3), 129-132, DOI: 10.1207/S15326985EP3803\_1
- Alexander, P. A. (2004). In the year 2020: Envisioning the possibilities for educational psychology. *Educational Psychologist*, 39(3), 149-156.
- Atteberry-Ash, B., Kattari, S. K., Speer, S. R., Guz, S., & Kattari, L. (2019). School safety experiences of high school youth across sexual orientation and gender identity. *Children and Youth Services Review*, 104(February) 104403.  
<https://doi.org/10.1016/j.chidyouth.2019.104403>
- Baams, L., Pollitt, A. M., Laub, C., & Russell, S. T. (2018). Characteristics of schools with and without gay-straight alliances. *Applied Developmental Science*, 24(4), 354–359.  
<https://doi.org/10.1080/10888691.2018.1510778>
- Berliner, D. C. (2006). Educational Psychology: Searching for Essence throughout a Century of Influence from: *Handbook of Educational Psychology Routledge*. Accessed on: 17 Nov 2021
- Burrell, G. & Morgan, G. (1979) Sociological Paradigms and Organisational Analysis: elements of the sociology of corporate life. *Heinemann Educational Books*.
- Calfee, R. (2006). Educational psychology in the 21st century. *Handbook of educational psychology*, 2, 29-42.
- Creswell, J. W. (2014) *A concise introduction to mixed methods research*. Thousand Oaks, CA: Sage.
- Day, J. K., Ioverno, S., & Russell, S. T. (2019). Safe and supportive schools for lgbt youth: Addressing educational inequities through inclusive policies and practices. *Journal of*

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

- School Psychology*, 74, 29–43. <https://doi.org/10.1016/j.jsp.2019.05.007>
- Elias, E. (2021). Muddled Measurement: A Historical Perspective on Questionable Practices in School Psychology's Assessment of Learning Disabilities. *Canadian Journal of School Psychology*, 36(2), 142-152.
- Fetters, M. D., & Freshwater, D. (2015). The 1+ 1= 3 Integration Challenge. *Journal of mixed methods research*, 9(2), 115-117.
- Fetters, M. D., & Guetterman, T. C. (2021). *Development of a Joint Display as a Mixed Analysis*. The Routledge Reviewer's Guide to Mixed Methods Analysis, 259.
- Greene, J. A., Sandoval, W. A., & Bråten, I. (Eds.). (2016). *Handbook of epistemic cognition*. New York, NY: Routledge.
- Hansen, J. T. (2006). Counseling theories within a postmodernist epistemology: New roles for theories in counseling practice. *Journal of Counseling & Development*, 84(3), 291-297.
- Hofer, B. K.. (2008). Personal epistemology and culture. In Khine ed. *Knowing, knowledge and beliefs* (pp. 25-44). Springer, Dordrecht.
- Hofer, B. K. (2004). Epistemological understanding as a metacognitive process: thinking aloud during online searching. *Educational Psychologist*, 39, 43–55.  
doi:10.1207/s15326985ep3901\_5.
- Hofer, B. K., & Bendixen, L. D. (2012). Personal epistemology: Theory, research, and future directions. In K. R. Harris, S. Graham, T. Urdan, C. B. McCormick, G. M. Sinatra, & J. Sweller (Eds.), *APA educational psychology handbook, Vol 1: Theories, constructs, and critical issues* (pp. 227–256). Washington, DC: American Psychological Association.  
doi:10.1037/13273-009

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

- Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67, 88–140. doi:10.3102/ 00346543067001088
- Hofer, B. K., & Pintrich, P. R. (2002). *Personal epistemology: The psychology of beliefs about knowledge and knowing*. Mahwah, NJ: Erlbaum.
- Hofer, B. K. (2000). Dimensionality and disciplinary differences in personal epistemology. *Contemporary Educational Psychology*, 25, 378-405. doi 10.1006/ceps.1999.1026
- Johnson, P., & Cassell, C. (2001). Epistemology and work psychology: New agendas. *Journal of Occupational and Organizational Psychology*, 74(2), 125-143.
- Khine, M.S. (2008). *Knowing, knowledge and beliefs*. Springer, Dordrecht.
- Mason, L. (2003). Personal epistemologies and intentional conceptual change. In *Intentional conceptual change* (pp. 204-241). Routledge.
- Moore, J. (2005). Recognising and questioning the epistemological basis of educational psychology practice. *Educational Psychology in Practice*, 21(2), 103-116.
- Moradi, B., & Grzanka, P. R. (2017). Using intersectionality responsibly: Toward critical epistemology, structural analysis, and social justice activism. *Journal of Counseling Psychology*, 64(5), 500.
- Muis, K. R., & Franco, G. M. (2010). Epistemic profiles and metacognition: Support for the consistency hypothesis. *Metacognition and Learning*, 5(1), 27-45.
- Muis, K. R., Bendixen, L. D., & Haerle, F. C. (2006). Domain-general and domain-specificity in personal epistemology research: Philosophical and empirical reflections in the development of a theoretical framework. *Educational Psychology Review*, 18(1), 3-54.

