

The Science Value Inventory (SVI): A Short Description

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The purpose of the SVI is to measure how much undergraduate students value science literacy. Our review of the literature, in particular the work of Jacquelynne Eccles and her colleagues, suggests that students will be more likely to value science literacy if

- they value being competent in science
- they believe there are direct benefits associated with understanding science
- they find science to be intrinsically interesting
- they find the costs associated with developing an understanding of science to be reasonable.

Consistent with this literature, we specified four areas, or domains, that theoretically should reflect how much students value science literacy. These four domains are referred to as:

- Interest in Science,
- Utility of Understanding Science,
- Need for High Achievement in Science, and
- Personal Cost of Understanding Science.

Factor Structure and Internal Consistency

The SVI was developed through extensive testing at a large regional state university. The theoretical, four-component factor structure was supported in two independent, large-scale administrations, each involving about 1,000 students. However, utility of understanding science separated into two facets (*present* and *future*), and personal cost separated into three facets (*time pressures*, *threats to self-efficacy*, and *conflict with religiosity*). Domain definitions are provided below. Drawing from the second large-scale item tryout ($n = 886$), results suggested item relatedness at both the subscale level and across the entire scale. Alpha coefficients for scores on the seven subscales were:

Interest in Science	$\alpha = .90$	Time Pressures	$\alpha = .84$
Present Utility of Science	$\alpha = .89$	Threats to Self-Efficacy	$\alpha = .90$
Future Utility of Science	$\alpha = .90$	Conflict with Religiosity	$\alpha = .84$
Need for High Achievement in Science	$\alpha = .84$		

Alpha for the full scale was .91.

Scale and Subscale Means

On the 42-item SVI, item scores range from 1 (strongly disagree) to 5 (strongly agree) to yield scale scores (with 6 items each) ranging from 6 to 30. Thus, the maximum SVI total score is 210, with higher scores reflecting greater perceived value of science. Drawing from our second large-scale administration, means and standard deviations for each of the four scales and the full scale were as follows:

	<i>M</i>	<i>SD</i>
Interest in Science	18.2	5.9
Present Utility of Science	20.0	5.0
Future Utility of Science	17.6	5.4
Need for High Achievement in Science	19.6	5.3
Time Pressures	17.1	5.0
Threats to Self-Efficacy	19.5	5.8
Conflicts with Religiosity	24.6	5.2
Full scale	136.7	22.3

Domain Definitions

Interest in Science refers to the importance a student places on science because of genuine interest in the subject. Items that assess interest in science ask students to reflect on the intrinsic satisfaction they receive from learning about science either inside or outside the classroom.

Utility of Understanding Science is the importance a student places on understanding science because it will help him or her to accomplish a variety of short- or long-term goals. Items that assess utility ask students to reflect on what they have to gain personally as a result of understanding scientific concepts or to reflect on the personal benefit of taking science courses. These items assess why it is useful to understand math, but do not assess what is lost or sacrificed. Utility has two facets:

Present Utility

This facet refers to the usefulness of science in helping students accomplish short-term goals. These benefits may include improving skills or abilities required for success in other college classes, or other things that produce similarly immediate benefits.

Future Utility

Future Utility refers to the usefulness of science in helping students meet their long-term goals after completing their study of science. These include the value of science in improving career prospects as well as performing well in future college courses.

Need for High Achievement in Science is the importance a student places on doing well in science. Items that assess need for high achievement ask students to reflect on how important it is to develop a good understanding of science or to achieve at high levels in their science courses. These items do not assess why it is important to have a good understanding of science.

Personal Cost of Understanding Science refers to the sacrifices a student believes are required to develop an understanding of science or to do well in science courses. Items that assess personal cost ask students to reflect on what may be lost, give up, or compromised in order to master scientific concepts. Personal Cost has three facets:

Threats to Self-Efficacy

This refers to the perceived impact of learning science on a student's judgment of his or her own abilities. Items that assess this facet ask students to reflect on how struggling with science may pose threats to their self-esteem or lead them to question their abilities or intelligence.

Time Pressures

This facet refers to the conflict that may arise between the time and effort required to understand science, and the time needed to accomplish other goals in a student's life. Items assessing time pressure ask students whether learning science takes too much time, particularly in the context of competing daily activities.

Conflict with Religiosity

This refers to the conflict that students may find between scientific ideas and their religious beliefs. Items that assess this facet ask students to consider how articles of their religious beliefs may be compromised or challenged in order to succeed in science classes.

