NDTAC | The National Evaluation and Technical Assistance Center
for the Education of Children and Youth Who Are Neglected, Delinquent, or At Risk

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STRATEGY GUIDE

Making it Count: Strategies for Improving Mathematics Instruction for Students in Short-Term Facilities

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Recommendations

1. Promote student engagement and a classroom environment conducive to learning.
2. Implement screening, diagnostic testing, and progress monitoring.
3. Use explicit instruction by knowledgeable teachers to teach new numeracy skills and grade-appropriate mathematics concepts.
4. Provide an environment that supports teachers, promotes educational leadership, and fosters high-quality mathematic instruction and numeracy.

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Introduction

This guide is designed to support the development of mathematics proficiency for youth in short-term juvenile correctional facilities. Mathematics proficiency includes mastery and fluency in foundational numeracy; an understanding of complex, grade-appropriate concepts and procedures; and application of those competencies to solve relevant, real-life problems.

This guide is primarily designed to help practitioners implement research-based, effective mathematics instruction in short-term facilities, defined as institutions that typically house youth detained in juvenile corrections or other residential facilities for periods of 90 days or less. A secondary audience includes local juvenile justice facilities program coordinators, facility administrators, and state Title I, Part D, coordinators.

This guide provides recommendations, strategies, and examples for teachers that increase the likelihood that students will become more proficient at understanding mathematics and applying existing and emerging skills. Just as important, the guide can help teachers promote the self-confidence of students in their ability to use mathematics to solve problems.

The 2004 census of youth in residential custody for delinquency, one-day count, showed that 94,875 children under age 21 were held in 3,257 publicly and privately operated facilities throughout the United States.[1] This number includes youth in state training schools and other residential treatment facilities, detention centers, and group homes. Short-term facilities such as detention centers may hold some youth overnight and other youth for more than 60 days.

According to Title I, Part D program data, 273,110 youth in juvenile detention in the 50 states, the District of Columbia, and Puerto Rico were served in programs with Title I, Part D funding for the 2007–08 school year. The average length of stay for youth in these detention facilities was 47 days. According to the National Evaluation and Technical Assistance Center for the Education of Children and Youth Who Are Neglected, Delinquent, or At Risk, approximately one-half of all detained youth were between 14 and 18 years old. African American youth represented the largest group of detainees followed by White, non-Hispanic youth; Hispanic youth; and a smaller number of American Indian/Alaska Native and Asian/Pacific Islander youth. Seventy-eight percent of youth in juvenile detention receiving Title I, Part D funds were males.[2] Recent studies provide some information on the academic abilities and school experiences of youth in detention.

Two recent studies of a large sample of adolescent boys and girls at intake in juvenile corrections in a mid-Atlantic state shed light on the academic performance of incarcerated youth. One study found that adolescent boys scored on average 4 years below their age-equivalent peers on standardized tests in both reading and mathematics.[3] In a comparable investigation in the same state, researchers assessed and interviewed 273 incarcerated girls.[4] They found reading and mathematics scores substantially below the girls' expected age-level performance. With regard to prior school experience, both studies found that detained youth experienced high rates of suspension, retention in grade, and expulsion from school prior to their incarceration. Over 80 percent of the more than 500 boys assessed had been suspended from school, over 60 percent had been retained in grade, and over 50 percent had been expelled from school prior to incarceration. Like their male counterparts, in excess of 80 percent of the girls had been suspended from school, 55 percent had been retained in grade, and 46 percent had been expelled from school prior to incarceration.

The academic skill levels and previous school experiences of the youth in your detention center or other short-term facility may differ from those of the youth in these studies. Still, they will exhibit, with some exceptions, academic abilities below their nonincarcerated peers and a history of exclusion and other negative school experiences. At least half or more of them will have a history of receiving special education services. This background information will be valuable as you shape your classroom climate and culture, establish expectations, and design assessment and teaching activities that are associated with improving mathematics outcomes among the youth in your facility.

Recommendations for Mathematics Instruction and Numeracy Activities

This guide presents four recommendations and 21 related strategies for improving mathematics proficiency, including numeracy, for students in short-term facilities. The recommendations focus on (1) engaging students, (2) assessing and monitoring students, (3) teaching students, and (4) developing an infrastructure at juvenile justice facilities to support high-quality learning opportunities. The guide offers multiple strategies and examples for enacting each of the four recommendations with a particular eye toward addressing the variety of challenges and talents that are typically presented by students in short-term juvenile facilities.

Recommendation 1: Promote student engagement and a classroom environment conducive to learning.

The goal of mathematics instruction in detention facilities should be threefold: (a) rapidly improve students' foundational skills, procedural fluency, and conceptual understanding; (b) provide access to grade-appropriate

1 Livsey, S., Sickmund, M., & Sladky, A. (2009). Juvenile residential facility census, 2004: Selected findings. *Juvenile Offenders and Victims National Report Series*. Washington, DC: Office of Juvenile Justice and Delinquency Prevention.

2 Data from Title I, Part D, 2007-2008, United States, Subpart 1. Retrieved July 8, 2010, from http://www.neglected-delinquent.org/nd/data/fastfacts_SP1.php?year=0708&yearname=2007-2008&state=US&name=United%20States&subpart=Subpart%201

3 Krezmien, M. P., Mulcahy, C. A., & Leone, P. E. (2008). Detained and committed youth: Examining differences in achievement, mental health needs, and special education status. *Education and Treatment of Children, 31*(4), 445–464.

4 Wilson, M., Zablocki, M., & Bartolotta, R. (2007). *Educational and behavioral status of females in a state juvenile detention and commitment facility.* Presentation at the Council for Exceptional Children, Louisville, KY.

mathematics concepts and domains (e.g., algebra, geometry); and (c) instill mathematics competence and confidence in students who have likely experienced major gaps in instruction and years of failure in mathematics.