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

- Muis, K. R., Winne, P. H., & Jamieson-Noel, D. (2007). Using a multitrait-multimethod analysis to examine conceptual similarities of three self-regulated learning inventories. *The British Journal of Educational Psychology*, 77, 177–195. doi:10.1348/000709905X90876.
- Nist, S. L. & Holschuh, J. P. (2005) Practical Applications of the Research on Epistemological Beliefs, *Journal of College Reading and Learning*, 35(2), 84-92, DOI: 10.1080/10790195.2005.10850175
- Olafson, L., & Schraw, G. (2010). Beyond epistemology: Assessing teachers' epistemological and ontological worldviews. In Lisa D. Bendixen & Florian C. Feucht (eds.), *Personal Epistemology in the Classroom: Theory, Research, and Implications for Practice*. Cambridge, University Press.
- Olafson, L., Schraw, G., & Veldt, M. V. (2010). Consistency and development of teachers' epistemological and ontological world views. *Learning Environment Research*, 13, 243-266. doi 10.1007/s10984-010-9078-3
- Pajares, F. (2003). In search of psychology's philosophical center. *Educational Psychologist*, 38(3), 177-181.
- Pekrun, R., Vogl, E., Muis, K. R., & Sinatra, G. M. (2017). Measuring emotions during epistemic activities: the Epistemically-Related Emotion Scales. *Cognition and Emotion*, 31(6), 1268-1276.
- Poteat, V. P., Calzo, J. P., Yoshikawa, H., Lipkin, A., Ceccolini, C. J., Rosenbach, S. B., O'Brien, M. D., Marx, R. A., Murchison, G. R., & Burson, E. (2020). Greater engagement in gender-sexuality alliances (gsas) and gsa characteristics predict youth empowerment and reduced mental health concerns. *Child Development*, 91(5), 1509–1528. <https://doi.org/10.1111/cdev.13345>

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

- Rosman, T., Seifried, E., & Merk, S. (2020). Combining intra-and interindividual approaches in epistemic beliefs research. *Frontiers in Psychology, 11*, 570.
- Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology, 82*(3), 498-504.
- Schraw, G. (2013). Conceptual integration and measurement of epistemological and ontological beliefs in educational research. *International Scholarly Research Notices, 2013*.
- Schraw, G. J., & Olafson, L. J. (2008). Assessing teachers' epistemological and ontological worldviews. In Khine ed. *Knowing, Knowledge and Beliefs* (pp. 25-44). Springer, Dordrecht.
- Schraw, G. J., & Olafson, L. J. (2008). Assessing teachers' epistemological and ontological worldviews. In *Knowing, Knowledge and Beliefs* M.S. Khine ed. (pp. 25-44). Springer, Dordrecht.
- Sulik, G. & Keys, J. (2014). "Many Students Really Do Not Yet Know How to Behave!" The Syllabus as a Tool for Socialization." *Teaching Sociology 42*(2):151–60.
- Trigwell, K. (2021). Scholarship of teaching and learning. In *University Teaching in Focus* (pp. 286-303). Routledge.
- Valentin, J. & Grauerholz, L. (2019). Exploring classroom climate in sociology courses using syllabi. *Teaching Sociology, 47*(3), 219-230. pDs:O//dIo: i1.o0r.g1/107.171/0707/90200925055X5X1919885500252
- Vassallo, S. (2017). *Critical Educational Psychology*. JHU Press.

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

**Table 1***Sample of U15 Canadian Departments of Educational Psychology*

| <b>University</b>   | <b>Department name</b>   | <b><i>N</i><br/>programs</b> | <b>Degrees<br/>granted</b> |
|---|--|------------------------------|----------------------------|
| University of Toronto,<br>Ontario Institute for<br>Studies in Education | Department of Applied Psychology<br>and Human Development                                | 5                            | MA, MEd,<br>PhD, EdD       |
| McGill University   | Educational & Counselling<br>Psychology  | 15                           | MA, MEd,<br>PhD            |
| University of British<br>Columbia                                       | Educational and Counselling<br>Psychology, and Special Education                         | 5                            | MA, MEd,<br>PhD            |
| University of Alberta   | Department of Educational<br>Psychology  | 8                            | MEd, PhD                   |
| University of Ottawa  | Counselling Psychology   | 2                            | MEd, MA                    |
| University of<br>Saskatchewan   | School and Counselling Psychology,<br>Special Education or Measurement<br>and Evaluation | 2                            | MEd                        |
| University of Manitoba  | School Psychology  | 1                            | MA                         |
| Western University  | Field of School and Applied Child<br>Psychology, Counselling Psychology                  | 3                            | MA, PhD                    |