Test/Retest Reliability

In order to examine the test-retest reliability of scores on the SVI, we also administered the inventory twice over a two-week period to a sample of undergraduates ($n = 81$). Two-week retest correlations for the seven SVI scales were:

	<i>r</i>
Interest in Science	.85
Present Utility	.74
Future Utility	.79
Need for High Achievement	.83
Time Pressures	.76
Threats to Self-Efficacy	.80
Conflict with Religiosity	.79

The two-week retest correlation of the SVI total-scale score, which was the sum of the 42 item scores, was $r = .92$. All correlations were statistically significant at $p < .001$.

Interpreting Results from the Science Value Inventory

N: Number of students in data set

Student ID numbers were used for matching pre-tests and post-tests. Only those students who completed both administrations are included in the analysis. Thus, the number of pre-test and/or post-tests submitted may differ significantly from N.

Scale Averages

Each of the seven sub-scales on the SVI ranges from 6 to 30, so that total scores can range from 42 to 210. In each case, higher scores indicate a higher value attached to science. This is true for the cost domains as well (Threats to Self-Efficacy, Time Pressures, and Conflict with Religiosity): for example, a score of 25 on the Conflict with Religiosity sub-scale indicates less of a perceived conflict between science and religion than a score of 20. Thus, the 25 indicates a lower cost associated with learning science—and a higher value.

Pre-test/Post-test results

We look for pre-test/post-test differences in the means of each of the seven sub-scales, as well as the total score, as indications of changes in students' valuing of science. These changes are listed to the right of the post-test results. Whether these changes are statistically significant depends on the number of students in each sample, the standard deviation of each scale or sub-scale, and the size of the change itself.

In order to characterize these results, we have used both *effect size* (as defined in Cohen's *d*) to indicate the relative size of any change detected by the post-test. The effect size indicates the difference between the means for the two populations, normed by the pooled standard deviation:

$$d = \frac{M_{post} - M_{pre}}{\sqrt{[\sigma_{post}^2 + \sigma_{pre}^2]}/2}$$

Thus, Cohen's *d* is essentially the change in the mean expressed as a multiple of the standard deviation: an effect size of +1.0 would indicate that the mean increased by 1σ from pre-test to post-test. Commonly accepted standards for effect size are:

$ d < 0.2$ Trivial	$0.5 < d < 0.8$ Moderate
$0.2 < d < 0.5$ Small	$0.8 < d $ Large

To help make this more evident in the table, the column next to the effect size indicates the relative effect size. When comparing pre-test and post-test scores, trivial effect sizes ($|d| < 0.2$) receive no marker. Others are highlighted as follows:

$0.2 < d < 0.5$ Sm Incr	$-0.2 > d > -0.5$ Sm Decr
$0.5 < d < 0.8$ Mod Incr	$-0.5 > d > -0.8$ Mod Decr
$0.8 < d$ Lg Incr	$-0.8 > d$ Lg Decr

We also indicate the significance of the change in subscale and total means via a paired sample t-test of pre- and post-test results. This estimates the probability p that such a difference could have arisen by chance. The lower the value of p , the more significant the result:

$p > .05$	not significant
$.05 > p > .01$	small significance
$.01 > p > .001$	moderate significance
$.001 > p$	strong significance

Comparison of Pre-Test Results with Norm Group

In addition, we have compared the pre-test results for your cohort against the norm group, which provides an indication of how similar or different your students may be from the development cohort. These differences are again measured by effect sizes, using the same classifications as above, and are characterized in the table by the following markers:

Small $+d$	Sm +diff	Small $-d$	Sm -diff
Moderate $+d$	Mod +diff	Moderate $-d$	Mod -diff
Large $+d$	Lg +diff	Large $-d$	Lg -diff

Positive differences indicate that your students valued science more than those in the norm group.

Birmingham-Southern College
Environmental Studies 150
Gibbons, Megan

See page 1 for description

See page 4 for interpretation

	Pre-Test Scale			Post-Test Scale			Pre/Post Change	Effect Size	
	N	Average	SD	N	Average	SD		Cohen's <i>d</i>	t-tes
Interest	10	24.1	6.7	10	24.9	5.1	0.8	0.13	0.
Present Utility	10	23.9	4.9	10	25.5	3.9	1.6	0.36 Sm Incr	0.
Future Utility	10	21.9	7.6	10	23.0	6.3	1.1	0.16	0.
Need for High Achievement	10	22.4	8.3	10	21.9	8.3	-0.5	-0.06	0.
Threats to Self-Efficacy	10	18.6	5.1	10	19.1	4.8	0.5	0.10	0.
Time Pressures	10	18.4	5.8	10	18.5	5.0	0.1	0.02	0.
Conflict with Religiosity	10	24.9	4.3	10	27.5	3.6	2.6	0.66 Mod Incr	0.
Total	10	154.2	26.9	10	160.4	23.1	6.2	0.25 Sm Incr	0.

