Instructor's Resource Guide

to accompany

Mathematics Education and Students with Autism, Intellectual Disability, and Other Developmental Disabilities

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Chapter 1: Contextualizing Mathematics Standards

Chapter Key Terms

Acquisition	Discrete skills	Inclusion
Alignment	Embedded Instruction (EI)	Maintenance
Anecdotal records	Error correction	Permanent product
Chained task	Evidence-based practice (EBP)	Progress monitoring
Concrete manipulatives	Explicit instruction	Reinforcement
Contextualized math	Generalization	Task analysis
Curriculum based measurement	Graphic organizer	

Chapter Objectives

1. List the three steps involved in the contextualized approach to mathematics instruction.
2. Use the 3 P's rule to make mathematics standards meaningful and accessible for students with ASD/IDD.
3. Write learning objectives that demonstrate alignment with grade-level standards and specify the condition, behavior, and appropriate measurement given the mathematics task.
4. Design data sheets for measuring discrete and chained mathematics tasks.

Chapter Focus Questions

1. How does the contextualized approach to planning mathematics instruction differ from traditional functional mathematics?
2. How does the 3 P's rule make mathematics standards meaningful and accessible for students with ASD/IDD?
3. What are the three components that need to be present in IEP goals and objectives?
4. How do data sheets for discrete and chained mathematics skills differ?

Chapter Activities

1. Provide students with a grade-level mathematics standard and have them fill out the contextualized mathematics planning form in the appendix.
2. Direct students to find their state's mathematics standards and write an aligned IEP goal and three corresponding short-term objectives that include the condition, behavior, and measurable criteria. Use "Carlos" from Figure 1 on page 8 as the student or use one from your own classroom experience.
3. Provide students with a grade-level mathematics standard and have them identify both a discrete and chained math skill that align with that standard. Then have students create a data sheet for each skill.

Cumulative Activity

Have students write an original vignette of a learner with ASD/IDD. The vignette should include a description of their current math skills in the format of a present level of performance statement, an appropriate math standard for their learner, a long-term IEP goal, and three corresponding short-term objectives.

Additional Suggested Readings and Resources

1. Collins, B. C. (2012). *Systematic instruction for students with moderate and severe disabilities.* Brookes.
2. Hedin, L., & DeSpain, S. (2018). SMART or Not? Writing specific, measurable IEP goals. TEACHING Exceptional Children, 51(2), 100-110. https://doi.org/10.1177/0040059918802587

Chapter 2: Using Data to Design and Evaluate Mathematics Instruction

Chapter Key Terms

Accommodations	Executive function	Permanent product
Acquisition	Explicit instruction	Reinforcement
Chained task	Fluency	Scaffolds
Constant time delay	Formative assessment	Summative assessment
Data-based decision making	Generalization	Systematic instruction
Direct observation	Graphic organizer	Task analysis
Error analysis	Heuristic	Technology-assisted instruction (TAI)
Discrepancy analysis	Indirect observation	Theory of Mind
Discrete skills	Intensive instruction	Think-alouds
Embedded Instruction (EI)	Iterative planning process,	Virtual manipulative
Error correction	Maintenance	Visual representations
Evidence-based practice (EBP)	Performance deficit	Weak Central Coherence

Chapter Objectives

1. List challenges to mathematical understanding that may be more prevalent for learners with ASD/IDD as a consequence of student characteristics and learning histories.
2. Describe the iterative process of instructional decision making and apply the process to a student example.
3. Compare and contrast direct and indirect observation and provide examples of each.
4. Identify when error analysis or discrepancy analysis is most appropriate.
5. Graph student data, aim lines, and trend lines and draw conclusions from this data.

Chapter Focus Questions

1. How can student characteristics and learning histories impact mathematical learning and response to instruction?
2. When selecting an instructional strategy for mathematics instruction, what two things should be considered?
3. Describe one way to collect data for instructional decision making when using direct observation.
4. What are the advantages and disadvantages of error analysis and discrepancy analysis?
5. How are aim lines and trend lines used to help make data-based decisions?

