Locating a Valid Instrument

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Should I Find an Instrument or Develop One of My Own?

• Finding an Instrument
  • What if one doesn’t exist?
  • What if the instrument doesn’t really match my project?

• Developing an Instrument
  • Time Consuming
  • Expensive
  • What happens if after all my work, the instrument is not valid?

• Options
  • Multiple measures
  • Mixed methods
  • Triangulation of results
Validity

Traditional Definition

Does the instrument measure what it claims to measure?

Updated Definition

When collecting data through the instrument, are the inferences researchers make defensible? (Fraenkel, 2015)
Reliability: Consistency

An instrument cannot be valid unless it is reliable.
### Types of Validity

<table>
<thead>
<tr>
<th>Content</th>
<th>Criterion-referenced</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Predictive</td>
<td>• Discriminant</td>
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<tr>
<td></td>
<td>• Concurrent</td>
<td>• Convergent</td>
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Content Validity

Specialists in the content measured by the instrument are asked to judge the appropriateness of the items on the instrument.
### Content Validity

Consider...

- *Do items cover the breadth of the content area?*
- *Are items in a format that is appropriate for those using the instrument?*

| A test that is intended to measure the quality of science instruction in fifth grade should cover material taught in the fifth grade science course in a manner appropriate for fifth graders. | A national science test might not be a valid measure of *local* science instruction, although it might be a valid measure of *national* science standards (Siegel, 2016). |
Establishing Content Validity

**TIMSS Instrument**: Trends in International Mathematics and Science Study (International Association for the Evaluation of Educational Achievement (IEA), 2015)

- Four experts reviewed the TIMSS instruments to determine which, if any items are related to a unit utilizing digital fabrication.
- Ten items were identified consistently. Those items are now considered a “subscale” of the TIMSS instrument.
- A unit utilizing digital and 2D fabrication has been taught to different student four times. Students who are taught the unit consistently perform higher on those 10 items when compared to a control group.
Cube from folded 2-dimensional net

Which of these cubes could be made by folding the figure above?

A.  
B.  
C.  
D.  

Item Number: B11
Volumes of stacks of blocks

All the small blocks are the same size. Which stack of blocks has a different volume from the others?

Option A: \[\text{Block A}\]

Option B: \[\text{Block B}\]

Option C: \[\text{Block C}\]

Option D: \[\text{Block D}\]
Criterion-Referenced Validity

Criterion-related evidence is collected by comparing the instrument with some future or current criteria. The purpose of an instrument dictates whether predictive or concurrent validity is warranted.
Types of Criterion Validity

Predictive Validity
If an instrument is purported to measure some future performance, the instrument must be compared with the behavior that it predicts. Predictive validity would be important for a screening test for 5-year-olds that is purported to predict success in kindergarten.

Concurrent Validity
Concurrent validity compares scores on an instrument with current performance on another measure. Concurrent validity for a science test could be investigated by correlating scores for the test with scores from another established science test that covers the same content.
Construct Validity

The degree to which an instrument measures an intended psychological construct or non-observable trait (intelligence, creativity, etc).
Types of Construct Validity

**Discriminant Validity**
An instrument does not correlate significantly with variables from which it should differ.

**Convergent Validity**
An instrument correlates highly with other variables with which it should theoretically correlate (Siegel, 2016).
HELP!!!!!!!!
Two of the teachers in my study did not administer the pretest. What can I do??????

Good research design gone bad...
10. Think back to before you completed the Solenoid Kit. How would you rate your knowledge about the following things:

<table>
<thead>
<tr>
<th>Topic</th>
<th>I didn't really know much about this topic</th>
<th>I knew a little about this topic</th>
<th>I knew a fair amount about this topic</th>
<th>I knew a lot about this topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your understanding of magnetism (specifically polarity, attraction, and repulsion)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your understanding of magnetic fields</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your knowledge of conductivity (including insulators and conductors)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to explain voltage, current and resistance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How compasses work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What electromagnetism is</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The similarities and differences between magnets and electromagnets</td>
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</tr>
<tr>
<td>How voltage affects the interactions between magnets and</td>
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### Retrospective Analysis

11. Now that you have completed the solenoid unit, how would you rate your knowledge:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Not at all</th>
<th>A little</th>
<th>A fair amount</th>
<th>A lot</th>
</tr>
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<tr>
<td>Your understanding of magnetism (specifically polarity, attraction, and repulsion)</td>
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Using Qualitative Data to Establish Content Validity
(Bull, 2016)
Conclusions/Hopes for the Future

- Instrumentation is important.
- Sharing data across projects can help to establish the worth of an instrument.
- Large data sets can provide valuable information about STEM learning.
References