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

**Table 2***Descriptives and Zero-order Correlations Between all Likert-scale Activity Items*

|                              | Poss.<br>range | Act.<br>range | <i>M</i> | <i>SD</i> | Skew | alpha | 1                 | 2     | 3    | 4    | 5    | 6     | 7    |
|------------------------------|----------------|---------------|----------|-----------|------|-------|-------------------|-------|------|------|------|-------|------|
| 1. Realism-Relativism        | 1-7            | 3-6           | 4.00     | 1.24      | .85  | –     |                   |       |      |      |      |       |      |
| 2. Positivism-Constructivism | 1-7            | 2-6           | 4.43     | 1.16      | -.66 | –     | .70*              |       |      |      |      |       |      |
| 3. Determinism-Volunteerism  | 1-7            | 3-7           | 5.00     | 1.11      | .00  | –     | -.11              | -.18  |      |      |      |       |      |
| 4. Nomothetic-Idiographic    | 1-7            | 2-6           | 4.43     | 1.34      | -.71 | –     | .14               | .17   | .05  |      |      |       |      |
| 5. Certainty                 | 1-5            | 1-4           | 1.83     | .42       | -.86 | .83   | -.59*             | -.55* | .20  | -.05 |      |       |      |
| 6. Personal justification    | 1-5            | 2-5           | 2.76     | .50       | .99  | .46   | .71*              | .46   | -.07 | -.06 | -.46 |       |      |
| 7. Authority                 | 1-5            | 1-4           | 2.56     | .50       | -.45 | .55   | -.09              | .19   | -.46 | -.12 | .20  | -.12  |      |
| 8. Attainment of truth       | 1-5            | 1-5           | 2.68     | .67       | .58  | .42   | -.51 <sup>+</sup> | -.21  | .21  | .29  | .11  | -.60* | -.02 |

*Note.* \*  $p < .05$  <sup>+</sup>  $p < .10$



## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

**Figure 1***2 x 2 Matrix for Word Selection Activity*

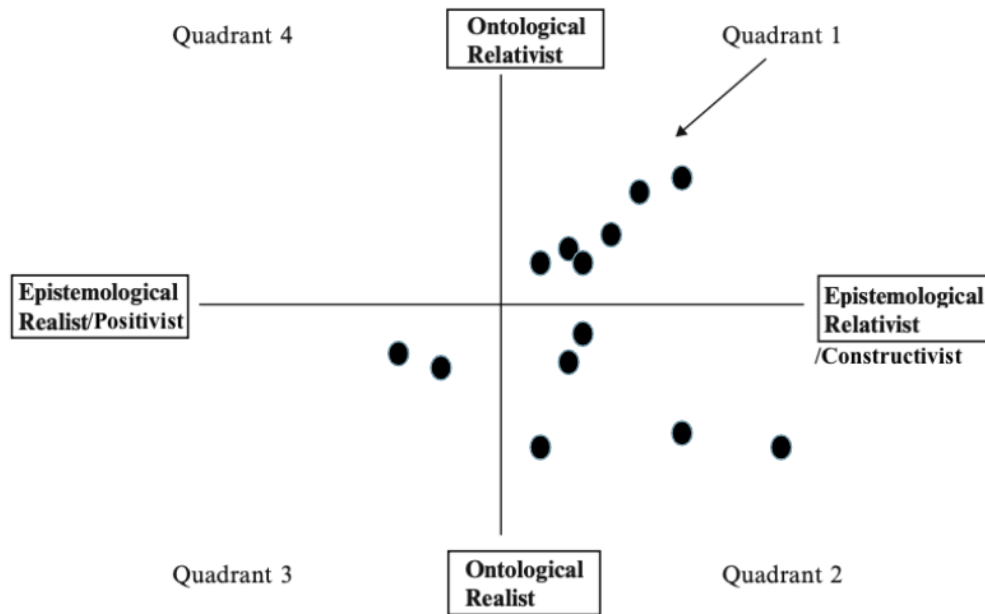
|   |  |
|---|--|
| <b>Quadrant A: Postpositivism (positivist)</b><br>Determinism (0)<br>Reductionism (1)<br>Empirical observation & measurement (8)<br>Theory verification (3)<br><br><i>Total frequency 12/86 words = 14%</i> | <b>Quadrant B: Constructivism (interpretivism)</b><br>Understanding (12)<br>Multiple participant meanings (4)<br>Social & historical construction (5)<br>Theory generation (1)<br><br><i>Total frequency 22/86 words = 26%</i> |
| <b>Quadrant C: Transformative</b><br>Political (1)<br>Power & justice oriented (5)<br>Collaborative (11)<br>Change-oriented (8)<br><br><i>Total frequency 25/86 words = 29%</i>                             | <b>Quadrant D: Pragmatism</b><br>Consequences of actions (4)<br>Problem-centred (9)<br>Pluralistic (3)<br>Real-world practice oriented (11)<br><br><i>Total frequency 27/86 words = 31%</i>                                    |

*Note.* Numbers in brackets indicate frequency of each word.

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

**Figure 2**

*2 x 2 Matrix Plot Representing  $n = 13$  Participants' Location on Epistemology and Ontology*

**Fig. 2.1** The four-quadrant scale

## EPISTEMOLOGY &amp; ONTOLOGY IN EDUCATIONAL PSYCHOLOGY

**Figure 3**

*Joint Display of Quantitative and Qualitative Data Describing Changes in Epistemological and Ontological Beliefs*