Chapter Activities

1. Use an example from Table 1 on page 37 to create a vignette that describes a student, an educational concern, and a specific example of how to support the student during mathematics instruction.
2. Provide a list of instructional goals; match goals to different forms of monitoring assessment (e.g., direct observation, checklists, math interviews, CBM).
3. Compare and contrast the graphs below. Provide in paragraph form instructional recommendations for each graph with evidence from the graph to justify each decision.

Student Name: Maxwell
Instructor Name: T. Wade
Class setting: General education/push in
Location of instruction: math small group

Upside down task analysis: Steps to decompose a 3-digit number into place value														
10. Say number using numerals			GP			SV	SV	SV		SV	10	10	10	10
9. Say number using blocks						SC	GP	SC		SC	9	9	9	9
8. Count and move units to place value mat	GP	GP	SV	GP	GP			GP	SC	SV	8	8	8	8
7. Say last digit						GP	SC	GP			7	7	7	7
6. Count and move rods to place value mat	SV	SV	GP	GP							6	6	6	6
5. Say second digit							GP				5	5	5	5
4. Count and move flats to place value mat	SV	GP	GP		SC	GP			SC		4	4	4	4
3. Say first digit										SV	3	3	3	3
2. Confirm that the number has a hundred place value	NR	NR	SV	SV			GP	SC			2	2	2	2
1. State how many digits are in the number										SV	1	1	1	1
Session number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Session date and start time	1/11 9:20	1/12 9:00	1/13 9:12	1/16 2:00	1/17 2:10	1/18 9:25	1/19 9:20	1/22 9:15	1/24 2:00	1/25 9:20				
Condition (Baseline/Intervention/Generalization)	B	B	B	I	I	I	I	I	I	I				
# correct/total # = % correct	60%	60%	50%	70%	80%	60%	50%	50%	80%	50%				
Annotation key: / - Independent correct SV – Specific verbal SC – Self correct GP – Gestural prompt NR – No response/teacher completed	Student mastery goal: Maxwell will complete 8 steps (80%) independently correct for three sequential sessions. Notes: Afternoon sessions are 70% and 80%													

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Upside down task analysis: Steps to decompose a 3-digit number into place value														
10. Say number using numerals	SV	SV	GP	SC		SC					10	10	10	10
9. Say number using blocks	NR	NR	NR	GP	GP	SC	SC				9	9	9	9
8. Count and move units to place value mat	GP	GP	SV	GP	GP						8	8	8	8
7. Say last digit											7	7	7	7
6. Count and move rods to place value mat	SV	SV	GP	GP							6	6	6	6
5. Say second digit											5	5	5	5
4. Count and move flats to place value mat	GP	GP	SC		SC				SC		4	4	4	4
3. Say first digit											3	3	3	3
2. Confirm that the number has a hundred place value	NR	NR	SV	SV		SC					2	2	2	2
1. State how many digits are in the number											1	1	1	1
Session number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Session date and start time	1/11 9:20	1/12 9:00	1/13 9:12	1/16 2:00	1/17 9:20	1/18 9:25	1/19 9:20	1/22 9:15	1/24 2:00	1/25 2:10				
Condition (Baseline/Intervention/Generalization)	B	B	B	I	I	I	I	I	I	I				
# correct/total # = % correct	40%	40%	40%	50%	70%	70%	90%	100%	90%	100%				
Annotation key: / - Independent correct SV – Specific verbal SC – Self correct GP – Gestural prompt NR – No response/teacher completed	Student mastery goal: Maxwell will complete 8 steps (80%) independently correct for three sequential sessions. Notes:													

Cumulative Activity

Have students create an observation plan and data sheet that is aligned to the IEP goal and objectives designed in Chapter 1 cumulative activity. A peer within the class can create data for their learner and then graph the data and make an instructional recommendation.

