# Using Learning Progressions to Develop Strong AA-AAS

## Alternate Assessments Based on Alternate Achievement Standards

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# Outline of Presentation

- What are learning progressions?

- How might learning progressions be used to help develop stronger AA-AAS?

  - Developing strong content standards

  - Developing valid assessment designs

- Learning progressions and helping students learn

- Questions for design, policy, and research

# Learning Progressions are…

- Developmental sequences of *content, proficiency,* and/or *learning experiences*

- May also refer to description of change in individual performance

# Examples of "Learning Progressions"

- Stages of Spelling Development (Mariotti & Homan)
- Counting and Ordering in math (Masters & Forster)
- Sinking and floating/density (Kennedy & Wilson)
- Science achievement (LaPointe et al.)
- Natural Selection (AAAS)
- Math Number Operations (MA DOE)

# Example 1: "Stages of Spelling Development" (Mariotti & Homan, 2005)

| Stage | Characteristics (abridged) |
|---|---|
| Pre-phonemic | The word is unreadable; letters and letter-like forms are used randomly and do not represent sounds.<br><br>Writing shows child is aware that words are made up of letters and that print is arrange horizontally. |
| Early Phonemic | The word is made up entirely of letters, usually in short strings of one to four letters; single letters are often used to represent whole words.<br><br>The word represents the discovery of the alphabetic principle: letters are used to represent some of the sounds in words.<br><br>Writing commonly features the use of consonants to represent initial sounds; sometimes final sounds and/or other important, clearly discernible sounds are presented too, but the spellings are very incomplete. |
| Letter-name | Writing shows the child's firm awareness that letters represent sounds, so the letters they use stand for sounds with no silent letters included. Some sounds clearly evident in words are systematically omitted, such as m's and n's before consonants, vowels in unstressed syllables, and many short vowels. |
| Transitional | Spelling is nearly complete; all phonemes are represented, long and short vowel sounds are generally spelled correctly or typically: hed (head).<br><br>Child shows awareness of marking systems, such as silent letters and consonant doubling but uses markers inappropriately: runing (running), makking (making), ducke (duck). |

# Example 2: "Counting and Ordering"
## (Masters & Forster, 1996)

**5**
- Uses unitary ratios of the form 1 part to X parts (The ratio of cordial to water was 1 to 4)
- Understands that common fractions are used to describe ratios of parts to whole (2 in 5 students ride to school. In school of 550, 220 ride bikes)
- Uses percentages to make straightforward comparisons (26 balls from 50 tries is 52%; 24 from 40 tries is 60%, so that is better)

**4**
- Counts in decimal fraction amounts ('0.3, 0.6, 0.9, 1.2,...')
- Compares and orders decimal fractions (orders given weight data for babies to two decimal places)
- Uses the symbols =, < and > to order numbers and make comparisons (6.75 < 6.9; 5 x $6 > 5 x $5.95)

**3**
- Counts in common fractional amounts ('two and one-third, two and two thirds, three, three and one-third')
- Uses materials & diagrams to represent fractional amounts (folds tape into five equal parts, shades 3 parts to show 3/5)
- Expresses generalisations about fractional numbers symbolically ('1 quarter = 2 eights' and '1/4 = 2/8')

**2**
- Counts forwards and backwards from any whole number, including skip counting in 2s, 3s,m and 10s
- Uses place value to distinguish and order whole numbers (writes four ten dollar notes and three one dollar coins as $43)
- Uses fractional language (one-half, third, quarter, fifth, tenth) appropriately in describing and comparing things

**1**
- Counts collections of objects to answer the question 'How many are there?'
- Makes or draws collections of a given size (responds correctly to 'Give me 6 bears')
- Uses numbers to decide which is bigger, smaller, same size (If he has 7 mice at home and I have 5, then he has more)

# Example 3: "Floating & Sinking"
## (Kennedy & Wilson, 2007)

| Instructional Focus | Useful Levels for Formative Feedback: WTSF | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Relative Density |
| | | | | | | | | | Density - Objects | Density - Medium | |
| | | | | | | | Mass and Volume | | | | | |
| | | Mass | Volume | | | | | | | | | |
| Introduction to curriculum | | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Investigations | | | | | | | | | | | | |