Student engagement and a positive classroom culture and climate are closely related to each other and to individual students' foundational numeracy and grade-appropriate concept development. Motivated students actively take part in and feel responsible for their own learning. Therefore, it is important for teachers, particularly those teaching learners with diverse backgrounds and needs, to engage their students through motivational activities.

Engaging students in juvenile facilities in numeracy activities may be a particularly challenging endeavor for teachers because many of these students have experienced repeated academic failure and exhibit low mathematics achievement. Thus, students may enter class with poor attitudes toward numeracy, low levels of confidence in their mathematics ability, and an unwillingness to persist through complex mathematics tasks. Moreover, it may be difficult for students to identify the relevance of mathematics in their lives, and consequently they may find little intrinsic value in the work.

In addition to motivation, learning may be affected by the context of the learning space.[5] In other words, students' willingness to engage in learning is influenced by the inclusiveness of the classroom environment. Therefore, teachers in juvenile facilities must be culturally competent and should recognize and integrate student diversity in the classroom. Teachers should be willing to engage in behaviors that support an inclusive classroom climate. Specifically, teachers must be aware of their own cultural understandings and the ways that this understanding may influence their interactions with students. For example, teachers attempting to improve classroom culture should avoid deficit thinking about students' sociolinguistic differences. Instead of criticizing, explicitly or implicitly, students' language abilities, especially those of minority students and English language learners, teachers should help students understand the differences between formal classroom language and the language that students use with friends and family. When teachers display a positive and caring attitude toward their students, they create the conditions and the classroom climate that are essential to engage students. At the same time, demonstrating a caring attitude toward students does not mean ignoring appropriate boundaries that should exist in the teacher-student relationship. Students' sense of safety and engagement can be tied closely to teacher-student interactions.

Despite the challenges in motivating students in numeracy and mathematics, teachers can use a number of strategies that are likely to engage students and increase their motivation to participate and invest in mathematics learning.

1. Use informal and formal channels to learn about and engage students.

To create a sense of community within the school and classrooms, it is important for teachers and other facility staff to engage students. But first, teachers must learn and understand the interests, experiences, and educational backgrounds of the students when they enter the facility. Teachers who show their students that they are "real people" who care about them can help create a trusting and engaging climate for students.

> *Michael Woods, a mathematics teacher in a juvenile detention facility in Maryland, says teachers showing their students that they are a "real person" can help create a trusting and engaging climate for students. "[I take]…a personal interest in their life and what they care about. I start my roll, my attendance at the beginning of each period, I make eye contact with every student and I ask them how they're doing. I engage a lot of humor in the classroom. We laugh a lot. [I talk about my]…personal life…not giving away personal information that's inappropriate but just let them know that, I have a family [or, what] my kids are doing."*

Juvenile facility staff can use informal discussions and formal surveys to learn about their students. Additionally, educators should review educational records that have been sent to the facility and familiarize themselves with any extant data on the students' learning experiences, including experiences with mathematics and numeracy.

After becoming familiar with students' backgrounds and interests, teachers can create real-life, meaningful mathematics activities that are relevant to students' lives to introduce and practice numeracy and grade-appropriate mathematics concepts.

2. Develop a classroom climate focused on high expectations for mathematics.

Even though many students in juvenile facilities have experienced failure in mathematics and may have considerable deficits in numeracy, teachers should set high expectations for student learning. All students should be expected to master the objectives that are delineated in the curriculum standards, thereby establishing uniform standards of expectations. Students need to also be given the academic support to realize the high expectations and guidance on how to ask for and access that support.

Further, socio-cultural practices within the facility and the classroom can convey various levels of expectations for student achievement. For instance, language can be a powerful tool for communicating expectations for student achievement and behavior. Consider the not-so-subtle difference in the message sent when staff refer to students as "scholars" instead of "juveniles" or "wards." Within the classroom, teachers can use the classroom environment, both physical and psychological, to set the expectation for the classroom as a place of learning. As an example, a mathematics teacher in juvenile corrections in California named his classroom the "Think Tank." This name adorned the walls outside and inside the classroom, along with drawings of tanks and images to convey a focus on academic learning within the classroom. Homework, tests, and in-class graded work can be kept and maintained in

5 Bandura, A. (1975). *Social learning and personality development*. New York: Holt, Rinehart & Winston.

a portfolio by each student. Finally, establishing classroom routines, such as requiring students to calculate and graph their grades to self-monitor progress, can also help keep students focused on academic expectations.

3. Incorporate culturally relevant practices into mathematics instruction.

Culturally relevant practices in the classroom are simply those that consider the cultural context of students. Teachers should attend to ways they can connect learning to culture and not simply place cultural symbols in the classroom or lesson independent of learning. For example, in Louisiana, many families rely on the Gulf Coast for their livelihood and income. Incorporating stories of fishing, shrimping, and the loss of business as a result of the massive oil disaster of 2010 into mathematics problem-solving opportunities can provide a level of relevance to the youths' lives. In rural upstate New York and Pennsylvania, many families work in stone quarries, so geometry problems using examples of cutting stone may be appropriate. Encouraging students to incorporate their own culture—stories, experiences, symbols, and language—into problem-solving opportunities, and developing those together, promotes engagement and a sense of classroom community.

In attempting to incorporate culture into teaching practices, teachers should also account for a number of other cultural considerations. The cultural makeup of a typical juvenile facility classroom can differ across generation, race, class, religion, and geographic orientation. For example, one teacher used a cultural ritual common among young males involved in hip-hop culture, called battling, to engage students in the practice of solving equations and communicating mathematics knowledge. Battling involves two or more individuals orally reciting hip-hop lyrics in a contest with one another. In this mathematics example, students were presented with separate equations to solve and won points in the battle on the basis of how accurate their solution were and how well they communicated their ideas for solving the problem. Battling can be used for practicing and reinforcing foundational numeracy skills or for solving higher-order mathematics problems.

