

MATH Strategies Supporting Students with ASD

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January 30, and Feb. 1, 2007

Overview

- Review characteristics of ASD that impact learning
- Clarify Asperger's Disorder "needs" and autism "needs"
- Identify strategies to support understanding the language of math that relate to problem solving as well as simple operations.
- Opportunities for free cue cards, some with schema based instruction supports, relative to conceptual language and "thinking" needs that impact participation and academic progress of this ASD population



Mathematical issues for ASD

- Math is compact so that every number and symbol is critical to understanding
- Math statements have high abstraction
 - Reading also has abstract word meanings, relationships between people, etc.
- Directionality issues: not always L to R
- Receptive/expressive language impacts learning from discussion
- Cognitive development difficulty-processing information

Importance of meaning; Avoid rote learning

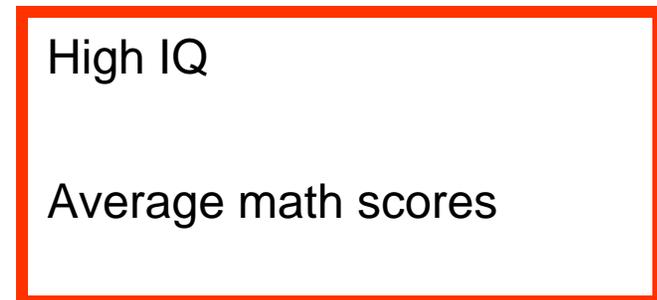
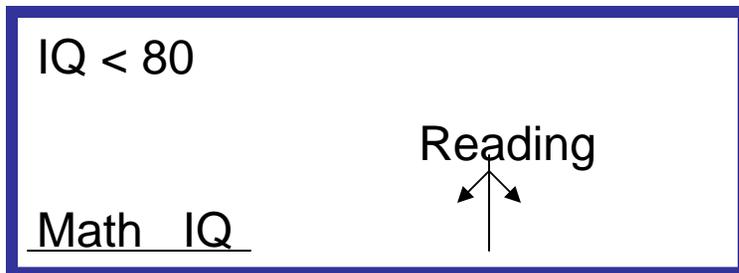
- Reading for meaning occurs when
 - Students are continually predicting and sampling (confirming, self-correcting, reprocessing)
 - Students have formed prior knowledge schemas, prerequisite skills and number sense (# meaning and relationships; relative magnitude, relative effects of operations; referents (quantities and measures in everyday life))
 - Engagement with purposes for solving

Processing problems associated with autism-Aspergers

- A learning deficit occurs in this brain processing disorder.
- They have difficulty processing information to comprehend its meaning.

Ability profiles in Children with Autism

- Influence of age and IQ on math performance research study Mayes 03
 - As the age increased, so did the IQ
 - School aged kids with IQ < 80, had math scores consistent with IQ and reading skills were above IQ
 - School aged kids with high IQ's had average math scores.



Cognitive profiles

- Ehlers '97 Children with autism have a different profile than those with Asperger's syndrome/disorder.
 - Autism profiles peaked on visuospatial abilities of Block Design
 - Asperger's Syndrome: had good verbal ability and troughs in Object Assembly and coding
 - Goldstein '01 study of HFA and LD found differing profiles
- Goldstein '94: HFA learn calculations early, have difficulty with problem solving. When expect problem solving maturity in Middle School, those skills don't develop with autism by history
- Williams '06: HFA have complex information processing deficits.
 - So what does this mean for learning math?

Question?