	Pre-Test Scale			Norm Group Scale			Diff.	Effect Size	
	N	Average	SD	N	Average	SD		Cohen's <i>d</i>	
Interest	10	24.1	6.7	875	18.3	5.9	5.8	0.92 Lg +Diff	
Present Utility	10	23.9	4.9	878	20.0	5.0	3.9	0.79 Lg +Diff	
Future Utility	10	21.9	7.6	880	17.6	5.4	4.3	0.65 Lg +Diff	
Need for High Achievement	10	22.4	8.3	882	19.6	5.3	2.8	0.40 Mod +Diff	
Threats to Self-Efficacy	10	18.6	5.1	877	19.5	5.8	-0.9	-0.16 Sm -Diff	
Time Pressures	10	18.4	5.8	873	17.1	5.0	1.3	0.24 Mod +Diff	
Conflict with Religiosity	10	24.9	4.3	876	24.6	5.2	0.3	0.06 Sm +Diff	
Total	10	154.2	26.9	835	136.7	22.3	17.5	0.71 Lg +Diff	

N = Number of students who completed both pre- and post-test for the SVI.

Pre-Test & Post-Test Data: Mean and Standard Deviation for each scale.

Norm Group: Student sample used in final development phase of the SVI.

Effect Size: Cohen's *d* for Pre/Post changes and Pre-Test/Norm Group Difference.

Millsaps College
Tim Ward/Stan Galicki

See page 1 for description

See page 4 for interpretation

	Pre-Test			Post-Test			Pre/Post Change	Effect Size	
	N	Average	SD	N	Average	SD		Cohen's <i>d</i>	t-test sig.
Interest	12	21.0	5.1	12	20.4	5.0	-0.6	-0.12	0.26
Present Utility	12	22.8	3.3	12	22.8	2.8	0.0	0.00	0.20
Future Utility	12	18.1	4.4	12	17.3	3.3	-0.8	-0.21 Sm Decr	0.38
Need for High Achievement	12	21.1	3.8	12	20.1	6.0	-1.0	-0.20 Sm Decr	0.41
Threats to Self-Efficacy	12	19.3	7.8	12	18.1	5.5	-1.2	-0.18	0.46
Time Pressures	12	19.6	5.7	12	16.1	4.1	-3.5	-0.70 Mod Decr	0.88
Conflict with Religiosity	12	25.5	4.2	12	23.5	5.9	-2.0	-0.39 Sm Decr	0.00
Total	12	147.4	25.0	12	138.3	21.7	-9.1	-0.39 Sm Decr	0.05

	Pre-Test			Norm Group			Diff.	Effect Size	
	N	Average	SD	N	Average	SD		Cohen's <i>d</i>	
Interest	12	21.0	5.1	875	18.3	5.0	2.7	0.53 Mod +Diff	
Present Utility	12	22.8	3.3	878	20.0	2.8	2.8	0.91 Lg +Diff	
Future Utility	12	18.1	4.4	880	17.6	3.3	0.5	0.13	
Need for High Achievement	12	21.1	3.8	882	19.6	6.0	1.5	0.30 Sm +Diff	
Threats to Self-Efficacy	12	19.3	7.8	877	19.5	5.5	-0.2	-0.03	
Time Pressures	12	19.6	5.7	873	17.1	4.1	2.5	0.50 Mod +Diff	
Conflict with Religiosity	12	25.5	4.2	876	24.6	5.9	0.9	0.18	
Total	12	147.4	25.0	835	136.7	21.7	10.7	0.46 Sm +Diff	

N = Number of students who completed both pre- and post-test for the SVI.

Pre-Test & Post-Test Data: Mean and Standard Deviation for each scale.

Norm Group: Student sample used in final development phase of the SVI.

Effect Size: Cohen's *d* for Pre/Post changes and Pre-Test/Norm Group Difference.

