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Research-Practice Brief
#64

Teaching Students with Disabilities

NC Collaborative for Mathematics Learning

With the adoption of the Common Core State Standards for Mathematics, North Carolina students and teachers are being asked to go beyond basic skills, to dig deeper into the mathematics, and make meaning for the procedures students need to learn. Additionally, the Standards for Mathematical Practice that serve as the basis for mathematical activity across all grade levels require students to construct viable mathematical arguments and justify their thinking, analyze the solution processes of others, create models of their mathematical thinking, and reason abstractly, to name a few. Because of this new rigor and these new process standards, teachers and researchers alike are asking if these standards are accessible to all students, including those with special needs. What do researchers say about all students' abilities to learn to think critically and make mathematical inquiries, and in particular, how do specific disabilities impact students in this mathematical shift? What teaching strategies are needed to support students with disabilities to allow them to create meaning for the procedures and facts they must learn?

CHOOSING APPROPRIATE TASKS

Design techniques for mathematics has emerged differently in the mathematics and special education fields yet both suggest using a Concrete Semi-concrete Abstract (CSA) or Concrete Representational Abstract (CRA) approach to task design/choice (Gravemeijer, 1994; Maccini & Hughes, 2000; Stephan & Smith, 2012). In these approaches, the teacher should sequence tasks by beginning with very concrete (C), manipulative-based activities. All students, but those particularly with disabilities, would manipulate the concrete materials to make sense of the mathematical quantities that are represented. Then, as students become more knowledgeable, teachers pose tasks that use representations (R) or semi-concrete (S) activities, i.e., drawings or other inscriptions. As the students apply what they have learned in the concrete situations to drawings, they move up in their level of abstraction. Finally, teachers should pose activities that are more abstract (A). Additionally, sequencing tasks is critical to build from students' informal to more formal strategies (Gravemeijer, 1994; Witzel et al., 2003). Teaching more than one heuristic for problem solving (Gersten et al, 2009) and posing problems that elicit more than one strategy also are critical design techniques.

SPECIFIC TEACHING TECHNIQUES TO USE WITH APPROPRIATELY DESIGNED CURRICULA

Explicit Instruction:
Two seemingly opposing teaching traditions exist in the literature about teaching students with special needs. The role of the teacher is to make the mathematical structures and procedures explicit for students and the role of the student is to practice what was modeled until she understands. Implicit instruction often has been equated with an inquiry approach to mathematics in which the teacher poses problems but not the method for solving it. The role of the student is to create a viable solution process to solve the problem. Explicit instruction has a strong tradition of increasing achievement significantly for students with mathematics disabilities (Bryant et al., 2008; Clarke et al., 2011) with research on implicit instruction emerging (cf. Stephan & Smith, 2012).

DISCUSS WITH YOUR COLLEAGUES

1. *How do you adapt lessons to ensure that students have a more concrete experience?*
2. *Do your lessons build logically on one another or are they separate tasks?*
3. *Do you use mostly explicit, implicit, or blended instruction? How do you decide when to use which?*

STAR is an example of an empirically-tested and validated technique that can aid students with disabilities in their general mathematical problem solving. STAR (Maccini & Hughes, 2000) is a mnemonic that stands for:

a. *Search the word problem;*
b. *Translate the problem;*
c. *Answer the problem; and*
d. *Review the solution*

The STAR strategy is most likely used with the Concrete-SemiConcrete-Abstract (CSA) design approach noted above and teaches the students to search the word problem for the most relevant information, translate the words into mathematical symbols and representations, answer the problem and make certain that the answer is reasonable. Another strategy is called the K-N-W-S. This strategy requires students to follow four steps: (1) What facts do I KNOW from the information in the problem? (2) Which information do I NOT need? (3) WHAT does the problem ask me to find? and (4) What STRATEGY/ operation/tools will I use to solve the problem? (Barton & Heidema, 2009). However, critics argue that a strategy alone, without understanding the complexity of the language intertwined with mathematics, may not be as helpful.