Additional Suggested Readings

1. The IRIS Center. (2015). *Intensive intervention: Using data-based individualization to intensify instruction*. Retrieved from https://iris.peabody.vanderbilt.edu/module/dbi1/
2. National Center on Response to Intervention (January 2013). Progress monitoring brief #3: Common progress monitoring graph omissions: Making instructional decisions. National Center on Response to Intervention. https://files.eric.ed.gov/fulltext/ED578046.pdf
3. Powell, S. R., & Stecker, P. M. (2014). Using data-based individualization to intensify mathematics intervention for students with disabilities. *TEACHING Exceptional Children*, 46(4), 31–37.

Chapter 3: Multi-Tiered Systems of Supports in Mathematics

Chapter Key Terms

Accommodations	Formative assessment	Progress monitoring
Concrete manipulatives	Graphic organizer	Think-alouds
Embedded Instruction (EI)	Inclusion	Universal Design for Learning (UDL)
Evidence-based practice (EBP)	Intensive instruction	Virtual manipulatives
Explicit instruction	Multi-Tiered System of Supports (MTSS)	
Flexible grouping	Positive behavioral interventions and supports (PBIS)	

Chapter Objectives

1. Define MTSS and how it is used as a framework to support student success
2. Identify supplementary strategies based on the tiers for students with ASD/IDD
3. Describe Universal Design for Learning (UDL) and its three principles
4. Give examples of collaborative planning to ensure students with ASD/IDD have access to mathematics content standards

Chapter Focus Questions

1. How does MTSS promote collaboration between general and special educators?
2. What are the indicators of inclusive MTSS?
3. How does the 3P's Rule apply to providing access to students with ASD/IDD as part of each MTSS tier?
4. How does planning with the UDL framework proactively support inclusion of students with ASD/IDD within MTSS in the area of mathematics?

Chapter Activities

1. Have students compare and contrast MTSS as it relates to academics vs behavior.
2. Give students math content standards and have them chart learning strategies, activities. that would give learners the opportunities described by the 3 UDL principles.
3. Have students collaboratively plan a lesson based on a specific tier of MTSS or a specific UDL principle.

Cumulative Activity

Using the student vignette and data from the chapters one and two cumulative activities, write a grade aligned mathematics lesson plan that incorporates tier one, two, and three supports. Make direct connections from the examples in the text to your lesson plan.

Additional Suggested Readings

1. CAST guidelines- https://udlguidelines.cast.org/
2. Center on Multitiered System of Supports Essential Components- https://mtss4success.org/essential-components
3. Intervention Central- https://www.interventioncentral.org/
4. National Center on Intensive Intervention- https://intensiveintervention.org/
5. Progress Center- https://promotingprogress.org/ IEP Tip Sheet https://promotingprogress.org/resources/iep-tip-sheet-series

Chapter 4: Manipulatives and Manipulative-based Instructional Sequences

Chapter Key Terms

Concrete manipulatives	Manipulative-based sequence of instruction
Explicit instruction	Overlearning
Generalization	Task analysis
Graduated sequence of instruction	Universal Design for Learning (UDL)
Maintenance	Virtual manipulative

Chapter Objectives

1. Identify benefits of concrete and virtual manipulatives.
2. Define manipulative-based instructional sequences.
3. Select manipulative-based instructional sequence based on student learning characteristic and targeted math concept.
4. Define explicit instruction and its relation to manipulative-based instructional sequences.

Chapter Focus Questions

1. What are the similarities and differences between the variations of manipulative-based sequences of instruction?
2. What factors would teachers consider when deciding whether or not to use concrete or virtual manipulatives with a given student?
3. What are the core instructional components of the manipulative-based instructional sequence?