4. Use games and constructive competition to practice and review numeracy skills.

Creating spaces where students can be competitive in constructive ways can be an engaging motivational tool. Having students use games to practice newly acquired skills or to evaluate skills can be effective. Teachers might consider applying the rules of popular sports games to a game focused on numeracy.

One easy and effective competitive application of numeracy practice is math bingo. Michael Woods uses a game of multiplication bingo at the end of many classes to help students practice multiplication, an important numeracy skill. Woods says that the activity gives students an opportunity to practice a skill that many of them struggle with and to compete in a constructive way. Students can also work in pairs or small groups to represent and solve algebraic equations using manipulatives. Points are awarded to the group that accurately represents a problem using manipulatives such as algebra tiles. Then, additional points are awarded to the group that accurately solves the problem first. Battling, math bingo, and the representation and solution examples can be helpful in both improving fluency and providing opportunities for mathematics practice and productive student interaction and engagement.

5. Use meaningful, relevant incentives to encourage student engagement.

Using motivational tools can help bridge gaps of interest as well as socio- and generational culture that traditional pedagogy may ignore. Giving students an incentive to complete academic tasks can be very effective. For example, teachers might consider allowing students to listen to their own music during independent seatwork. Alternatively, to encourage cooperative support toward goal achievement, teachers might provide a classroom incentive such as a weekly party as a reward for all students who successfully complete assigned work for the week. Involving students in developing a set of desirable incentives will also promote student engagement. Weekly parties can be used either as a tool for individual goal-setting (i.e., only students who earn the reward by completing assigned work participate in the party) or as a cooperative goal (i.e., students work together to achieve a common goal). These techniques help build individual and group responsibility and nurture a positive classroom climate.

Incentives and other motivational activities are not intended to replace or undermine the intrinsic value of learning. However, motivational activities recognize the limitations of the intrinsic motivational stance in practical application.

Recommendation 2: Implement screening, diagnostic testing, and progress monitoring.

Facilities receiving Title 1, Part D funding must conduct pre/post testing on all youth served for more than 90 days. The use of curriculum-based measures (CBMs) in public schools has gained favor by many teachers as an easy and effective way to monitor student progress and can be used in juvenile corrections classrooms to respond to the pre/post assessment requirement. An advantage of using CBMs in detention facilities is that with the high mobility of students, facility staff can capture academic progress over the course of a student's stay, regardless of length.

All programs should conduct screening and diagnostic testing of the mathematics skills of individual students as well as ongoing progress

Screening: *General assessment of mathematics skills; administered within 5 days of entry*

Diagnostic testing: *Based on identified needs and strengths from initial screening, an in-depth follow-up of specific skill areas*

Progress monitoring: *Ongoing assessment of foundational numeracy skills to record progress throughout stay and to develop and refine learning goals and instructional focus for individual students*

Curriculum-based assessment (CBA): *Assessment tool that is directly related to the curriculum; used to measure instructional impact, change instruction, and determine student mastery of instructional objectives*

Curriculum-based measure (CBM): *One type of CBA with particular features including brief, timed, and standardized administration; repeated measures are graphed for progress monitoring; measure of foundational academic skills*

monitoring to inform instruction. An effective evaluation system should include initial screening and in-depth diagnostic testing to get the best picture of each student's mathematical strengths and weaknesses, as well as progress monitoring to get the best picture of what the student has learned and still needs to learn. Progress monitoring should be continuous, assess the achievement gains of students throughout their programming, and use curriculum-based measures to ensure that the teaching strategies are working and are sufficient. The following section provides specific considerations for administrators, teachers, and staff developers as they put into place an assessment program that includes screening, diagnostic testing, and progress monitoring.

In light of the limited and/or unknown time available to educators in short-term juvenile facilities, programs and teachers need to implement a comprehensive academic evaluation system. The evaluation system should include gathering available information on the students' past and current functioning in mathematics, including teacher reports, report cards, individualized education plans, and student products. The evaluation system must allow teachers to develop an appropriate individualized course of study that can be used during each student's stay in the facility. Ideally, the evaluation and the course of study would follow the student to his or her subsequent placement.

1. Use initial screening to develop a broad picture of students' abilities.

Facility administrators should institute a policy requiring all students who enter the facility to take part in a broad screening of their mathematics knowledge. This screening can be conducted using a short tool, administered individually, to quickly assess students' mathematical capabilities across a broad array of skill areas. Although the screening instrument should be brief, it is important that test items align with the content priorities of the curriculum standards. This screening should be sensitive to the physical, emotional, and psychological status of youth entering the facility, yet must require participation in screening within a reasonable amount of time. It may be necessary to delay screening to prevent unwanted effects such as invalid results or escalation of emotional distress. However, facility administrators should develop guidelines that allow relevant staff to address issues of toxicology or emotional distress and still conduct screening within about 5 days of entry. A widely used screening tool is the mathematics sections of the Woodcock-Johnson-III.

In addition to intake academic screening, facilities should have in place a system for transferring school records from the students' previous school placements. Some systems have successfully set up electronic databases that allow facility staff to immediately access records when students are placed in the juvenile facility. In addition to reviewing and analyzing school records, facility staff can use student interviews as a useful tool for collecting information on students' mathematics history. Interviews should inquire about students' strengths, weaknesses, interests, and past school experiences (i.e., retention, expulsion, attendance lapses, special education service, mental health service, course taking).

2. Use diagnostic testing to identify students' strengths and weaknesses.

Following the broad screening of foundational numeracy skills and mathematics concepts, an in-depth diagnostic testing of areas of particular strength and weakness should be conducted. Such diagnostic testing can provide valuable insight into the foundational skills on which to focus during a student's stay. These particular skills should also be outlined in the student's education plan.