**Morehouse College
Biology 111/101
Blumer, Larry**

See page 1 for description

See page 4 for interpretation

	Biology 101			(No Post-Test)		Pre/Post Change	Effect Size	
	N	Scale Avg.	SD	Scale Avg.	SD		Cohen's <i>d</i>	t-test
Interest	115	18.4	5.7					
Present Utility	115	19.9	4.8					
Future Utility	114	16.0	5.1					
Need for High Achievement	110	21.1	5.1					
Threats to Self-Efficacy	114	19.8	5.2					
Time Pressures	114	16.4	4.7					
Conflict with Religiosity	110	24.0	4.8					
Total	95	135.0	20.3					

	Biology 101			Norm Group			Diff.	Effect Size	
	N	Average	SD	N	Average	SD		Cohen's <i>d</i>	
Interest	19	18.4	5.7	875	18.3	5.9	0.1	0.01	
Present Utility	20	19.9	4.8	878	20.0	5.0	-0.1	-0.03	
Future Utility	19	16.0	5.1	880	17.6	5.4	-1.6	-0.30	Sm -diff
Need for High Achievement	19	21.1	5.1	882	19.6	5.3	1.5	0.29	Sm +diff
Threats to Self-Efficacy	20	19.8	5.2	877	19.5	5.8	0.3	0.05	
Time Pressures	19	16.4	4.7	873	17.1	5.0	-0.7	-0.14	
Conflict with Religiosity	20	24.0	4.8	876	24.6	5.2	-0.6	-0.11	
Total	17	135.0	20.3	835	136.7	22	-1.7	-0.08	

N = Number of students who completed both pre- and post-test for the SVI.

Pre-Test & Post-Test Data: Mean and Standard Deviation for each scale.

Norm Group: Student sample used in final development phase of the SVI.

Effect Size: Cohen's *d* for Pre/Post changes and Pre-Test/Norm Group Difference.

**Morehouse College
Biology 111/101
Blumer, Larry**

	Biology 111			Biology 101			Diff.	Effect Size Cohen's <i>d</i>
	Scale			Scale				
	N	Average	SD	N	Average	SD		
Interest	19	22.9	3.6	115	18.4	5.7	4.5	0.95 Lg +diff
Present Utility	20	23.2	4.5	115	19.9	4.8	3.3	0.72 Mod +diff
Future Utility	19	25.2	3.4	114	16.0	5.1	9.2	2.13 Lg +diff
Need for High Achievement	19	23.8	4.0	110	21.1	5.1	2.7	0.59 Mod +diff
Threats to Self-Efficacy	20	16.5	6.8	114	19.8	5.2	-3.3	-0.54 Mod -diff
Time Pressures	19	13.9	4.3	114	16.4	4.7	-2.5	-0.56 Mod -diff
Conflict with Religiosity	20	25.4	5.1	110	24.0	4.8	1.4	0.27 Sm +diff
Total	17	149.8	14.8	95	135.0	20.3	14.8	0.83 Lg +diff

	Biology 111			Norm Group			Diff.	Effect Size Cohen's <i>d</i>
	Scale			Scale				
	N	Average	SD	N	Average	SD		
Interest	19	22.9	3.6	875	18.3	5.9	4.6	0.94 Lg +diff
Present Utility	20	23.2	4.5	878	20.0	5.0	3.2	0.67 Mod +diff
Future Utility	19	25.2	3.4	880	17.6	5.4	7.6	1.68 Lg +diff
Need for High Achievement	19	23.8	4.0	882	19.6	5.3	4.2	0.89 Lg +diff
Threats to Self-Efficacy	20	16.5	6.8	877	19.5	5.8	-3.0	-0.47 Sm -diff
Time Pressures	19	13.9	4.3	873	17.1	5.0	-3.2	-0.69 Mod -diff
Conflict with Religiosity	20	25.4	5.1	876	24.6	5.2	0.8	0.16
Total	17	149.8	14.8	835	136.7	22	13.1	0.69 Mod +diff

N = Number of students who completed both pre- and post-test for the SVI.

Pre-Test & Post-Test Data: Mean and Standard Deviation for each scale.

Norm Group: Student sample used in final development phase of the SVI.

Effect Size: Cohen's *d* for Pre/Post changes and Pre-Test/Norm Group Difference.