Chapter Activities

1. Give students a math standard and have them identify which manipulative-based instructional sequence(s) would be appropriate and propose options for manipulatives (concrete and virtual).
2. Have students identify a math state standard, write a corresponding instructional objective, and develop a task analysis that can be using for instruction that requires manipulatives.
3. Compare how manipulative-based instructional sequences could be used in whole groups, small groups or with individual students.

Cumulative Activity

Write a draft email to a school administrator requesting virtual or physical manipulatives that would support the learner from your vignette. Include a justification based in research and a specific example of the manipulative you would like to purchase for your classroom.

Additional Suggested Readings

1. Bouck, E. C., Working, C., & Bone, E. (2018). Manipulative apps to support students with disabilities in mathematics. *Intervention in School and Clinic, 53*(3), 177-182. https://doi.org/10.1177/1053451217702115
2. Bouck, E. C., Shurr, J., & Park, J. (2020). Virtual manipulative-based intervention package to teach multiplication and division to secondary students with developmental disabilities. *Focus on Autism and Other Developmental Disabilities, 35*(4), 195–207. https://doi.org/10.1177/1088357620943499
3. Illuminations is a website that supports mathematics instruction by increasing access to quality standards-based resources for teaching and learning mathematics, including interactive tools for students and instructional support for teachers. https://illuminations.nctm.org/Default.aspx
4. Paulsen, K., & the IRIS Center. (2006). Algebra (part 1): Applying learning strategies to beginning algebra. Retrieved from http://iris.peabody.vanderbilt.edu/case_studies/ ICS-009-IG.pdf https://iris.peabody.vanderbilt.edu/wp-content/uploads/pdf_case_studies/ics_alg1.pdf

Chapter 5: Teaching Problem Solving Using Modified Schema-based Instruction

Chapter Key Terms

Abstract representations	Generalization	Schema-based instruction
Concrete manipulatives	Graphic organizer	Systematic instruction
Considerate text	Heuristic	Task analysis
Constant time delay	Keyword strategy	Technology-assisted instruction (TAI)
Error correction	Maintenance	Think-Alouds
Evidence-based practice (EBP)	Modified Schema-Based Instruction (MSBI)	Universal Design for Learning (UDL)
Executive function	Procedural fluency	Virtual manipulative
Explicit instruction	Prompting hierarchy	Visual representations
Fluency	Schema	

Chapter Objectives

1. List the four core features of SBI and MSBI.
2. Compare and contrast SBI and MSBI.
3. List the four questions that teachers should consider as they plan for and implement MSBI.
4. Use the individualized needs of students to make decisions related to the implementation of MSBI.

Chapter Focus Questions

1. In what ways may students with ASD/IDD need more supports to be independent in problem solving than what is provided in traditional SBI?
2. How do the four considerations of MSBI implementation guide and influence teacher planning?
3. List and describe one barrier with one solution to each of the four planning considerations of MSBI implementation.

Chapter Activities

1. Provide students with matching cards that list the planning barriers of MSBI implementation and the solutions that can be used to support them. Have students match the barrier to the appropriate support solution (e.g., “What are the barriers to accessing the problem?” Card states “Reading Level” and a match option says “Adjust the reading level of the problem by using considerate text”).
2. Put students into small groups and have them use the blank planning worksheet from the appendix on page 196 to plan how to use MSBI to teach multiplicative or additive

schemas to a student in their practicum or field placement. Alternatively, use Calvin or Jerika vignettes and have students plan a lessons targeting a different problem type than is presented in the chapter.

Cumulative Activity

Using Figure 1 on page 147 as a guide, design an instructional sequence for your learner using MSBI. The skill taught should **support or expand** the skill taught in the lesson plan developed in chapter three and require the manipulatives discussed in chapter four cumulative activity.