The appropriateness of tests is of vital concern to all test users. Questions on the diagnostic test should assess across appropriate content and process standards (see http://www.corestandards.org). Additionally, testers as well as consumers of test reports (teachers) should be aware of test properties such as the reliability and validity of the test for the individual student.

Students identified with disabilities or, in many localities, limited English language proficiency are highly represented among youth in juvenile facilities. Therefore, testers must be prepared to use appropriate accommodations for these students to ensure the accuracy of test results. Appropriate accommodations may include differentiating test presentation, response modes, settings, and scheduling for students with disabilities or using translated texts for students with limited English language proficiency.[6]

Diagnostic testing can take the form of commercial tests (e.g., KeyMath), instructor-developed curriculum-based assessments, or diagnostic interviews. During a diagnostic interview, the instructor presents the student with several mathematics problems. As the student solves the problems, the instructor asks him or her to explain the processes and thinking the student is using. Diagnostic interviews are conducted to gather qualitative performance data regarding a student's (a) content knowledge, (b) cognitive processes, (c) strategy use, and (d) disposition to mathematics.

Questions on diagnostic tests appropriate for student testing should be aligned with the standards and principles delineated by the National Council of Teachers of Mathematics,[7] the Common Core Standards, and state and local mathematics standards.

3. Use progress monitoring to assess students' mastery of foundational numeracy skills and content standards.

Curriculum-based measures (CBMs) are brief tests given regularly (weekly) to students to assess their progress in mastering an academic skill. CBMs are one type of curriculum-based assessment that are standardized, brief, timed, and graphed by the teacher or student. CBMs are used to measure fluency and accuracy and are typically used for foundational skills. They are also sensitive to changes over a short amount of time and can be normed. Progress monitoring is necessary to support student learning and use instructional strategies efficiently. Although progress monitoring is important in all learning situations, it is particularly important when students lack grade-level skills and will be in a facility for a short time. For example, a teacher can construct a series of tests with items assessing a student's skill

6 Salvia, J., Ysseldyke, J. E., & Bolt, S. (2010). *Assessment in special and inclusive education* (11th Ed.). Boston: Wadsworth Publishing Company.

7 National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

in graphing functions. The teacher would then track the change in the number of items correct from week to week on the series of tests. In addition, the student can self-monitor and graph his or her own progress on CBMs.

To evaluate student progress as a result of numeracy activities in the classroom, teachers should use tests aligned with the specific curricular goals enacted with students. Additionally, this alignment allows teachers to determine student learning in numeracy skill area deficits identified during screening or diagnostic testing and addressed in students' educational plans.[8]

Although tests are an important component of progress monitoring, they should not be the only component. Teachers should use formal and informal observations, student products, diagnostic interviews, and communications with other teachers to evaluate student progress in relevant numeracy skill areas and other mathematics concepts.

Recommendation 3: Use explicit instruction by knowledgeable teachers to teach new numeracy skills and grade-appropriate mathematics concepts.

After the classroom climate and culture and the effective diagnosis of students' mathematics strengths and weaknesses, it is the student-teacher interactions—the actual instruction—that directly affects students' mathematics proficiency. Effective teachers of students in short-term facilities can have a substantial effect on both remediating and advancing their students' numeracy skills and overall mathematics proficiency. Effective mathematics teachers are knowledgeable about relevant mathematics content and use this deep understanding of mathematics content to more effectively teach the concepts of numeracy.

In addition to having deep content knowledge, teachers should use explicit instruction of content. Explicit instruction is effective for teaching numeracy concepts and processes, particularly for students with deficits in mathematics.[9] Explicit instruction can be an effective teaching practice that supports the acquisition of new mathematics facts.

1. Provide instruction that is flexible to meet the variable lengths of stay of students in detention.

Youth in detention tend to have variable lengths of stay; one youth may enter and leave a facility in just a few days, whereas others may remain for 90 days or more while they await placement in a long-term facility. Because students enter and leave class intermittently and sometimes unpredictably, mathematics instruction should be tailored to a highly mobile student population with a wide range of abilities. Teachers need to provide short-term (i.e., weeklong) instructional units that focus on remedial numeracy as well as grade-appropriate concepts and problem-solving skills.

For example, a weeklong instructional unit on the area and perimeter of parallelograms might follow this schedule:

Sample Schedule for a Weeklong Instructional Unit on the Area and Perimeter of Parallelograms

Monday:

- Teacher: Determine prerequisite skills and current knowledge by using a curriculum-based assessment (CBA)
- Students: Classify quadrilaterals
- Teacher: Review vocabulary related to area and perimeter of parallelograms

Tuesday:

- Teacher: Review formulas for area and perimeter of triangles and rectangles
- Students: Apply knowledge of area and perimeter formulas for triangles and rectangles to finding area and perimeter of parallelograms
- Teacher: Provide additional instruction on pre-requisite skills necessary for mastery of area and perimeter of parallelograms

Wednesday:

- Students: Derive a formula for finding area and perimeter of parallelograms
- Teacher: Provide multiple practice opportunities

Thursday:

- Students: Using real-world examples, apply knowledge of area and perimeter formulas to solve one-step and multistep problems

Friday:

- Students: Review and practice concepts and skills from unit
- Teacher: Administer a CBA to gauge student understanding and mastery of unit
- Teacher: Administer a curriculum-based measure (CBM) to monitor progress in foundational skills

8 For an in-depth discussion of developing curriculum-based measures for progress monitoring, see Hosp, M. K., Hosp, J. L., & Howell, K. W. (2007). *The ABCs of CBM: A practical guide to curriculum-based measurement.* New York: Guilford Press.

9 Maccini, P., & Gagnon, J. C. (2000). Best practices for teaching mathematics to secondary students with special needs. *Focus on Exceptional Children, 32,* 1–21.