- Historically ASD were taught rote learning and master of facts
- CAN DIRECT INSTRUCTION IN PROBLEM SOLVING TRANSFER TO HIGHER ORDER SKILLS LIKE REASONING AND PROBLEM SOLVING?
 - To improve practices for students with learning disabilities like autism requires attention to number of issues:

- The students with autism may learn tasks differently than those with Asperger's
- Asperger students may be able to learn from interactions with others better than children with more severe autism
- Asperger students have a different profile than those with attention problems alone suggesting they may learn differently than those students
- It may not be what we are teaching but how we are teaching that is the key (break down complexity)
- Teaching techniques for autism may need to include experiencing and manipulating to learn
- **INDIVIDUAL INTERVENTIONS ARE NEEDED AND A SPECIAL ED CLASSROOM MAY NOT ALL RESPOND TO SAME INSTRUCTION**

Issues for improving practices for special needs learners

- Time constraints: issues of **what** they learn changes (process not emphasizing facts computation), **how much** they learn, and **when they learn it** (in gen ed, supported in gen ed, special instruction in spec ed)
- Immature strategies have not focused on teaching a **number sense** (like doubling, sharing, etc.), how facts **relate** to everyday context
- Instruction was in computation, regrouping for subtraction via drill and practice

Issues for improving practices for special needs learners

Emphasis now on **problem solving** and **analysis** to manipulate numbers conceptually and develop **multiple strategies** for approximating numbers.

- Instruction is now on problem solving using metacognitive strategies:
 - Graphically representing word problems using relational schematics, make a simpler version of the problem and solve it, look for a pattern, work backwards, using discussion to engage our ASD students (teach STAR plan for listening and learning from discussion)
 - Schemas is general description of a group of problems that share a common underlying structure requiring similar solutions.
- Less is more philosophy; instead of 10-15 1 step problems, they have 1-2 problems from a lesson, with dialogue, multiple solutions, evaluate problem solving, how to use scaffolding in math, cue cards
- Emotional dimensions of problem solving instruction
 - Negative attitude about their capabilities, little value in math activities, asking for help when challenged versus teaching perseverance and trying new things.

Autism versus cognitive delay

- Most (50-75%) students with autism also have mental retardation (mild-profound)
- Students without cognitive delay have **differences** from those with cognitive delays especially in language, social skills, and rigid behaviors.
- Students with autism perform differently on mathematical concepts than other groups and since their brains function differently, they need specific intervention supports.

Characteristics of autism affecting educational performance: FIRST

- Communication
 - May/may not look like attending; may/may not tell you they understand/follow your explanations; may/may not indicate yes and no appropriately; may/may not ask for help
- Language skills interface with math skills
 - Concepts or more and less are difficult, etc.

- We have to observe the products of their thinking to determine how language ability or disability is affecting math learning
- Assume they ARE having language disabilities

- Language is the scaffold that can help organize and communicate accurately math concepts

Language strategies in math

- Don't use yes-no responses with non or low verbal students with autism. Their language errors may interfere with understanding of math.
- Often successful with direct specific responses of giving or other performance related activities
 - Research shows “show me” led to errors
 - **Doing or manipulating** was most successful:
i.e. sorting the same quantities

Language strategies continued

- Choose vocabulary wisely:
 - Are they same number or different number (not the abstract word ‘amount’)
 - Avoid “one” since it can be a pronoun or an amount (everyone needs one means a reference to everyone for counting purposes) so use one in math and the name/noun otherwise.
 - “enough” can be difficult word; try using the words ‘extra’ and ‘no extras’ to suggest a more specific concept

Key word to cue the operation

- This strategy is often not effective
 - Frequently this does not teach: does the answer make sense?
 - Altogether=addition; “left” signals subtraction
 - It may not support problem solution
 - We want to teach the concepts as a knowledge base. Teach there is a visual representation for the structure of a problem

Second: Social Participation

- Reference cooperative small group work, large group discussion weaknesses; implication for teaching two functions of manipulatives as toys AND learning tools
- ‘Shared meaning between students about a given concept’ is a difficult concept given problems in perceiving other people’s perspective, understanding others, learning from others’ thinking given this brain disorder

3rd: Repertoire of activities, interests, and imaginative development is limited

- Tendency to use manipulatives in their preferred style (lining up, sorting) rather than be challenged using them for learning
- Often need direct teaching manipulatives can be used in different ways
- Flexibility in interests, thinking, activities needs direct teaching