# Example 4: Science "Learning Progression" (LaPointe et al, 1989)

| | |
|---|---|
| Interprets experimental data involving several variables.  Interrelates information represented in text, graphs, figures, diagrams.  Makes predictions based on data and observations.  Demonstrates a growing understanding of more advanced scientific knowledge and concepts (e.g., calorie chemical change. | Level 5 |
| Demonstrates an understanding of intermediate scientific facts and principles and applies this in designing experiments and interpreting data.  Interprets figures and diagrams used to convey scientific information.  Infers relationships and draws conclusions by applying facts and principles, especially from the physical sciences. | Level 4 |
| Has a grasp of experimental procedures used in science, such as doing experiments, controlling variables, and using equipment.  Indentifies the best conclusions drawn from data on a graph and the best explanation for observed phenomena.  Understands some concepts in a variety of science content areas, including the Life, Physical, Earth, and Space Sciences. | Level 3 |
| Exhibits a growing knowledge in the Life Sciences, particularly human biological systems, and applies some basic principles from the Physical Sciences, including force.  Also displays a beginning understanding of some of the basic methods of reasoning used in science, including classification, and interpretation of statements. | Level 2 |
| Knows some general scientific facts of the type that can be learned from everyday experiences.  For example, exhibits some rudimentary knowledge concerning the environment and animals. | Level 1 |

# Example 5: (Natural Selection) AAAS Atlas of Science Literacy

When an environment, including the organisms that inhabit it, changes the survival value of inherited characteristics may change.

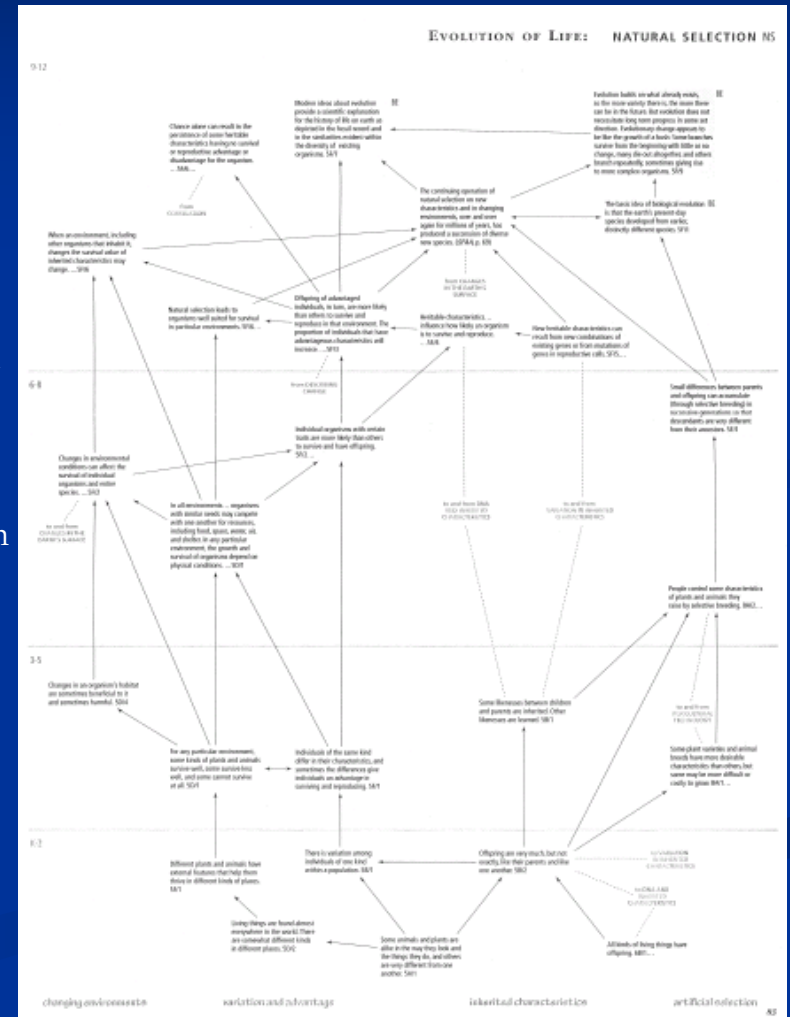Natural selection leads to organisms well suited for survival in particular environments

Offspring of advantaged individuals are more likely than others to survive.

