PhysPort Implementation Guide: Views on Science and Education Questionnaire (VOSE)

Version 1

PhysPort
Supporting physics teaching with research-based resources

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Implementation

Purpose of the VOSE

To be a valid, meaningful, and practical instrument for creating in-depth profiles of the views of college students or adults, including pre- and in-service teachers, about the nature of science, and NOS instruction.

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

Upper-level, Intermediate, Intro college, and High school

Content: What does it test?

Beliefs / Attitudes (nature of science, theories and laws, tentativeness, creativity, objectivity, subjectivity, scientific method, teaching the nature of science)

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

15 minutes

Example Questions

Sample question from the VOSE:

When two different theories arise to explain the same phenomenon (e.g., fossils of dinosaurs), will scientists accept the two theories at the same time?

A. Yes, because scientists still cannot objectively tell which one is better; therefore, they will accept both tentatively.	SD	D	U	A	SA
B. Yes, because the two theories may provide explanations from different perspectives, there is no right or wrong.	SD	D	U	A	SA
C. No, because scientists tend to accept the theory they are more familiar with.	SD	D	U	A	SA
D. No, because scientists tend to accept the simpler theories and avoid complex theories.	SD	D	U	A	SA
E. No, the academic status of each theory proposer will influence scientists' acceptance of the theory.	SD	D	U	A	SA
F. No, scientists tend to accept new theories which deviate less from the contemporary core scientific theory.	SD	D	U	A	SA
G. No, scientists use intuition to make judgments.	SD	D	U	A	SA
H. No, because there is only one truth, scientists will not accept any theory before distinguishing which is best.	SD	D	U	A	SA

Access: Where do I get the test?

Download the test from physport at www.physport.org/assessments/VOSE.

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

The latest version of the VOSE, released in 2006, is version 1. Several pilot versions were tested starting in 2000 before creating this version.

Administering: How do I give the test?

- If you are interested in learning how your students' nature of science ideas change as a result of your course, give it as both a pre- and post-test.
    - Give the pre-test before you cover relevant course material.
    - 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 there are no right or wrong answers to any item and that the intention is to elicit their views on some issues related to nature of science. 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?

- The VOSE has 15 statements, each of which has 3-9 possible responses for students to agree or disagree with. Students may agree with more than one of the responses. There are no right or wrong answers, but each statement corresponds to a particular "position" on one or more subtopics of nature of science (NOS). The developer has created an extensive list of coding categories to "create and in-depth profile of a [student's] NOS views and educational ideas." For the coding categories, see below.

Coding categories for VOSE (from Chen 2006)

Table 1: NOS issues, philosophical positions, and item number tested by VOSE

Issue	Position	Item[a]
Tentativeness	Revolutionary	4A
	Cumulative[b]	4B
	Evolutionary[b]	4C
Nature of observations	Theory-laden	8A,8B,8E
	Theory-independent	8C,8D
Scientific methods	The universal scientific method[b]	9A,9B,9F
	Diverse methods	9C,9D,9E
Theories and laws	Epistemology	
	Discovered[b]	5A,5B (Theory) 6A,6B (Law)
	Invented	5D,5E,5F (Theory) 6D,6E (Law)
	Discovered or invented	5C (Theory) 6C (Law)
	Comparison	
	Laws being more certain[b]	7A,7B
	Different types of ideas	7C,7D
Use of imagination	Yes	3A,3B
	No[b]	3C,3D,3E
Validation of scientific knowledge	Empirical evidence	1A,1H
	Paradigm	1C,1F
	Parsimony	1D
	Authority	1E
	Intuition	1G
Subjectivity and objectivity	Subjectivity	
	Parsimony	1D (Actual)
	Authority	1E (Actual)
	Paradigm	1C,1F,8A,8B (Actual)
	Personal factors	1G,8A (Actual) 15A,15D,15H (Ought)
	Socio-cultural influence	2A,2B (Actual) 15B,15C (Ought)
	Imagination	3A,3B (Actual)

	Methodology	9D (Actual)
	Neutral	1B (Actual)
	Objectivity	
	No influence of socio-culture	2C,2D (Actual) 15F (Ought)
	Use no imagination	3C,3E (Actual)
	Based on experimental facts	5B,6B,8D (Actual)
	No influence of personal beliefs	8C (Actual) 15E,15I (Ought)
	Methodology	8E,9A,9B (Actual)
	Overall	1A,1H (Actual) 15G (Ought)

Notes:
[a]The numerical number indicates the question, while the letter represents the response for that question.
[b]The corresponding items were scored in reverse to calculate the means of the issues.