4th: Developmental rates and sequences

- Splinter skills: Those with Asperger Disorder, though cognitively bright, may have math (and reading and writing) failures, unless they have math as their special interest area.
 - They have their own unconventional method of solving problems that may yield a correct response; can't explain how they work.
 - When the individual has the ability to calculate a complex math question yet cannot correctly answer a one-step addition problem

Developmental Rates and Sequences cont

- Impaired sequencing abilities: Ability to sequence simple pictures about objects and actions is often below what is expected from typically developing kids
 - Zalla 2006: show large and small actions in sequence story
 - Understanding others actions depends on ability to infer motives, goals, and intentions from observed ongoing behavior which is difficult for ASD population.
 - MAKE LINK TO MATH: COOPERATION, SEQUENCING STEPS

Asperger Disorder

- Composite or test scores alone will not help teachers/teams determine strengths or weaknesses in learning
- Individual item analysis of skills and deficits within each subtest can be helpful
 - Direct observation of student can tell you more about student processes engaged in to solve problems and reason through situations.

Low scores on numerical operations of WIAT

- Numerical operations: assesses ability to write dictated numerals, answer mathematical problems, and solve equations.
- Asperger students have a common math deficit and can be expected to need support in this area of curriculum (Woodward '02)
 - Especially targeted : applying math principles, understanding functions, and performing accurate calculations.

5th: Sensory processing

- Noises, space, etc. interrupt their thinking, bother them
 - May go beyond using felt under noisy manipulatives on their desk
 - May go beyond difficulty following a conversation in a large group
 - Accommodations such as changing setting the assignment is completed, sound blocking headphones, etc.

6th: Cognition

- Thinking style: some may work math problems in their head, but can't tell or show their work for how they got answer.
- Have difficulty selecting the important information and selecting appropriate strategies or the correct pattern
- Have difficulty monitoring the steps in their thinking; can be disorganized or not know where to begin, may not stop to evaluate their work

Strategies in cognitive area

- True-False format is difficult for Asperger students. Statements can be difficult for a number of reasons:
 - One word can be incorrect
 - Multiple words can be incorrect
 - Meaning is implied instead of directly stated which can be confusing
- **Accommodations** (See Guidelines for Use during instruction and DW Assessment on www.iowa.gov website)
 - Multiple Choice is best
 - Fill in the Blank is best

Math learning is conceptual and procedural

- Concept understanding provides a context for procedural learning. It provides “hooks” for memory work later. It targets memory tasks so that memory can be used more effectively
- Memorization is still important. You could say that memorization IS a learning strategy, but it must be scaffolded by conceptual understandings.

Concept Representations

- a means of helping students *picture* a math concept or procedure.

Perceptual or cognitive strategies for those with autism

- Conservation skills are not acquired for youngsters with autism, despite their chronological age of 6 years
 - Strategies: Strength in rote counting (they respond to rhythms or music) but not one to one correspondence
 - Line up objects in a line to encourage “take one” from many
 - Visually teach one to one correspondence matching functional pairs (boy and hat, bowl and spoon), using concepts of enough, visual space for “extra”, writing how many more (count)

Practical Use of one to one

- Overview cue card procedures-request via evaluation form
- Site presentations of teaching one to one using vocabulary listed instead of “more”

Math Content Standards

- 1. understand and apply a variety of math concepts
- 2. understand and apply methods of estimation
- 3. solve a variety of math problems
- 4. interpret data presented in a variety of ways

Understand a variety of math concepts

- Properties and operations
 - One to one correspondence leads to comparing two sets, determining more, less
 - Suggest concrete language words to teach the concepts then blend in typical more, less
 - Addition and Subtraction
 - Suggest starting with understanding change concept, making relationships between two points in time

Practical Use of CHANGE concept

- Overview cue card procedures-select on evaluation form
- Click to remote sites to share experiences