Changes in environmental conditions can affect the survival of individual organisms and entire species.

Individual organisms with certain traits are more likely than others to survive and have offspring.

In all environments organism with similar needs may compete with one another for resources.

Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful.

# Example 6: Number Sense and Operations  (MA Alt.)

| Grade Level:  PreK – K | | |
|---|---|---|
| **Concept** | **Learning Standard as written** | **Essence of the Standard(s)** |
| Number Sense | **K.N.1** Count by ones to at least 20. | ♦ Begin to count, group, sort, and match quantities of numbers<br>♦ Use the "language" of numbers (both verbal and written)<br>♦ Identify coins<br>♦ Learn concepts of whole and half |
| | **K.N.2** Match quantities up to at least 10 with numerals and words. | |
| | **K.N.3** Identify positions of objects in sequences (e.g., first, second) up to fifth. | |
| | **K.N.4** Compare sets of up to at least 10 concrete objects using appropriate language (e.g., none, more than, fewer than, same number of, one more than) and order numbers. | |
| | **K.N.5** Understand the concepts of whole and half. | |
| | **K.N.6** Identify U.S. coins by name. | |
| Operations | **K.N.7** Use objects and drawings to model and solve related addition and subtraction problems to ten. | ♦ Represent operations of addition and subtraction concretely |
| Estimation | **K.N.8** Estimate the number of objects in a group and verify results. | ♦ Use objects and manipulatives to estimate numbers in group<br>♦ Compare exact answer with estimates |

# Possible Entry Points and Access Skills

**Less Complex** ⟵————————————⟶ **More Complex**

| | ACCESS SKILLS The student will: | ENTRY POINTS The student will: | The student will: | The student will: |
|---|---|---|---|---|
| **Operations** | ♦ Place a number of manipulatives into a container<br>♦ Activate an electronic device to access text, communicate with others, or participate in an instructional activity<br>♦ Turn attention toward another person<br>♦ Grasp, manipulate, and materials relevant to the instructional activity<br>♦ Organize instructional materials<br>♦ Take turns appropriately during classroom discussion<br>♦ Respond to/initiate contacts with others<br>♦ Apply rules for appropriate classroom behavior<br>♦ Use appropriate social greetings<br>♦ Follow simple directions<br>♦ Identify self and/or others<br>♦ Initiate or respond to request for joint attention | ♦ Add ("put together") and subtract ("take away") using the numbers 1, 2, and 3 (with manipulatives and objects) | ♦ Manipulate objects in order to compare sets using concepts (more, less, same, enough, some)<br>♦ Add ("put together") and subtract ("take away") using the numbers 1 – 5 | ♦ Manipulate objects to solve addition and subtraction problems<br>♦ Identify and demonstrate the meanings of "add to" (make more) and "subtract from" (make less)<br>*Continue to address skills and concepts that approach grade-level expectations in this subject* |

# Learning Progressions are…

- Developmental sequences of *content*, *proficiency,* and/or *learning experiences*

- *and*

- May be very different from each other according to:
  - Purpose
  - Content/skills
  - Context (scope, setting, role of student)
  - Details of *what*, *how*, *when*, *who*, *how much*, and *why*

  - Sources: Disciplinary "Beliefs, Values, & Traditions"

# Some Important Dimensions

- **What**: Focus on Content, Proficiency, Developmental psychology? Anchored to GLEs?
- **How**: Assimilation/Accommodation; Accumulating/Cumulative; Linear/S-curve/exponential/saw-tooth?
- **When**: Dependent on instruction/experience/age/cognitive development…?
- **Who**: All students/all students with X?
- **How much**: what is unit of development and unit of performance growth? How much time?
- **Why**: Rationale and evidence for this learning progression?