2. Ensure high standards for mathematics instructor's mathematics content knowledge.

Numerous studies indicate that many U.S. mathematics teachers possess inadequate mathematics content knowledge. Further, the typical variability of students' numeracy skills in juvenile facilities often demands that teachers have a knowledge of mathematics across the elementary and high school curriculum. In addition to recruiting teachers with strong backgrounds in mathematical content, facility administrators should focus ongoing professional development activities on improving the mathematics curriculum content knowledge of their current teachers. Teachers with a deep understanding of mathematics content are better positioned to teach foundational numeracy and grade-appropriate mathematics concepts.[10] In addition to deep content knowledge, teachers should be familiar with explicit instruction of content as it is effective for introducing new concepts, particularly for students with mathematics difficulty.

> *Woods advises teachers to present lessons in small steps. Also, he presents new information using "little bite-sized lessons, just enough for [students] to get a taste of the topic and have success in it, and then the next day you can reinforce it. But to give [students] 60 minutes of math computations will be completely ineffective."*

3. Integrate explicit instruction into the teaching of mathematics content and processes for both new concepts and the review of previously learned concepts.

Explicit instruction is an effective teaching practice that can support students in acquiring new mathematics facts. Explicit instruction includes teacher-directed instruction of prerequisite skills, modeling of target skills, guided practice, independent practice, and corrective feedback. Explicit instruction can support the acquisition of factual, procedural, and conceptual knowledge and is supported in research on effective strategies for teaching students with disabilities.[11] Students are not receiving explicit instruction when they are consigned to drill and practice worksheets for long periods of time. Nor are they receiving explicit instruction when mathematics instruction is reduced to show-tell-practice approaches that are devoid of student-engaged activity or application.

Mathematics proficiency and numeracy attainment is hierarchical. In other words, developing new skills is heavily based on understanding previously learned foundational skills. Therefore, it is important that teachers explicitly review and reteach previous knowledge. In addition, lessons should be focused on one skill or concept; each part of the lesson should introduce and reinforce that skill or concept. Students should receive explicit instruction of related vocabulary and multiple demonstrations (modeling) of new skills or concepts.

For example, to provide instruction on solving a linear equation with a variable in the denominator of a fraction, teachers must first ensure that students are familiar with several background concepts. If presenting the problem $x + 4/x + 1 = 5$, teachers need to provide explicit instruction on the three concepts: (1) equations or equivalence in relation to operations performed to an equation; (2) manipulating/multiplying of fractions; and (3) the distributive property. Once these constitutive parts have been taught, instruction on solving the equation may begin.

During the modeling phase, students should be encouraged to participate using "think alouds" that ask them to provide the next step in a procedure. Students can then be required to complete the steps at their desks, using manipulatives or personal whiteboards. Maximizing student engagement during the modeling phase of a lesson allows teachers to gauge student understanding and alter instruction accordingly.

Within an explicit instruction framework, providing opportunities for students to guide their own learning is part of a balanced instructional lesson.[12] Student-directed activities may include holding problem-solving sessions where students work together to solve a complex mathematics problem or having students develop their own problems or assessments on the basis of the numeracy lesson. Including opportunities for student-directed instruction within an explicit instruction framework also helps engage and invest students in the instructional activities.

4. Use guided and independent practice to review acquired numeracy skills.

Guided practice allows students to demonstrate and check their understanding while teacher direction gradually decreases. With guided practice, teachers incrementally fade, or reduce guidance, to allow students to take increasing responsibility for learning and practice. Independent practice is important for developing and maintaining mathematics knowledge.[13] Near the end of the lesson, teachers can incorporate independent practice by using a short, five-question "ticket out." Providing accurate responses demonstrates student mastery.

In addition to having guided and independent practice time during class, students in juvenile facilities should be expected to complete homework that serves as additional independent practice of skills developed during class. Homework requires strong collaboration between education staff and residential or security staff. Providing a set time in the evenings, with appropriate space

10 National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Advisory Panel.* Washington, DC: U.S. Department of Education.

11 Hudson, P., & Miller, S. P. (2006). *Designing and implementing mathematics instruction for students with diverse learning needs.* Boston, MA: Pearson Education; Mulcahy, C. A., & Gagnon, J. C. (2007). Teaching mathematics to secondary students with emotional/behavioral disorders. In L. M. Bullock & R. A. Gable (Eds.), *Seventh CCBD mini-library series: Ensuring a brighter future for troubled children/youth: Challenges and solutions.* Arlington, VA: Council for Children with Behavioral Disorders.

12 Explicit instruction is supported by the National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Advisory Panel.* Washington, DC: U.S. Department of Education. Retrieved June 17, 2010, from http://www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf

13 Hudson, P., & Miller, S. P. (2006). *Designing and implementing mathematics instruction for students with diverse learning needs.* Boston: Pearson Education.

and tools for completing homework, reinforces the importance of school and homework and youth as students and learners. Homework should be practice, not an introduction to new concepts or skills; therefore, it is the responsibility of teachers to make sure that students fully understand the lesson prior to assigning homework. Ensuring understanding can be accomplished through a daily CBA or other informal measure (e.g., ticket out) at the end of each lesson.

5. Use questioning and feedback loops to monitor learning.

Teachers must provide students with feedback throughout the instructional process and use questioning to gauge student understanding and learning during a lesson. It is important to note that feedback should not only be corrective, that is, noting right and wrong answers. Teachers may help students deepen conceptual understanding by exploring the thinking behind students' answers in terms of how they derived an answer or why they believe their answer is right or wrong. Students should have numerous opportunities to explain their thinking orally and in writing; it should become a routine part of daily lessons.

Teachers should constantly use open-ended questions (e.g., "Why?" "Can you explain that?") to monitor learning within individual numeracy activities and to provide cumulative assessments of skill areas. This should take the form of weekly or monthly CBMs. Students can record and graph their progress on CBMs to reinforce progress and further invest in their own learning.