Table 2: Attitudes toward teaching the NOS issues tested by VOSE

Topic	**Attitude**	**Item**[a]
Tentativeness	Teaching the tentativeness of scientific knowledge	12A,12B
	Avoid teaching the tentativeness of scientific knowledge[b]	12C,12D,12E
Nature of observations	Training students to make objective observations[b]	11A,11B,11C
	Revealing the theory-laden nature of observations	11D,11E
Scientific methods	Teaching the universal scientific method[b]	10A,10B,10C, 10D,10E,10F
	Encouraging different methods	10G,10H,10I
Theories and laws	Teaching the relationship between theories and laws	13A,13B
	Avoid teaching the relationship[b]	13C,13D
Subjectivity and objectivity	Teaching subjectivity	
	Personal factors	14A,14D
	Socio-cultural influences	14B,14C
	Emphasizing objectivity	
	No influence of personal beliefs	14E
	No influence of socio-culture	14F
	Value free in science courses	14G

Notes:
[a]The numerical number indicates the question, while the letter represents the response for that question.
[b]The corresponding items were scored in reverse to calculate the means of the issues.

Calculating a numerical score:

Burton 2013 developed a numerical system for calculating a numerical score for each issue or topic, by assigning a number between 0 and 4 to a student's response for each item listed under that issue or topic in Table 1 or 2 above and calculating the average. (Strongly Disagree = 0, Disagree = 1, Uncertain = 2, Agree = 3, Strongly Agree = 4).

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

The clusters on the VOSE are listed in Tables 1 and 2 above.

Typical Results: What scores are usually achieved?

Typical scores on the VOSE from (Burton 2013)

Table 2
Results of the views on science and education – philosophical stances.

	Pre-test		Post-test		$t(1,16)$	p	Effect size (d)
	M	SD	M	SD			
Tentativeness	3.09	0.38	2.99	0.47	0.97	0.35	0.23
Nature of observations	2.33	0.47	2.36	0.30	0.20	0.85	0.07
Scientific methods[a]	1.57	0.61	2.49	0.33	6.67	0.000[a]	1.88
Theories and laws[a]	1.85	0.35	2.39	0.30	5.00	0.000[a]	1.66
Use of imagination	2.90	0.77	3.16	0.64	1.45	0.16	0.37
Validation of scientific knowledge	1.46	0.44	1.30	0.50	1.66	0.112	0.23
Subjectivity and objectivity[a]	2.08	0.23	2.31	0.23	5.15	0.000*	1.00

[a] Indicates significance for 2-tailed test.

Table 3
Results of the views on science and education – attitudes toward teaching.

	Pre-test		Post-test		$t(1,16)$	p	d
	M	SD	M	SD			
Tentativeness	3.55	0.40	3.36	0.56	1.64	0.12	0.39
Nature of observations	2.51	0.52	2.63	0.71	0.71	0.49	0.19
Scientific methods[a]	1.55	0.62	2.61	0.34	8.36	0.000[a]	2.12
Theories and laws	3.06	0.63	3.26	0.49	1.52	0.14	0.35
Subjectivity and objectivity	2.24	0.37	2.28	0.36	0.38	0.71	0.11

[a] Indicates significance for 2-tailed test.

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

Review your students' responses:

One way to use the VOSE is to read through your students' responses to get a qualitative feel for how they are thinking about the responses. You can use Tables 1 and 2 above to see which NOS positions each item represents.

Calculate a numerical score:

You can use Burton's numerical scheme, described above, to calculate a numerical score for each issue or position, and compare to Burton's results in the Typical Results section.

Resources

Where can I learn more about this test?

S. Chen, Development of an Instrument to Assess Views on Nature of Science and Attitudes Toward Teaching Science, Sci. Educ. **90** (5), 803 (2006).

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

You can download translations of this test in the following languages from PhysPort:

- **Chinese** translated by Sufen Chen
- **English**

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 Tests

The VOSE and the VNOS cover similar topics around the nature of science. The main difference between them is the format. The VNOS is open-ended while the VOSE asks students to agree/disagree with different options. Another difference between the VOSE and VNOS, is that in addition to asking about students' philosophical beliefs about science, the VOSE asks students to agree/disagree with statements about how to teach the nature of science, which the VNOS does not.

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

Research Validation: Silver

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

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

Research Overview

The VOSE Likert-scale questions were developed based on questions from the VOSTS. An initial version of the VOSE was given to 14 American and 10 Taiwanese pre-service teachers, who were all interviewed about their responses. The survey questions were substantially revised, and the “draft VOSE” was created. It was given to 120 biology students in Taiwan, and further revised to ensure variation across respondents and to reduce the rate of neutral responses. The VOSE underwent expert review and further student interviews and was again revised. The VOSE was written and tested in Chinese and translated into English. The VOSE has been used with over 300 students in multiple majors at two Taiwanese universities and results published in two journal publications.

Developer: Who developed this test?

Sufen Chen

References

- S. Chen, Development of an Instrument to Assess Views on Nature of Science and Attitudes Toward Teaching Science, Sci. Educ. **90** (5), 803 (2006).
- E. Peters Burton, Student work products as a teaching tool for nature of science pedagogical knowledge: A professional development project with in-service secondary science teachers, Teaching Teacher Education **29** (1), 156 (2012).