Additional Suggested Readings

1. Archer, A. L., & Hughes, C. H. (2011). *Explicit instruction: Effective and efficient teaching*. Guilford Press.
2. Hughes, E. M., Powell, S. R., & Stevens, E. A. (2016). Supporting clear and concise mathematics language: instead of that, say this. *TEACHING Exceptional Children, 49*(1), 7-17.
3. Powell, S. R., & Fuchs, L. S. (2018). Effective word problem instruction: Using schemas to facilitate mathematical reasoning. *TEACHING Exceptional Children, 51*(1), 31-42.
4. Project STAIR Word Problem Instruction Resources - https://blog.smu.edu/projectstair/category/educator-resources/tailored-professional-development/word-problem-instruction/

Chapter 6: Embedded Instruction

Chapter Key Terms

Acquisition	Fluency	Multi-Tiered System of Supports (MTSS)
Constant time delay	Generalization	Progress monitoring
Data-based decision making	Instructional trials	Systematic instruction
Embedded Instruction (EI)	Intensive instruction	Universal Design for Learning (UDL)
Explicit instruction	Learning trajectory	

Chapter Objectives

1. Define embedded instruction and provide examples of learning opportunities in which they are most effective.
2. Design EI program and trials for students with ASD/IDD.
3. Plan and decide how and when learning trials should be distributed within lessons and activities.
4. Determine how, when, and why progress monitoring should be used during EI.

Chapter Focus Questions

1. How can students with ASD/IDD benefit from embedded instructional trials?
2. How does Embedded Instruction (EI) fit within the context of a Universally Designed math classroom?
3. In what ways does EI lend itself to the MTSS process? How can EI be used with Tier 2 and Tier 3 interventions?
4. Why is identifying specific learning goals an essential part of planning for EI?
5. Why is determining the number of instructional trials important when planning for EI?
6. Why does providing explicit instruction in communication, social skills, and behavior benefit EI?

Chapter Activities

1. Provide students with a lesson plan or recorded lesson from a general education mathematics class. Using the appendix on page 197 (part 2), Have students identify opportunities to use EI to teach early numeracy skills within the math lesson.
2. Provide vignettes of learners with ASD/IDD and have students determine a plan to include EI within the general education setting that best benefits the students specific learning needs and objectives. Using the appendix on page 197 (part 1 and 2) have students describe/list the roles of the educational team within this plan.
3. Have a maximum of 3 students collaborate on planning a math lesson focusing on EI within a math lesson, describing explicitly the role of each provider. Along with the plan

have students create a progress monitoring sheet or using the appendix on page 198 (part 3). Have students practice implementing the lesson each taking turns being a student while teachers/service providers will practice recording data for progress monitoring for the EI tasks.

Cumulative Activity

Using the lesson plan developed in the chapter three cumulative activity, isolate a skill that will require embedded instruction for your learner to reach mastery. Then write a plan for two or more school staff members to use embedded instruction in two or more school settings to support your learner.

Additional Suggested Readings

1. Bowman, J. A., McDonnell, J., Ryan, J., Coleman, O., Conradi, L. & Eichelberger, C. (2019). *Effects of general education teacher-delivered embedded instruction to teach students with intellectual disability to solve word problems. Education and Training in Autism and Developmental Disabilities, 55*(3), 318–331.
2. Clements, D. H., & Sarama, J. (2017/2019). *Learning and teaching with learning trajectories [LT]2.* Retrieved from Marsico Institute, Morgridge College of Education, University of Denver. Website: www.LearningTrajectories.org
3. Jameson, M. J., McDonnell, J., Riesen, T., Polychronis, S. (2020). Embedded instruction in the general education classroom for students with intellectual and developmental disabilities. *Council for Exceptional Children.*
4. Jimenez, B. A. & Kamei, A. (2015). Embedded Instruction: An evidence-based practice to support academic achievement in inclusive core academics. *Inclusion*, 3, 132-144.
5. McDonnell, J., Jameson, M. J., Riesen, R., Polychronis, R. (2014). Embedded instruction in inclusive settings. In D. M., Browder & F. Spooner (Eds)., *Language arts, math, and science for students with significant cognitive disabilities* (pp. 15-36). Paul H. Brookes.