Learning Progressions: An Overview of Current Validation Methods

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Learning progressions represent a set of skills or pieces of knowledge ordered sequentially from least to most complex relative to how a majority of students might acquire those skills and knowledge. Learning progressions describe successive levels of understanding in a subject area based on descriptions and examples (called learning performances). For example, the skills required to multiply whole numbers might include basic number sense, identifying quantities, and adding whole numbers. Learning progressions are typically developed through backwards analysis by first identifying an end point and then the steps or skills required to move from a naïve to an advanced approach. These skills are arranged in sequence to guide instruction, but can also be used to guide creation of formative and summative assessments of the content (which can in turn inform instruction through assessment results and achievement patterns).

The majority of learning progressions represented in the peer-reviewed literature are focused on small units of classroom time and narrow, specific curricular concepts. The research and development of a robust learning progression requires a significant investment on the part of the research team designing the progression, as well as piloting the hypothesized sequence in an actual school, or group of schools, that can validate the progression. Validating a learning progression requires a significant investment of classroom time and can involve additional time for supplemental assessments and interviews.

Several methods exist for empirically validating learning progressions. Not all methods can be applied in all cases, depending on the nature of the learning progression and the resources available for validation.

Validated learning progressions can be used to guide the scope and sequence of instruction or formative and summative assessment programs (see Smith, Wiser, Anderson, & Krajcik, 2006). Learning progressions can serve as part of an iterative validation process between an assessment, curriculum, and the progression itself as students’ performance on one element may suggest appropriate revisions to another. For example, if students were very successful on an “out of level” assessment item, that content may be misplaced in the learning progression (or should be taught at a different time during the course of study). Several authors have also used learning progression-based diagnoses or assessments to suggest curricular change (Gunckel, Salinas, Covitt, Anderson, 2012), such as when students are not reaching the upper levels of the learning progression when being taught with standard curricular materials.

Methods for Validating Learning Progressions

Student Interviews
To the degree that students can articulate their thought processes, cognitive interviews and think-aloud protocols can provide strong evidence for learning progression-based diagnostic categories (e.g., between intermediate understanding and mastery) and can provide good examples of learning performances at each level. Perhaps a student with a naïve understanding may conceptualize the problem in an entirely different way than an advanced student; this difference could emerge during an interview and guide the development and refinement of the progression.

A less formal interview process can also be useful for assessing student mastery and relating student performance to the curriculum.
and learning progression. Gunstone, Boo, and Watson (2001) conducted student interviews at two points in time to better understand students’ progress through a chemistry learning progression. Jin and Anderson (2012) involved students in several rounds of interviews and assessments when developing a progression of students’ understanding of the carbon transferring processes.

**Ordered Multiple-Choice Assessment Items**

Cognitive interviews are ideal on a smaller scale, but ordered multiple choice (OMC) items, or assessments composed of OMC items, may be more efficient when working with large groups of students. This type of test item is designed with carefully-crafted answer options to assess not only whether the student can correctly answer the question, but also to provide additional information about the development of the student’s understanding of the topic based on which of the incorrect answer options a student might select (Briggs, Alonzo, Schwab, & Wilson, 2006). Results from OMC assessments were compared with cognitive interviews and found to provide relatively consistent diagnostic information across the two methods. OMC items present a unique challenge for item writers because they require a deeper understanding of both the subject area and the learning progression. OMC items have not yet been integrated into large-scale assessment and may require a careful content validity review before being integrated into a test, as the use of OMC items may introduce construct irrelevant variance due to their structure (also referred to as format effects, see Steedle, 2006). OMC items have the potential to provide great insight into student understanding of a topic, but may address content too specifically to be included in a summative, or end of year, type test that requires broad content coverage. In other words, very little content can be covered by a test consisting of OMC items, though it can be covered in great depth, while traditional multiple choice items can cover a broader range of content, but with less depth (and less reliable diagnostic information).

In the case of OMC or open-ended items, which are commonly used on learning progression-based assessments, it may be difficult to distinguish a student’s place within the learning progression because of incomplete content coverage or inconsistency of student responses (indicating varying levels of understanding). Careful development of the assessment to reflect the construct underlying the learning progression (Wilson, 2009) and attending to the designs and applications of “learning progressions” more generally (see a review by Duschl, Maeng & Sezen, 2011) can bring some clarity to validation and score interpretation. By developing an assessment that provides adequate construct representation, it will be easier to support the argument that students’ scores reflect their content mastery and are not biased by test construction decisions (like including different item types, or prioritizing a few key content areas).

**Statistical Methods**

Statistical models, including Rasch Item Difficulty estimates for assessment items, can be used to “locate” the items in a developmental scale. Johnson & Tymms (2011) used this technique in validating a large-scale assessment in Chemistry. A similar method was used by Renaissance Learning to validate the relationship between a learning progression and an external assessment. Latent class analysis is another statistical method used to validate a learning progression (Steedle & Shavelson, 2009) by assessing the relationship between students’ ability and their performance on the test; see Corcoran (2009) for a more complete review of these statistical methods.

The current literature indicates that overall validation efforts are most effective when they are tied to initial development of the learning progression and are used to guide an iterative development process between the learning progression and related curriculum and assessments.
Existing Data

It is possible to build a learning progression retrospectively based on student assessment results or other previously collected data (Berland & McNeill, 2010; Stevens, Delgado, & Krajcik, 2010). Designing a learning progression solely based on data and without student input requires either a strong familiarity with the subject area of the progression or interfacing with subject area experts to hypothesize how an understanding of the subject may develop over time (Duncan, Rogat, Yarden, 2009; Plummer & Krajcik, 2010). Ideally this type of progression would include possible assessments or examples of student work at each level so that interested educators could subsequently gather additional data and further validate the progression, leading to revision of the progression when student data (from assessments or other work) indicates that the progression does not represent students’ process through the material.

Conclusion

Learning progressions can be used to further examine the interactions between curriculum, assessment, and pedagogy and to guide assessment construction. The current literature indicates that overall validation efforts are most effective when they are tied to initial development of the learning progression and are used to guide an iterative development process between the learning progression and related curriculum and assessments. This bulletin described several useful methods for validating learning progressions including validating the relationship between the progression and student knowledge as well as between the progression and associated assessments.

References


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