Standard 2 Estimation Ex: Estimation relates to Number Sense=common sense

- Rounding, estimating require flexible brain that accepts being close to the right answer
- Teach students to look to see if their answer makes sense
- Each grade needs to apply this common sense training to build a framework for integrating new information: ongoing
- Number sense provides a frame of reference
- Teach and reinforce estimating behaviors, which will include behavioral thinking training

Practical Use of estimation

- Overview cue card-select on evaluation card
- Click on remote site to share experience

Curriculum Adaptations: Asperger's

Adaptations: individualized, relevant, effective

- **Modify the way curriculum is presented**
 - Modify giving directions: simplify; use reference charts to aid comprehension and recall, repeat the complex, check for understanding in writing (see setting?)
- **Response:** Modify the way they complete curriculum or organize or solve problems
- **Setting:** change location assignment is completed
- **Time and Schedule:** increase allowable length of time or a change in the way time is organized

Modify the way curriculum is presented

- **Organizational Strategies**
 - Use visuals (organizers etc.); hands on
 - Aspergers will have difficulties unless auditory based instruction is supplemented by visuals and other supports.
 - Cue Cards: Make written steps in a multi-step problem more clear by using different colors (colored pencils/markers) for the different steps.
 - Use different colored blocks, pencils, or manipulatives to illustrate the different processes/sets involved in the problem
- **Direct Teaching** combining using representational techniques or **schema based strategic instruction**: teach students to translate problems into equations whose components are inserted into parts of a diagram.
 - Research supports: When taught a schema strategy to solve word problems, performance on acquisition, maintenance, and generalization better than traditional strategies (See Jitendra, Griffin)

Direct Teaching

- Some principles include
 - Explicit explanation of the rules
 - Strategy modeling
 - Guided practice in controlled materials
 - Monitoring and corrective feedback
 - Independent practice

Research using specific routines prompts,
ABA style illustrates direct teaching

Using applied behavior analysis: Neef 03

- Teaching precurent skills in solving addition and subtraction story problems to 19+23 y/o with DD

- Problems had five component parts
 - 1 initial set: number in possession in beginning
 - 2. change set: verbs or phrases stating which objects added or subtracted
 - 3. operation; verbs indicated operations to be performed
 - 4. result set: Final number objects in possession in the end
 - 5. Solution: one set was unknown (?) and provided the question to the problem. The answer to that question was solution.
See worksheets with 6 formulas to illustrate to adults

Using the models teaching concepts: Jitendra

- Step 1 Identify problem types, translate information and map features of situation onto schema/visual diagrams
- Step 2 Action schema and strategic knowledge: find identify of total amount in problem by looking at text information
 - “change” problem: student determines if problem ended with more or less than beginning amount. (end would be total when change was increase; a decrease in ending state indicated beginning state represented the total)
 - “Group” always has the larger group as total
 - “Compare” also teach a generalized rule base

Modify the way curriculum is presented continued

- **Word problems:** have confusing words (how many ways to say add) or they don't tell you what must be compared suggesting inference skills which Asperger students don't have without direct teaching.
 - 1. Historically, process category charts were made to make the language words that signal a specific process clear

Modify the way curriculum is presented continued

- **Word problems confusing: don't signal steps, while sequencing the order of the operations**
 - Ex. Start with the ending to calculate before performing the operation “faster than 6 times the average” (1st find average, then do X)
 - 2. Not sure strategy taught

Modify the way curriculum is presented continued

- Word problems can be confusing: for students who have trouble attending to the significant information and don't know how to sort out unimportant information.
 - Ex. Store had 8 baseballs left. Tom bought 2; What % did he buy? Asperger students spends time wondering, How many did the store have in the beginning? since “left” means subtract from a larger total. End up saying I can't do this problem.
 - 3. Strategy: verbally fill in potential problem information suggesting problem is about the current supply-not the entire supply.