Implicit Instruction:
In this method, students are presented with a mathematical problem situation, usually grounded in a realistic context or prior experience, and students use their knowledge base to create their own personally meaningful solutions. Tasks are designed so that everyone, regardless of ability, have an access point to be successful. Students can then talk with peers to test the viability of their solutions and processes, and with the guidance of the teacher, mathematically sound processes are accepted and recorded in students' notebooks. The implicit approach is full of student discourse, and the teacher does not model solutions strategies. Rather, students model and use the strategies that are most meaningful to them. Student discourse is an important component to teaching students with disabilities regardless of the explicit or implicit approach (Gersten et al., 2009; Stephan & Smith, 2012).

Blended Instruction:
Some special education researchers see value in both approaches and have recommended a blending of two methods (Hudson et al., 2006). In the blended model students might be allowed to come to an understanding via implicit instruction, yet be provided with strategy instruction to help them retain procedures they clearly understand to ensure faster processing or use of strategies.

Peer assistance:
Peer assisted problem solving has been shown to be unsuccessful for students with disabilities (Gersten et al, 2009) because partnering low achievers with high achievers typically leads the high achiever to do most of the work. Partnering a low achiever with another low student also impedes progress because there no one to push either of them forward. However, partnering low achievers with students just slightly above their level or with students who work well with others can be an advantage.

Technology:
Classroom instruction that utilizes some type of computer assisted instruction (CAI) has been shown to increase achievement in students with mathematics disabilities (Leh & Jitendra, 2012). Providing multiple opportunities to practice skills and understanding in engaging, interactive formats can greatly enhance students' mathematical proficiency.

References

Barton, M. L., & Heidema, C. (2009). Teaching reading in mathematics: A supplement to Teaching reading in the content areas teacher's manual (2nd Ed.). Aurora, CO: Mid-Continent Research Association.

Bryant, B., Bryant, D., Gersten, R., Scammacca, N., Funk, C., Winter, A., & Pool, C. (2008). The effects of tier 2 intervention on the mathematics performance of first-grade students who are at risk for mathematics difficulties. Learning Disability Quarterly, 31, 47–63.

Clarke, B., Smolkowski, K., Baker, S., Fien, H., Doabler, C., & Chard,

D. (2011). The impact of a comprehensive tier 1 core kindergarten program on the achievement of students at-risk in mathematics. Elementary School Journal, 111, 561–584.

Gersten, R., Chard, D., Jayanthi, M., Baker, S., Morphy, P., & Flojo, J. (2009). Mathematics instruction for students with learning disabilities: A meta-analysis of instructional components. Review of Educational Research, 79, 1202–1242.

Gravemeijer, K. (1994). Developing realistic mathematics education. Utrecht: Cd-ß Press.

Hudson, P., Miller, S., & Butler, F. (2006). Adapting and merging explicit instruction within reform based mathematics classrooms. American Secondary Education, 35(1), 19-32.

Leh, J., & Jitendra, A. K. (2012). A comparison of the effects of teacher-mediated and computer-mediated instruction on the mathematical word problem solving performance of third grade students with mathematics difficulties. Learning Disability Quarterly.

Maccini, P. & Hughes, C. (2000). Effects of a problem solving strategy on the introductory algebra performance of secondary students with learning disabilities. Learning Disabilities Research & Practice, 15(1), 10-21.

Stephan, M. & Smith, J. (2012 Spring/Summer). Teaching common core standards to students with disabilities. Journal of the American Academy of Special Education Professionals, pp. 162- 175.

Witzel, B., Mercer, C. D., & Miller, M. D. (2003). Teaching algebra to students with learning difficulties: An investigation of an explicit instruction model. Learning Disabilities Research and Practice, 18, 121–131.

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SUGGESTED CITATION
NC²ML (2018, July). Teaching Students with Disabilities. *Research-Practice Briefs*. North Carolina Collaborative for Mathematics Learning. Greensboro, NC. Retrieved from nc2ml.org/brief-64