In addition to using curriculum-based measures of foundational numeracy skills, teachers should pretest and posttest students at the beginning and end of each unit using an instructor-developed CBA (also known as a unit test). This practice will help teachers refine and redirect instruction, gauge student mastery of concepts and objectives covered in units, and provide student work for the portfolio.

6. Use graduated instructional sequencing to teach abstract concepts.

Graduated instructional sequencing is a research-based strategy for introducing mathematical concepts to students.[14] Graduated instruction is often referred to as the concrete-semiconcrete-abstract (CSA) sequence and can be advantageous for helping students who struggle with the symbolic, or abstract, language of mathematics. For example, the CSA sequence has been effective in teaching algebra to students who are unfamiliar with or unskilled in solving algebraic equations. This strategy may be particularly effective for students who struggle with algebra because they lack conceptual understanding of numbers, symbols, and the relationship between the two. However, the strategy may be used to teach a variety of concepts, such as fractions, percents, geometry, and basic computation.

The first step in a graduated instructional sequence is to introduce students to mathematical (often algebraic) concepts using a concrete item, or manipulative, to represent the concept (concrete stage). Specialized manipulatives or common resources found in the classroom can be used. For example, students may represent numbers and symbols in an algebra equation by using blocks of differing colors and sizes, such as algebra tiles. The concrete stage may last a single lesson or several lessons, depending on student mastery. Using manipulatives in a detention setting requires considerable planning because some manipulatives, such as items that might be used as weapons, may not be appropriate for the environment. As in any classroom, procedures for dispensing and collecting manipulatives need to be developed.

The second step of the sequence is to use pictures to represent the objects used in the first step (semiconcrete stage). Teachers should explicitly identify the link between the pictorial representation and the concrete representation to students. In an explicit instructional cycle, teachers model this several times with student involvement and then provide several opportunities for guided practice. As with the concrete stage, using pictorial representations in the semiconcrete stage may last a lesson or several lessons depending on student mastery.

The final step of the sequence is to use numbers and symbols to represent the equation (abstract stage). Again, teachers should explicitly note the link between the abstract notation of the current step and the representational and concrete examples used in the previous two steps. The abstract stage should not begin until students master problem-solving at the semiconcrete stage. The abstract stage could involve a single lesson or several lessons.

For example, teachers might use pencils to represent constants and a pencil box to represent a variable in the simple problem $x + 13 = 20$. In the second step, the pencils and box would be represented in picture form, and the final step would eliminate representations and simply use the variable and constants to represent the problem. Another example might be to use a classroom table, a drawing of the table, and finally the abstract formula for solving for perimeter ($P = 2L + 2W$). This representation of the problem could also be extended into a discussion of how to solve for the width by using the same formula.

7. Use explicit problem-solving strategies.

Cognitive planning strategies, including explicit attention to problem-solving strategies, give students tools for organizing their own thinking when solving mathematical problems. Cognitive organization is important for students who have not developed metacognitive habits on their own. Cognitive planning strategies help students understand how they should be thinking about a problem or organize the problem-solving sequence and is a precursor to metacognitive thinking. Metacognition involves recognizing and understanding one's thinking processes. The ability to use metacognition allows students to plan, choose appropriate strategies, and solve problems by using the best strategy. A general overview of the steps in instruction that uses cognitive planning strategies is provided below. Teachers should provide explicit instruction in each of these steps to students, using modeling prior to allowing students to practice the strategy independently.

In strategy instruction, students use explicit steps to plan, solve, and check their work in a problem-solving situation. First, students read the problem and ensure that they understand the words in the problem, identify what information is provided, and understand what the problem is asking them to find. Second, students draw a pictorial representation of the problem to be solved. Students may also simply write out the problem as

14 Maccini, P., Mulcahy, C. A., & Wilson, M. G. (2007). A follow-up of mathematics interventions for secondary students with learning disabilities. *Learning Disabilities Research and Practice, 22*(1), 58–74.

a mathematical equation in this step. Third, students solve the problem based on the pictorial or abstract representation of the problem employed in step 2. Fourth, students reexamine their answer and justify why it is correct.

Within a strategy instruction model, students also have opportunities to self-monitor their progress through the steps. For example, in the STAR (Search, Translate the words, Answer the problem, Review the solution) strategy, students have a card that identifies the steps and a space for checking when they complete a step. Self-monitoring is an important part of any strategy instruction approach because it helps build metacognitive skills.

8. Teach students mnemonic devices to remember concepts or processes

Steven Leinwand, the former mathematics supervisor for the Connecticut Department of Education and currently a Principal Research Analyst at the American Institutes for Research, suggests that teachers emphasize the use and meaning of mathematical terms and their connectedness to the real world. For example understanding the relationships between mathematical terms and everyday language (cylinder and can, prism and box, and average and typical) helps students internalize new terminology and concepts in the classroom.

Mnemonic devices can be used within a strategy instruction approach to teach new concepts to students. Mnemonics assist in the memorization of new or difficult concepts by developing artificial cognitive structures that organize and order concepts so that they are mutually evocative. This cognitive structure gives students an easier way to encode and, most important, recall new information. For example, in mathematics, students are taught a mnemonic sentence (Please Excuse My Dear Aunt Sally) to remember that parentheses, exponents, multiplication, division, addition, and then subtraction make up the order of operations for solving an equation. Within the strategy instruction approach, the mnemonic is paired with a technique for self-monitoring the use of the mnemonic.

Keyword method. Students use words that sound like the unknown word, which can be associated with pictorial representations to assist encoding and recall of verbal information.[15] For example, students might associate the word "integer" with "finger" and use the mental or physical picture of a finger to recall that an integer is a whole number in the sense that it can be written without a fraction or decimal point.

