

# Teachers' scientific thinking: How does teachers' epistemic thinking relate to their inquiry-based teaching practices?

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## Teachers' scientific thinking:

### How does teachers' epistemic thinking relate to their inquiry-based teaching practices?

#### Introduction

The last decades, policymakers in both Europe and the US have been arguing for the use of inquiry-based learning and teaching in science education (European Commission, 2007; National Research Council, 2012), and more recently, the inquiry-based approach has also found its way to other educational domains (Levy, Thomas, Drago & Rex, 2013). Epistemic thinking is considered to be at the core of the inquiry-based approach, such as illustrated by Windschitl, Thompson, and Braaten (2008) encouraging for inquiry frameworks focusing on both content and the epistemic practices of authentic science. In order for teachers to improve students' levels of epistemic thinking, they need to show advanced levels themselves (Kuhn, Iordanou, Pease & Wirkala, 2008). In the present study, we therefore examine the epistemic thinking of teachers from different educational domains, and the way their epistemic thinking relates to their inquiry-based teaching practices. The study is set in the context of international schools, as the International Baccalaureate (IB) curriculum that is frequently used at international schools, has a strong emphasis on inquiry-based teaching.

Kuhn & Weinstock's (2002, in Kuhn et al., 2008) defined the development of epistemic thinking in terms of the coordination between the objective and subjective dimensions of knowing. They distinguished multiple perspectives of epistemic thinking: at the absolutist perspective one only takes into account objective dimensions, at the multiplist perspective one only takes into account subjective dimensions, and at the evaluativist perspective one is able to coordinate both objective and subjective dimensions of knowing. In the present study, we use Barzilai and Weinstock's (2015) scenario-based assessment of epistemic thinking, which was based on the theoretical perspective developed by Kuhn and colleagues, to assess teachers' epistemological understanding.

#### Method

*Participants.* Secondary teachers of three international secondary schools in The Netherlands were asked to participate in the study. A total of 147 teachers (64% of all teachers at the three schools) from different educational domains (sciences, humanities, languages, other) participated and gave consent for the use of their data.

*Procedure.* The study was introduced at staff meetings at the participating schools. At these meetings, teachers were asked to complete an online questionnaire, including an inquiry-based teaching practices section and an epistemic thinking section. Follow-up e-mails were sent to reach teachers who were not present at the meetings.

*Inquiry-based teaching measure.* The questionnaire section included five items. The items referred to five steps students engage in inquiry-based learning (Audet & Jordan, 2005), and asked teachers to indicate per step 1) what teaching practices they apply in encouraging students to engage in these behaviors, and 2) how often they encourage students to engage in these behaviors. Table 1 shows an example item concerning the first inquiry-based learning step: 'asking answerable questions and identifying researchable problems'. The following four items covered the steps 'developing plans', 'gathering and processing resources', 'drawing conclusions', and 'reflecting on processes'. An

optional last question in the section asked teachers in what situations they use the most and in what situations they use the least inquiry-based teaching practices.

Table 1: Example of inquiry-based teaching item

<p>1. In inquiry-based learning students engage in <u>asking answerable questions and identifying researchable problems</u>.</p> <p>a) What teaching practices do you apply in encouraging students to engage in these behaviors and to support their learning process?</p> <p>b) In general, how often do you encourage students to engage in these behaviors?</p>
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Note. Option a refers to the type and option b to the quantity of inquiry-based teaching practices.

*Epistemic thinking measure.* This questionnaire section was based on the scenario-based approach of Barzilai and Weinstock (2015). Teachers domain groups (humanities, languages, sciences, other) were randomly assigned to either the biology or the history scenario. Teachers assigned to the biology scenario read a brief story about ‘deformed frogs’, and were asked to rate agreement (on a scale of 1-10) with eleven statements (from 1=very much disagree to 10=very much agree), each having three sub-statements corresponding with Kuhn’s (2008) absolutist, multiplist and evaluativist perspectives of (see Introduction). Teachers assigned to the history scenario read a brief story about ‘The Fifth Livian War’, and were asked to rate their agreement with ten statements, each having three sub-statements. Table 2 shows an example statement concerning the biology scenario.

Table 2: Example of epistemic thinking item (Barzilai & Weinstock, 2015)

What should the knowledge about the deformed frogs be based on?										
a. Mainly on interpretations of data	1	2	3	4	5	6	7	8	9	10
b. Mainly on personal points of view	1	2	3	4	5	6	7	8	9	10
c. Only on the facts	1	2	3	4	5	6	7	8	9	10

Note. Option a = evaluativist perspective, option b = multiplist perspective, option c = absolutist perspective

## Results & Discussion

Results are being analyzed momentarily. We will assess the epistemic perspectives of teachers, and relate these to the type and quantity of their inquiry-based teaching practices. In addition, we will examine whether the relation between teachers’ epistemic thinking and inquiry-based teaching practices differs for different educational domains.

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### **Brief abstract**

The last decades, policymakers have been arguing for the use of inquiry-based learning and teaching in science education. More recently, the inquiry-based approach has also found its way to other educational domains. Epistemic thinking is considered to be at the core of the inquiry-based approach. In order for teachers to improve students' levels of epistemic thinking, they need to show advanced levels themselves. In the present study, we therefore examine the epistemic thinking of secondary teachers from different educational domains, and the way their epistemic thinking relates to their inquiry-based teaching practices. The study is set in the context of international schools, as the International Baccalaureate (IB) curriculum that is frequently used at international schools, has a strong emphasis on inquiry-based teaching. Teachers' (N=147) epistemic thinking is measured by using the scenario-based approach of Barzilai and Weinstock (2015) that is based on the theoretical perspective of Kuhn and Weinstock's (2002, in Kuhn et al., 2008). In this perspective, the development of epistemic thinking is defined in terms of the coordination between the objective and subjective dimensions of knowing. Both teachers' epistemic thinking and their inquiry-based teaching practices are assessed with a digital questionnaire. The study's results (are momentarily being analyzed, and) will bear relevance to the educational context by providing a possible explanation for the difficulties in implementing inquiry-based approaches, as well as by providing suggestions for teacher training in the area of inquiry-based teaching.