PhysPort Implementation Guide:
Epistemological Beliefs Assessment for Physical Sciences (EBAPS)
Version 5

PhysPort
Supporting physics teaching with
research-based resources

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Implementation

Purpose of the EBAPS

To probe the epistemological stances of students in introductory physics, chemistry and physical science.

Course Level: What kinds of courses is it appropriate for?

Intro college and High school

Content: What does it assess?

Beliefs / Attitudes (epistemological beliefs, structure of knowledge, nature of knowing and learning, real-life applicability, evolving knowledge, source of ability to learn)

Timing: How long should I give students to take it?

15-22 minutes

Example Questions

Sample questions from the EBAPS:

DIRECTIONS: For each of the following items, please read the statement, and indicate (on the scantron answer sheet) the answer that describes how strongly you agree or disagree.

A: Strongly disagree B: Somewhat disagree C: Neutral D: Somewhat agree E: Strongly agree

Tamara just read something in her science textbook that seems to disagree with her own experiences. But to learn science well, Tamara shouldn't think about her own experiences; she should just focus on what the book says.

DIRECTIONS: In each of the following items, you will read a short discussion between two students who disagree about some issue. Then you'll indicate whether you agree with one student or the other

Brandon: A good science textbook should show how the material in one chapter relates to the material in other chapters. It shouldn't treat each topic as a separate "unit," because they're not really separate.

Jamal: But most of the time, each chapter is about a different topic, and those different topics don't always have much to do with each other. The textbook should keep everything separate, instead of blending it all together.

With whom do you agree? Read all the choices before circling one.

(a) I agree almost entirely with Brandon.
(b) Although I agree more with Brandon, I think Jamal makes some good points.
(c) I agree (or disagree) equally with Jamal and Brandon.
(d) Although I agree more with Jamal, I think Brandon makes some good points.
(e) I agree almost entirely with Jamal.

Access: Where do I get the assessment?

Download the assessment from physport at www.physport.org/assessments/EBAPS.

Versions and Variations: Which version of the assessment should I use?

The latest version of the EBAPS, released in 2006, is version 5.0.

Administering: How do I give the assessment?

- Give it as both a pre- and post-test. This measures how your class shifts student thinking.
  - Give the pre-test at the beginning of the term.
  - Give the post-test at the end of the term.
- Use the whole test, with the original wording and question order. This makes comparisons with other classes meaningful.

- Make the test required, and give credit for completing the test (but not correctness). This ensures maximum participation from your students.
- Tell your students that the test is designed to evaluate the course (not them), and that knowing how they think will help you teach better. Tell them that correctness will not affect their grades (only participation). This helps alleviate student anxiety.
- For more details, read the **PhysPort Guides** on implementation:
  - **PhysPort Expert Recommendation on Best Practices for Administering Belief Surveys** (www.physport.org/expert/AdministeringBeliefSurveys/)

Scoring: How do I calculate my students' scores?

- Download the scoring scheme from PhysPort (www.physport.org/key/EBAPS)
- Each item is scored on a scale of 0 (least sophisticated) to 4 (most sophisticated). The scoring scheme is non-linear to take into account question-by-question variations in whether, for instance, neutrality is more or less sophisticated. A subscale score is simply the average of the student's scores on every item in that subscale. (When an item within a given subscale is left blank, the average is calculated without that item included.) You can multiply by 25 in order to report subscale scores on a scale of 0 to 100.
- See the **PhysPort Expert Recommendation on Best Practices for Administering Belief Surveys** for instructions on calculating shift and effect size (www.physport.org/expert/AdministeringBeliefSurveys/)

Clusters: Does this assessment include clusters of questions by topic?

EBAPS probes students' views along five non-orthogonal dimensions:

1. *Structure of scientific knowledge*. Is physics and chemistry knowledge a bunch of weakly connected pieces without much structure and consisting mainly of facts and formulas? Or is it a coherent, conceptual, highly-structured, unified whole? (Q. 2, 8, 10, 15, 17, 19, 20, 23, 24, 28)
2. *Nature of knowing and learning.* Does learning science consist mainly of absorbing information? Or, does it rely crucially on constructing one's own understanding by working through the material actively, by relating new material to prior experiences, intuitions, and knowledge, and by reflecting upon and monitoring one's understanding? (Q. 1, 7, 11, 12, 13, 18, 26, 30)
3. *Real-life applicability*. Are scientific knowledge and scientific ways of thinking applicable only in restricted spheres, such as a classroom or laboratory? Or, does science apply more generally to real life? These items tease out students' views of the applicability of scientific knowledge *as distinct from* the student's own desire to apply science to real life, which depends on the student's interests, goals, and other non-epistemological factors. (Q. 3, 14, 19, 27)
4. *Evolving knowledge.* This dimension probes the extent to which students navigate between the twin perils of absolutism (thinking all scientific knowledge is set in stone) and extreme relativism (making no distinctions between evidence-based reasoning and mere opinion). (Q. 6, 28, 29)
5. *Source of ability to learn.* Is being good at science mostly a matter of fixed natural ability? Or, can most people become better at learning (and doing) science? As much as possible, these items probe students' epistemological views about the efficacy of hard work and good study strategies, *as distinct from* their self-confidence and other beliefs about themselves. (Q. 5, 9, 16, 22, 25)

NOTE — The following items belong to no dimension except for Overall: Q. 4, 21

Typical Results: What scores are usually achieved?