**Southwestern University
Chemistry for Non-Majors
Bruns, Kerry**

See page 1 for description

See page 4 for interpretation

	Pre-Test Scale			Post-Test Scale			Pre/Post Change	Effect Size	
	N	Average	SD	N	Average	SD		Cohen's <i>d</i>	t-test
Interest	13	19.9	6.4	13	20.7	4.3	0.8	0.15	0.5
Present Utility	13	20.7	5.2	13	20.1	4.6	-0.6	-0.12	0.6
Future Utility	13	16.4	5.6	13	17.3	5.9	0.9	0.16	0.5
Need for High Achievement	13	20.7	2.9	13	21.2	5.0	0.5	0.12	0.6
Threats to Self-Efficacy	13	15.9	4.2	13	17.5	4.6	1.6	0.36 Sm Incr	0.1
Time Pressures	13	14.9	3.5	13	17.9	3.8	3.0	0.82 Lg Incr	0.0
Conflict with Religiosity	13	26.2	3.7	13	26.3	4.6	0.1	0.02	0.8
Total	13	134.8	21.4	13	140.9	15.4	6.1	0.33 Sm Incr	0.1

	Pre-Test Scale			Norm Group Scale			Diff	Effect Size	
	N	Average	SD	N	Average	SD		Cohen's <i>d</i>	
Interest	13	19.9	6.4	872	18.3	5.9	1.6	0.26 Sm +diff	
Present Utility	13	20.7	5.2	872	20.0	5.0	0.7	0.14	
Future Utility	13	16.4	5.6	872	17.6	5.4	-1.2	-0.22 Sm -diff	
Need for High Achievement	13	20.7	2.9	872	19.6	5.3	1.1	0.26 Sm +diff	
Threats to Self-Efficacy	13	15.9	4.2	872	19.5	5.8	-3.6	-0.71 Mod -diff	
Time Pressures	13	14.9	3.5	872	17.1	5.0	-2.2	-0.51 Mod -diff	
Conflict with Religiosity	13	26.2	3.7	872	24.6	5.1	1.6	0.36 Sm +diff	
Total	13	134.8	21.4	872	136.7	22.3	-1.9	-0.09	

N = Number of students who completed both pre- and post-test for the SVI.

Pre-Test & Post-Test Data: Mean and Standard Deviation for each scale.

Norm Group: Student sample used in final development phase of the SVI.

Effect Size: Cohen's *d* for Pre/Post changes and Pre-Test/Norm Group Difference.

**Trinity University
Pope, Denise**

See page 1 for description

See page 4 for interpretation

	Pre-Test Scale			Post-Test Scale			Pre/Post Change	Effect Size	
	N	Average	SD	N	Average	SD		Cohen's <i>d</i>	t-test
Interest	118	24.9	3.5	118	24.6	4.5	-0.3	-0.07	0.0
Present Utility	118	25.0	3.0	118	24.0	3.4	-1	-0.31 Sm Decr	0.0
Future Utility	118	26.6	2.5	118	24.8	4.8	-1.8	-0.47 Sm Decr	<.0
Need for High Achievement	118	22.9	3.7	118	21.5	4.7	-1.4	-0.33 Sm Decr	<.0
Threats to Self-Efficacy	118	18.4	4.7	118	15.2	5.8	-3.2	-0.61 Mod Decr	<.0
Time Pressures	118	19.7	4.4	118	16.6	5.5	-3.1	-0.62 Mod Decr	<.0
Conflict with Religiosity	118	26.4	4.3	118	25.8	5.0	-0.6	-0.13	0.0
Total	118	163.9	13.5	118	152.4	21.5	-11.4	-0.64 Mod Decr	<.0

	Pre-Test Scale			Norm Group Scale			Diff.	Effect Size	
	N	Average	SD	N	Average	SD		Cohen's <i>d</i>	
Interest	118	24.9	3.5	875	18.3	5.9	6.6	1.36 Lg +Diff	
Present Utility	118	25	3.0	878	20.0	5.0	5.0	1.21 Lg +Diff	
Future Utility	118	26.6	2.5	880	17.6	5.4	9.0	2.14 Lg +Diff	
Need for High Achievement	118	22.9	3.7	882	19.6	5.3	3.3	0.72 Mod +Diff	
Threats to Self-Efficacy	118	18.4	4.7	877	19.5	5.8	-1.1	-0.21 Sm -Diff	
Time Pressures	118	19.7	4.4	873	17.1	5.0	2.6	0.55 Mod +Diff	
Conflict with Religiosity	118	26.4	4.3	876	24.6	5.2	1.8	0.38 Sm +Diff	
Total	118	163.9	13.5	835	136.7	22.3	27.2	1.48 Lg +Diff	

N = Number of students who completed both pre- and post-test for the SVI.

Pre-Test & Post-Test Data: Mean and Standard Deviation for each scale.

Norm Group: Student sample used in final development phase of the SVI.

Effect Size: Cohen's *d* for Pre/Post changes and Pre-Test/Norm Group Difference.