Pegword method. Students use rhyming words (pegwords) to replace numbers that are associated with the information to be recalled.[16] The pegword method can help students recall ordinal information. For example, a pegword for 6 is "stix." Students can apply this pegword to multiplication facts: 6 × 6 (Stix × Stix) = 36 (Dirty Stix).[17]

Acronyms. Students use initial letters as prompts to recall a list of facts. One of the most common acronyms in mathematics is for the order of operations (PEMDAS).

Teacher- and student-developed strategies. Teachers can help students learn procedures for developing their own mnemonics and then have them generalize to various domain areas. It may also be helpful to give students sentences or phrases related to various mathematics processes. For example, the distributive property is used in solving various types of algebra equations and is therefore an important process for students to commit to memory. Teachers may choose to provide a distributive property mnemonic to students:[18]

To distribute means to give it to everyone.

The distributive property gives whatever is outside the parentheses to everything inside:

$a(b + c) = ab + ac$

9. Create a language-rich classroom.

As noted earlier, explicit instruction of related vocabulary should be a consistent part of the lesson. One teacher of secondary students with mathematics difficulties required her students to keep a math vocabulary notebook. In the notebook, students wrote their own definitions of vocabulary words, provided pictorial examples, and practiced spelling the vocabulary words through word pyramids by writing the words in a series of lines, starting with the first letter on the first line, the first two letters on the second line, the first three letters on the third line, and so on. The point of the vocabulary notebooks was to promote literacy across the content areas and to establish the fact that mathematics is abundant with literacy opportunities.

Carrie Stewart uses hands-on and real-life examples to teach. She likes using the newspaper to generate problems that coincide with the skills she's teaching. For example, newspapers can be used to connect current events to math activities. Problem-solving, probability, and data analysis activities can use poll results, weather data, or scores of sporting events from the newspaper.

Vocabulary instruction is one aspect of creating a language-rich environment. Teachers and students should practice using appropriate mathematics terminology in the classroom, in a type of immersion class. Students should also regularly be asked to discuss their problem solving by explaining to the teacher or to a fellow student. In addition, students should be required to write out their explanations for their problem-solving steps and solutions to problems.

15 Scruggs, T. E., & Mastropieri, M. A. (1990). Mnemonic instruction for students with learning disabilities: What it is and what it does. *Learning Disability Quarterly, 13*(4), 271–280.

16 Mastropieri, M. A., & Scruggs, T. E., (1998). Enhancing school success with mnemonic strategies. *Intervention in School and Clinic, 33*(4), 201–208.

17 For more information, see http://www.k8accesscenter.org/index.php

18 For more examples, see http://www.onlinemathlearning.com/index.html

Recommendation 4: Provide an environment that supports teachers, promotes educational leadership, and fosters high-quality mathematics instruction and numeracy.

Teachers and administrators in juvenile detention programs face many challenges, some similar to those in mainstream secondary education settings and some unique to their programs. These include staff knowledge of and capacity for high-quality instruction in mathematics, financial resources to build capacity and change instructional offerings, and highly mobile staff and students.

The following strategies can help facilities develop a setting that supports adolescent learners and anticipates and responds to the negative experiences many students have had in learning mathematics and becoming math literate.

1. Establish a culture that celebrates the importance of mathematics and numeracy.

Many of the strategies mentioned in this guide contribute to establishing a mathematics-focused program culture. Asking students about mathematical abilities and numeracy skills during screening and diagnostic testing, setting high expectations for mathematics achievement, and creating a language-rich classroom all communicate to students that mathematics matters. A focus on increasing students' mathematical abilities reinforces the message that the juvenile justice facility is a place for learning. Current events, sports, and popular culture all provide opportunities for teachers to publicly post, discuss, and introduce mathematical concepts to students. During class warm-up time, as part of instruction, or during closing, teachers can pose questions such as these:

- Which new movie will gross the most money during the next week? Does it matter that some movies are shown in more theaters than others?
- How do hospitals determine how many pints of blood they need for emergencies? How would you estimate how much they would need?
- How much money do you think the [local sports team] grosses during the year from sale of tickets to its games? How much net profit do you think the team makes from each game? How would we figure that out?

Posing questions like these in the classroom helps students understand that using mathematical concepts and skills is an everyday phenomenon. It also demonstrates that all staff, administrators and teachers alike, value mathematics and numeracy and expect that all students are capable of using mathematics and basic numeracy skills to understand their world and solve problems.

2. Devote sufficient resources to support changes in instructional practice.

Administrators in detention facilities can play a leadership role in demonstrating the value they place on the recommendations in this guide by supporting ongoing professional development for teachers and providing appropriate classroom materials. Creating a program that supports the development of mathematics proficiency requires adequate space, well-trained personnel, and appropriate instructional tools.

3. Provide intensive interventions to address specific areas of weakness and build areas of strength.

Some adolescents, particularly those who struggle with mathematics and foundational numeracy, have significant gaps in their ability to conceptualize and think numerically. These youth need intensive, specialized instruction that builds on areas of strength and focuses on the essential elements of knowledge and skill that are weak. Individual and small-group instruction may be able to provide the critical support that these students need to succeed.

Models for intervention include intensive individual or small-group instruction that supplements or replaces regular instruction. For example, students with the most significant needs may be pulled out for assistance instead of participating in regular mathematics class. Sometimes intensive interventions are offered after school or during other times when school is not in session. Instruction that makes a difference and is associated with achievement gains is intensive, is regularly scheduled for an extended period of time, and targets students' identified needs.

There are a variety of options for providing intensive supports. First, teachers should plan lessons that focus on critical information that every student should know. Students who have mastery of those concepts and skills can be assigned enrichment problem-solving activities individually or in small groups. Students may work in small groups based on math ability. After an initial brief lesson with the whole group, the teacher or an instructional assistant can rotate through the groups and to individual students over the remainder of the class period. The key to successfully delivering intensive supports is setting up a classroom environment that demands responsibility and self-control on the part of all scholars. The expectations should be consistent and clear with the students and all staff in the room.