# How Learning Progressions can help AA-AAS

- Learning progressions are powerful supports for key AA-AAS *assessment* development tasks

- Learning progressions are powerful supports for *instruction, formative assessment, and curriculum*

- Learning progressions may provide useful supports for *emerging applications* such as individual student growth models and different alignment methodologies for AA-AAS

# Key Assessment Development Tasks

- Establish solid regular content standards for grades 3-8 and high school

- Establish solid extended content standards for AA-AAS grades/grade spans

- Develop rationale for assessment design

- Design assessment, including task scores to overall scores to proficiency determinations

- Show alignment

- Develop assessment validity evidence

# Assessment Development – Establish grade-level expectations

| Grade 1 | Grade 2 | Grade 3 | Grade 4 |
|---|---|---|---|
| M(N&O)–1–3 **Demonstrates conceptual understanding of mathematical operations involving** addition and subtraction of whole numbers (from 0 to 30) by solving problems involving joining actions, separating actions, part-part whole relationships, and comparison situations; and addition of multiple one-digit whole numbers. (Local) | M(N&O)–2–3 **Demonstrates conceptual understanding of mathematical operations involving** addition and subtraction of whole numbers by solving problems involving joining actions, separating actions, part-part whole relationships, and comparison situations; and addition of multiple one-digit whole numbers. (State) | M(N&O)–3–3 **Demonstrates conceptual understanding of mathematical operations** by describing or illustrating the inverse relationship between addition and subtraction of whole numbers; and the relationship between repeated addition and multiplication using models, number lines, or explanations. (State) | M(N&O)–4–3 **Demonstrates conceptual understanding of mathematical operations** by describing or illustrating the relationship between repeated subtraction and division (no remainders); the inverse relationship between multiplication and division of whole numbers; or the addition or subtraction of positive fractional numbers with like denominators using models, number lines, or explanations. (State) |

# GLE – What develops?

- Content
  - Some new content is introduced
  - Some old content disappears from the GLE (?)
  - Some content/skills are expanded in very specific ways and scope
  - Some content reflects more sophisticated models
  - Some content/skills are expanded to full generalization for the class of problems/actions
  - Some content/skills move from "instruction and local assessment" to official "state assessment"

# GLE – What develops? – 2

- **Proficiency** (content, heuristic, control, belief…)
  - Understanding – able to operate on content
    - Multiple representations
    - How it fits into domain
    - How it can be applied
    - Limitations, short-cuts, etc.
    - When to (not) apply
    - Independence in use and in further learning
    - Self-monitoring at strategic and procedural levels
    - Automaticity

# Complexity continua
## (from Lesh et al., 1992)

- Rote recall to strategic thinking (Webb)
- Memorize, perform routine procedures, communicate understanding, perform nonroutine problems, conjecture/generalize/prove (Porter & Smithson)
- Concrete to abstract (Dienes)
- Global to analytic to deductive (van Hiele)
- Pre-operational to operational (Piaget & Beth)
- Concepts to rules to problem-solving (Gagne)
- Enactive to symbolic (Bruner)
- External to internal (Vygotsky)
- Situated to decontextualized (Cole & Griffen; Greeno)
- Facts/skills to applications to analysis/synthesis/evaluation (Bloom)
- Naïve interpretations (based on superficial characteristics) to scientific models (focused on key attributes and underlying regularities) (Steen)
- Application, learning potential, metacognition, beliefs and values, whole (Ginsburg et al.)

# Progressing up, extending down?

- Learning progressions identify *most important content and skills necessary for "proficiency" at that level and to be able to progress to next level*

- Are our downward extensions for the AA-AAS coherent and indicative of good learning progressions?
  - Avoid reductions in depth, breadth, complexity that create AA-AAS learning progressions with "dead-ends, unbridgeable gaps, highways with no exits or entrance ramps, only 'blue-line roads,'" etc.

# Coherence Criteria

- When we create our extended content and performance standards for the AA-AAS, "can we get there from here?"
  - Does the content from one grade span build to the next?
  - Do the achievement levels from one grade span connect to the next in a coherent way?
  - Do the content and proficiency on the 1% assessment connect with the 2%, and the 2% with the regular assessment so that students can change learning targets and classifications if warranted?