Typical scores on the EBAPS for different teaching methods from Marx et al. 2004.

Traditional courses had little or no research-based pedagogy. Class time is largely filled with lectures and demonstrations; slides and videos; and laboratories that follow prescribed instructions, some of which are computer-based. Traditional classes had some group work.

Transitional courses had approximately half of the classroom time devoted to research-based activities. These activities come in several forms including exploratory laboratories, activities modeled after Interactive Lecture Demonstrations, and group worksheets designed to reinforce relevant physical concepts and build numeracy. The other half of the time is lecture-based.

Learning-centered courses incorporated research- based curricular materials of the kind discussed above in every class meeting, and lecture time is minimized. Each course had traditionally-graded assignments,including several homework sets, quizzes, tests, projects, and a final exam. None of the graded assignments were intended to foster or reinforce students' epistemologies.

TABLE 2. Comparison of various instructional styles. Statistically significant ($\alpha = 0.95$) changes within a particular style are in boldface.

	Learning-centered		Transitional		Traditional	
	Pre	Post	Pre	Post	Pre	Post
N	(107)		(47)		(101)	
Overall	60	60	57	61	**53**	**48**
Cluster						
Structure	52	55	**41**	**51**	43	39
Nature	56	53	54	58	51	49
Reality	77	75	**71**	**77**	**64**	**58**
Evolving	42	50	36	37	40	40
Source	72	68	**74**	**68**	**64**	**54**

Typical results for high school students from Elby 2001:

Table II. Virginia EBAPS scores. The first two rows show the mean pre- and post-scores for each subscale. "Source of ability..." stands for *Source of Ability to Learn*. Because these scores are not percentages of favorable responses, they cannot be compared directly to MPEX scores. Each student's *gain score* is the difference between his/her pre- and post-test score. The fourth row shows the standard deviation of the gain scores, relevant for the paired (matched) samples *t*-test of statistical significance. ($n = 55$ students.)

	Overall	Structure of knowledge *Concepts, Coh.*	Nature of learning *Independence*	Real-life applicability *Reality link*	Evolving knowledge	Source of ability...
Pre	67.4	67.9	66.8	72.4	67.0	67.4
Post	71.8	76.1	72.7	77.1	69.5	66.3
Mean gain score	4.4[a]	8.2[a]	5.9[a]	4.7[a]	2.5	−1.1
s.d. of gain scores	7.5	16.2	12.3	14.5	18.3	16.1

[a]$p < 0.02$.

Interpretation: How do I interpret my students' scores in light of typical results?

Look at the shift between pre- and post-test

Your EBAPS results are especially useful for comparing shifts in students' epistemological beliefs before and after you have made a change to your teaching, for example, trying teaching methods that explicitly focus on developing expert-like beliefs. You can compare the shifts in percent favorable or unfavorable beliefs before and after you try new teaching techniques as one measure to gauge the effectiveness of the techniques.

Look at the effect size of the change

Look at the effect size of the change between your pre- and post-test. This tells you how substantially your pre- and post-test scores differ. Compare your effect size to the ranges given below to find out how substantial the change from pre- to post-test was. For more details, read the **PhysPort Expert Recommendation on Effect Size** (www.physport.org/expert/effectsize)

Effect Size	Cohen's d
Large	~0.8
Medium	~0.5
Small	0.2-0.3

Look at clusters of questions

You can also gain insight into what areas of your students' beliefs are being improved through your course by looking at their shifts in favorable or unfavorable beliefs by cluster.

Resources

Where can I learn more about this assessment?

A. Elby, Helping physics students learn how to learn, Am. J. Phys. **69** (S1), S54 (2001).

The developer has an online paper describing The Idea Behind the EBAPS.

Translations: Where can I find translations of this assessment in other languages?

We don't have any translations of this assessment yet.

If you know of a translation that we don't have yet, or if you would like to translate this assessment, please contact us!

Background

Similar Assessments

The content on the EBAPS, MPEX and CLASS is similar. The main difference between the EBAPS and the CLASS and MPEX is the style of the questions, where the EBAPS has three styles of questions, and the MPEX and CLASS just include agree/disagree questions.

Research: What research has been done to create and validate the assessment?

Research Validation: Silver ⬤

This is the second highest level of research validation, corresponding to at least 5 of the validation categories below.

- ☑ Based on research into **student thinking**
- ☐ Studied using **student interviews**
- ☐ Studied using **expert review**
- ☑ Studied using **appropriate statistical analysis**
- ☑ Research conducted **at multiple institutions**
- ☑ Research conducted **by multiple research groups**
- ☑ **Peer-reviewed publication**

Research Overview

The EBPAS questions were developed based on an extensive literature review of other epistemological surveys. The developers synthesized other researchers ideas to create guiding principles, which they used to write the EBAPS questions. The EBAPS was given to pilot subjects, and about 100 community college students who answered the survey and provided their reasoning for each question. The questions were subsequently revised. The reliability of the EBAPS categories was calculated, and results were acceptable in four of five categories. The EBAPS has been given to over 1000 students in high school and introductory university physics courses at multiple-institutions the results published in over eight peer-reviewed publications.

Developer: Who developed this assessment?

Andrew Elby, John Frederiksen, Christina Schwarz, and Barbara White

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