Modify the way curriculum is presented continued

Word Problem Conditions: when the goal is to master an operation rather than to decipher the complex language in word problems

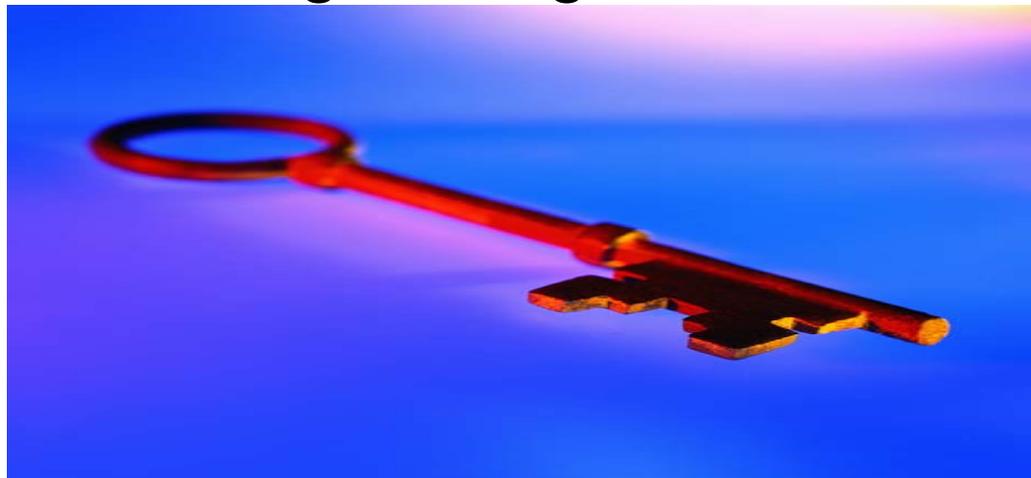
- 4. Re-write the problem to assure that the language is not confusing Ex. How many more problems (without telling 2 components) can be re-written as How many more X than Y

Modify the way curriculum is presented continued

5. Remove unnecessary words and change pronouns to names to make references easier.

Ex. Tom blah blah. Mary blah blah. ~~She~~
Mary had broken one, how many did ~~she~~
Mary have left?

- 6. Teach the identification of what type of problem to be solved.
 - Problem solving instruction defined as understanding problems, selecting and implementing appropriate solution strategies, and checking one's work, rather than on carrying out computational skills.
 - This is where we teach students who need problem-solving strategies of direct instruction



Modify the way curriculum is presented continued

- **Share problem solving solutions card**
 - Teaching specific patterns of solutions, then providing experiences in using these to solve problems seems a good match for learners with Asperger Disorder
 - Jitendra research with students at risk or with mild MR is ranked as strong evidence on the NCLB Scientifically Based Research list (content network)

Graphic Representations

- Representations are the link to conceptual understanding (to solve word problems)
- Concept development process: An effective representation leads to...
- Visualization of that concept.
- Visualization leads to RE-visualization
- Re-visualization leads to memory

Imager: like TGrandin's book Thinking in Pictures

- Prefers to reason by mental pictures
 1. BRIDGE: Way to associate math concepts with Background knowledge, Environmental objects, Age-appropriate perceptions, Any other familiar relationship
 - 2 SYMBOLIC
 3. LIMITED
 4. Enable the child to "BUILD THE PROBLEM."
 5. hooks for MEMORY

Representations are

- Meaningful to the kid
- Well presented so that you make it meaningful (alligator mouth is less than sign)
- Developmentally appropriate
- Cognitively appropriate

Jitendra's graphic representation strategy: in three different problems types in addition and subtraction Prerequisite for

understanding the problem

- Change
- Group
- Compare
- Strategies
 - Identify the problem schema (involves recognizing the problem pattern from those above)
 - Problem representation refers to translating a problem from words into a meaningful graphic representation.