# Three Approaches to Extensions

- On-grade reductions that do not cross the grade boundaries

- Related academic content but clearly at a lower grade level and/or lower proficiency level but within a few grade levels of the GLEs

- Related academic content that is billed as "below grade 3 extension" or that would align most with GLEs several grade levels below label

# A personal observation

- Task analysis, task decomposition, or pursuing "prerequisite skills" must stay focused on the construct ("essence"), or it risks assessing something other than the key learning target and drifting away from standards-based assessment and instruction

# One more example to think about…

- What am I building towards?

$$3$$
$$+ \ 4$$
_____

$$3 + 4 = \ \rule{3cm}{0.4pt}$$

# Key AA-AAS Learning Supports

- Curriculum

- Instruction

- Formative assessments

- Program evaluation

# Vygotsky: Zone of Proximal Development
## (What a child can do *with assistance* today)

**What a child can do independently now**

**What a child can do independently tomorrow/future**

Actual Development Area

**The ZONE**

Potential Development Area

Dynamic area

Causes development to move forward

Social interaction essential (scaffolding)

# Learning progressions and scaffolding

- If one held that learning primarily took place when the right scaffolding was present, then learning progressions should include descriptions of scaffolding, and

- assessments might profit from assessing under different conditions of scaffolding (content, tasks, materials; provided by task, teacher, peers) (Dickson, Simmons, & Kame'enui, 1995)

# Comment about Sources & Traditions

- Curriculum

- Instruction

- Cognitive science

- Developmental psychology

- Instructional technology

- Assessment

# Questions/Areas to Work On

- Design and Development
- Research
- Policy

# Assessment Design

- Learning progressions may inform assessment design
  - Why performance tasks, checklists, structured portfolios, or "less structured portfolios"
  - "Does the student know X / Is the student proficient?" versus "What does the student know / What can (not) the student do, under what conditions?"
  - If we used learning progressions, how would we design an assessment of student growth?

# Assessment Credibility

- Under what conditions does classroom-based assessment yield credible evidence about student proficiency?
  - The "standards, not standardization" argument
- Under what conditions does large-scale assessment yield credible evidence about student proficiency?
  - The "grade-level assumption"

# Research

- What are effective learning progressions for the key content areas *for the AA-AAS students?*

- How standardized are the learning progressions, and the time?

- How can a student *accelerate* through a learning progression in order to catch up?

# Policy

- How can coherent and effective assessment and accountability programs be implemented and yet benefit from advances in research and development?

# References

- AAAS. (2001, 2007). *Atlas of Science Literacy (Vols. I and II).* Washington, DC: American Association for the Advancement of Science and the National Science Teachers Association.

- Applebee, Arthur. (1978). *The Child's Concept of Story: Ages Two to Seventeen.* Chicago: University of Chicago Press.

- Bruner, Jerome. (1960). *The Process of Education.* Cambridge, MA: Harvard University Press.

- Gong, Brian, Venezky, Richard, & Mioduser, David. (1992). Instructional Assessments: Lever for systemic change in science education classrooms. In *Journal of Science Education and Technology, 1 (*1), 157-176.

- Kennedy, Cathleen & Wilson, Mark. (2007). Using progress variables to map intellectual development. Presentation at the MARCES Conference, University of Maryland-College Park.

- Lesh, Richard, Lamon, Susan J., Gong, Brian, & Post, Thomas R. (1992). Using learning progress maps to improve instructional decision making. In R. Lesh & S.J. Lamon (Eds.), *Assessment of Authentic Performance in School Mathematics.* Washington, DC: AAAS Press.

- Masters, Geoff & Forster, Margaret. (1996). *Progress Maps.* (Part of the *Assessment Resource Kit*) Melbourne, Australia: The Australian Council for Educational Research.

- Mariotti, Arleen S. & Homan, Susan P. (2005) Linking reading assessment to instruction (4th ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

- National Science Foundation solicitation, http://www.nsf.gov/pubs/2005/nsf05612/nsf05612.htm

- Smith, Wiser, Anderson, & Krajcek (in press).

- Wilson, Mark & Bertentahl, Meryl (Eds.). (2005). *Systems for State Science Assessment.* Board on Testing and Assessment, Center for Education, National Research Council of the National Academies. Washington, DC: National Academies Press.

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