Epistemic Cognition

Petr Johanès

Fourth Annual ACM Conference on Learning at Scale
2017-04-20
The purpose of the paper is to show how epistemic cognition can enrich large-scale online research both at a high level and at a granular level. The purpose of this presentation is to serve as a primer for the paper.
State of Epistemic Cognition Research
Epistemic cognition has roots in philosophy (for millennia) as well as psychology (for decades).

related to knowledge and knowing

“epistemic cognition”

mental models and processes
Epistemic cognition is a mode of cognition that is not always elicited by every learning task.

epistemic cognition (e.g., evaluating sources of knowledge)

metacognition (e.g., monitoring strategy)

cognition (e.g., processing)

“Did the author arrive at his/her knowledge claim in a way I consider valid and credible for my purposes?”

“How have I read through the entire text? Do I comprehend everything the author is writing?”

“What am I reading?”

(Kitchener, 1983)
Differing epistemologies lead to different interpretations and different learning.

\[
F = \frac{kQq}{r^2} \\
E = \frac{F}{q}
\]

(Lising & Elby, 2005)
Epistemologies influence not only the processes of cognition, but also the artifacts of cognition.

### Epistemic Misalignment

- When the epistemological demands of the task differ from the cognitive moves of the learner
  
  (Elby & Hammer, 2001)

- When the epistemological foundation of the material differs from the epistemological profile of the learner
  
  (Franco, et al, 2012)

### Epistemic Climate

- The overall epistemic influences from the learning environment (e.g., texts, exams, peers)
  
  (Feucht, 2010; Muis & Duffy, 2013)

- The set of epistemic practices that a community engages in when producing, evaluating, and consuming knowledge
  
  (Kelly, 2016)
Prior research has validated the utility and scalability of epistemic cognition for learning.

<table>
<thead>
<tr>
<th>Curriculum Design</th>
<th>Instructional Design</th>
<th>Task/Material Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reading Like a Historian for onboarding</td>
<td>• Different epistemologies lead to different prior knowledge reconciliations</td>
<td>• Different representations correlate with different recall and conceptual change</td>
</tr>
<tr>
<td>• Statistics course for epistemic change</td>
<td>• Epistemological resources can contextualize efficacy of a class discussion</td>
<td>• Different epistemological beliefs correlating with different text comprehension strategies</td>
</tr>
</tbody>
</table>
## Theoretical Models

<table>
<thead>
<tr>
<th>Developmental Stages</th>
<th>Stable, synchronous, naturally-occurring, and linearly-evolving beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measurement Methods</strong></td>
<td>• Interviews</td>
</tr>
<tr>
<td></td>
<td>• Discourse analysis</td>
</tr>
<tr>
<td></td>
<td>• Longitudinal observation</td>
</tr>
<tr>
<td>(King &amp; Kitchener, 1994, 2004; Perry, 1968)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensional Beliefs</th>
<th>Independent, asynchronous dimensions of beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measurement Methods</strong></td>
<td>• Likert-scale self-reports</td>
</tr>
<tr>
<td></td>
<td>• Surveys</td>
</tr>
<tr>
<td></td>
<td>• Activity performance</td>
</tr>
<tr>
<td>(Hofer &amp; Pintrich, 1997; Schommer-Aikins, 2002)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Situated Resources</th>
<th>Distinct, deployable, and context-sensitive mental resources or representations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measurement Methods</strong></td>
<td>• Think-aloud protocols</td>
</tr>
<tr>
<td></td>
<td>• Semi-structured interviews</td>
</tr>
<tr>
<td></td>
<td>• Cognitive interviews</td>
</tr>
<tr>
<td>(Elby &amp; Hammer, 2001; Hammer &amp; Elby, 2002)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Socio-Cultural Practices</th>
<th>Interactional, socialized, and group-based practices/habits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measurement Methods</strong></td>
<td>• Video analysis</td>
</tr>
<tr>
<td></td>
<td>• Discourse analysis</td>
</tr>
<tr>
<td></td>
<td>• Semi-structured interviews</td>
</tr>
<tr>
<td>(Kelly, 2016)</td>
<td></td>
</tr>
</tbody>
</table>
Affordances to Online Learning Research
Online learning researchers already investigate epistemic cognition without using this literature.

<table>
<thead>
<tr>
<th>Confusion in online discussion forums</th>
<th>Epistemic affect and epistemic anxiety/curiosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge modeling and knowledge tracing</td>
<td>Epistemic affect and epistemic anxiety/curiosity</td>
</tr>
<tr>
<td>Reflection activities in online environments</td>
<td>Epistemic affect and epistemic anxiety/curiosity</td>
</tr>
<tr>
<td>Student opinion on course epistemology</td>
<td>Epistemic affect and epistemic anxiety/curiosity</td>
</tr>
</tbody>
</table>


(Nacu, et al, 2016)

(Swan, Day, & Bogle, 2016)

(Pekrun, 2011)

(Elby & Hammer, 2001 ; Hofer & Pintrich, 1997)

(Elby & Hammer, 2001 ; Hofer & Pintrich, 1997)

(Elby & Hammer, 2001 ; Hofer & Pintrich, 1997)

(Elby & Hammer, 2001 ; Hofer & Pintrich, 1997)

(Elby & Hammer, 2001 ; Hofer & Pintrich, 1997)

(Elby & Hammer, 2001 ; Hofer & Pintrich, 1997)
This analysis requires at its core:
(1) mapping of the possible knowledge,
(2) modeling of the knower,
(3) making of a knowledge trajectory.
Two illustrative ways to weave epistemic cognition into existing research.

<table>
<thead>
<tr>
<th>Dimensional Beliefs</th>
<th>Situated Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cluster learners according to their epistemological beliefs profiles</td>
<td>• Classify learning tasks according to the epistemological resources they require</td>
</tr>
<tr>
<td>• Use epistemological beliefs models and learner performance to infer epistemological foundations for different learning tasks and materials</td>
<td>• Code/mine student explanations and reflections for activations of epistemological resources over time</td>
</tr>
</tbody>
</table>
This analysis requires a sense of (1) which factors are consequential to student disengagement in online learning environments and (2) how individual learner development meshes with the wider learner community.
Two illustrative ways to weave epistemic cognition into existing research.

**Developmental Stages**

- Analyze early disagreements in discussion forums to more precisely identify the epistemological developmental stage that learners are currently in
- Track learner handling of knowledge over time to trace learner development

**Socio-cultural Practices**

- Analyze the epistemic climate (e.g., videos, assessments, discussions) for practices the instructional team is strongly promoting and not promoting
- Track learner adoption and replication of epistemic practices to gauge disciplinary epistemologies
Conclusions
When planning online learning research, be mindful of the pervasiveness of epistemology.

• The epistemological choices we make as learning designers inform the epistemologies and learning of our learners.

• The epistemological choices we make as learning researchers inform the epistemologies and learning of our colleagues.

• Many intriguing open questions:
  • How do knowledge state transitions interact with epistemological belief transitions?
  • How does epistemologically-conscious design contribute to a greater inclusivity and diversity in online learning environments?

• Overlap between epistemic cognition and online learning research will most likely only increase – solid foundation for collaborations.
Thank You

Petr Johanes
pjohanes@stanford.edu
References
Reference List (1/2)


Reference List (2/2)