Instruction

- Identify the separate features of each problem type involving a change, a grouping or comparison.
- 1. Organize and represent the important information in the story situation using a schematic diagram
 - See cue card for teacher, special ed, and student for change, grouping and comparison.

continued

- Select and apply an operation based on the representation
 - A. What is the action needed? (add, subtract,) See the cue card for figuring out the operation
 - What is the sequence of steps?
 - B. Do the action in the plan
 - C. Then you can teach students to solve word problems from real word problems
 - REVIEW: What is the problem type? What are key important features? Map information on a diagram, flag missing information in the problem using a question mark.

Comparison traditional and special needs

- Traditional format
 1. Relies heavily on rote memory
 2. Not interrelated enough
 3. Does not intentionally incorporate concepts
 4. Moves to meet year-end goals
 5. Lacks adequate review
 6. Learner is “unprotected”
- Special Needs
 1. Supports memory through concept development and distributed practice
 2. Interrelates math concepts and procedures
 3. Intentionally incorporates concepts
 4. Is needs-based and moves to meet student learning needs
 5. Daily review of skills
 6. Protects the learner

Fuchs research: success

- showed that teaching when problems requiring the same method of solution are grouped together
- and that schemas can help students see connections between familiar and new problems.

Could this be helpful for students with autism or Asperger's, too?

Types of Changes from study

- Change of cover story (same format, similar numbers but different narration)
- Different look, multiple choice response rather than setting out problem themselves
- Different words, dozen for 12
- Different question structure, not how much spent, but how much change left from amt
- Different scope: greater range of items

Look for patterns!

- All learners including those with learning disabilities benefit when they are taught to link new problems to what they have learnt already by looking for patterns. Schema studies are providing more details.

Modify the way they complete curriculum

- Organizational Strategies
 - Rather than write out math problems on lined paper, turn the paper sideways and students can use columns created by the lines.
- Accepting different solution processes
 - Students should not be required to use a particular solution strategy for a given problem. They should be encouraged to find as many ways as possible to solve problems.

Modify the way they complete curriculum continued

- They need teaching in making alternative choices, brainstorming different options
STAR plan for brainstorming solutions
- Speed of completion may not be the best measure or expectation for students with autism spectrum disorders. Students can be praised for being persistent and careful rather than being speedy in problem solving.

Modify the way they complete curriculum continued

- Consider a scoring rubric that communicates expectations, quality, and consistency
 - See the rubric for scoring

Modify the way they complete curriculum continued

- They may need modifications in expecting written answers due to coordination difficulties with writing
- They many need modifications in requiring them to explain their thinking or answers (show visually?) accept giving answer without language
- They may need support in the various problem solving ways (guess and check; make a pattern)
- They may need repeated practice using various strategies to solve a problem

Modify the way they complete curriculum continued

- They may need support in learning to transition from one use of material one day to a different way the next day
 - STAR plan about flexibility
- They many need support in coping with pace set in Gen Ed class (provide breaks)
- They may not need to learn from mass practice: adjusting to selecting the most important concept or changing the quantity of work they complete (followed by a break).

Modify the way they complete curriculum continued

- They may need support in participating in partnering or cooperative activities
 - Select small group of peers to work with ASD student, providing peers exposure to how best to encourage alternative thinking, motivate, show by visual example, using STAR for cooperative expectations of sharing materials, share paper, share roles of recorder, watch, write, do, accept others' answers
- They may not be able to participate in daily cooperative sessions; reduce to 1/week

Modify the way they complete curriculum continued

- They may benefit from previewing strategies of making different choices, transitioning use of materials, etc. before expected to work in class

Modify giving directions: simplify; repeat the complex, check for understanding in writing

- May need to support flexibility in thinking
- May need individualized expectations in group directions: fair: not giving everyone the same expectations, but what they need to be successful (given different thinking styles)
 - brain processing is different, so homework expectations may be reduced in complexity or length

When dealing with work that is too difficult

- modify the work by
 - changing the quality (i.e. breaking down the abstract task into simpler steps)
 - or changing the quantity of work (followed by a break).