The cost of purchasing commercially developed intervention programs and training teachers to use this material may present a challenge to program administrators. Identifying instructional priorities and the needs of students should help determine how to spend Title I, Part D funds as well as other supplemental state and local funds. Facilities should consider the unique needs, including high mobility, of students in detention before choosing expensive commercially developed programs.

Even a fairly small amount of time in an intensive intervention class can make a difference for students. Pulling students out of class for intensive services and supports does not conflict with the concept of educating students eligible for special education in the least restrictive environment, particularly when these students have been remarkably unsuccessful learning mathematics in larger group settings in the past.

19 Gay, G. (2000). *Culturally responsive teaching: Theory, research, and practice.* New York: Teachers College Press.

4. Provide professional development opportunities to strengthen teachers' understanding of mathematics and basic numeracy.

Few administrators and teachers in juvenile corrections have been trained to focus on mathematics and numeracy for their students. Typically, developing literacy and reading skills takes precedent when identifying instructional priorities. The recommendations in this guide suggest how promoting and supporting student engagement, carefully assessing the skills of students at entry and as they move through the curriculum, and providing explicit instruction can help teachers help students in short-term facilities further develop critical mathematics skills and basic numeracy.

> *Leinwand, in* Accessible Mathematics: 10 Instructional Shifts That Raise Student Achievement, *offers a number of suggestions for thinking differently about how to create a classroom culture that supports high-quality mathematics instruction and numeracy.*

Professional development that describes ways of engaging students and examples of instructional practice has great potential to transform teaching mathematics in detention and other short-term settings. Well-developed sessions encourage teachers to practice new strategies, such as making progress monitoring an integral part of classroom routines and using culturally relevant practice. Providing examples of flexibility in instructional planning and setting high expectations for student performance are also essential elements for staff development.

Finally, classroom management is a perennial component of staff development sessions. The strategies described under **Recommendation 1: promote student engagement and a classroom environment** conducive to learning are critical to minimizing classroom disruptions and distractions. Students who are actively engaged, who care about what is going on in class because they are competing with classmates in a group activity that involves estimating, computing, and proving or disproving the "facts" of some activity are motivated to succeed. Recommendation 1 advises teachers to open up their classrooms in ways that will welcome and involve students and help them think of themselves as learners. Teachers need clear directions for making such a shift, and they need support as they try out the strategies to make this happen.

When teachers examine their classroom management styles, they can deepen their understanding of the interpersonal aspects of teaching and learning and promote greater student engagement and motivation. Becoming culturally competent[19] and developing the ability to "not chase every fire engine"—or knowing which behaviors to ignore and which ones deserve corrective action—are part of this process. Increasing the amount of classroom discussion, peer interaction, and individualized attention can motivate and engage students. However, when activities do not go as planned or when their authority is challenged, teachers need be able to talk with a fellow teacher or an administrator about specific situations and develop problem-solving strategies. Over time while working in juvenile corrections, teachers develop a sense of which patterns of behaviors suggest the need to refer a youth for mental health services and which behaviors pose a serious threat to the safety and security of the teacher and other students.

In addition to regularly scheduled staff development activities, teachers in short-term facilities should have the opportunity to visit similar facilities to learn from colleagues and share their expertise. It is too easy for teachers in correctional settings to become isolated and to feel cut off from their colleagues. A staff development program that links teachers in short-term facilities to evidence-based instructional practices and educators in similar settings will provide support and opportunities for professional growth.

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Annotated Bibliography

Hosp, M. K., Hosp, J. L., & Howell, K. W. (2007). *The ABCs of CBM: A practical guide to curriculum-based measurement.* New York: Guilford Press.

This practitioner-oriented book provides a step-by-step guide to developing, implementing, and evaluating curriculum-based measures in reading, mathematics, spelling, and writing. The guide includes directions for administration as well as procedures for graphing data.

Hudson, P., & Miller, S. P. (2006). *Designing and implementing mathematics instruction for students with diverse learning needs.* Boston: Pearson Education.

This textbook uses examples from K–6 curriculum aligned with National Council of Teachers of Mathematics standards; however, the concepts can be applied to mathematics instruction at any level. Chapters cover designing lessons within the explicit instruction cycle; developing a scope and sequence; assessing students (including curriculum-based assessment); and developing procedural, conceptual, and declarative knowledge.

Leinwand, S. (2009). *Accessible mathematics: 10 instructional shifts that raise student achievement.* Portsmouth, NH: Heinemann.

This book challenges teachers to engage students and teach mathematics more effectively by using a range of explicit strategies. Among other things, Leinward directs his readers to provide real-world examples, use probing questions, and build students' number sense. This publication contains numerous examples of specific strategies that teachers can use in the classroom.

Maccini, P., Mulcahy, C. A., & Wilson, M. G. (2007). A follow-up of mathematics interventions for secondary students with learning disabilities. *Learning Disabilities Research and Practice, 22*(1), 58–74.

This article provides a review of research-based mathematics interventions for students with learning disabilities at the secondary level. The article discusses research on strategy instruction, the graduated instructional sequence, technology-based instruction, and grouping for instruction. Results of quasi-experimental studies and their original references are provided.

Mulcahy, C. A., & Gagnon, J. C. (2007). Teaching mathematics to secondary students with emotional/behavioral disorders. In L. Bullock & R. A. Gable (Eds.), *Seventh CCBD mini-library series: Ensuring a brighter future for troubled children/youth: Challenges and solutions.* Arlington, VA: Council for Children with Behavioral Disorders.

This monograph provides practical suggestions for teaching mathematics to students with emotional and behavioral disorders. Sample lesson plans, instructional strategies, and procedures for developing lessons are included.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

Revised from original policy in 1989, this document provides an overview of what and how mathematics instruction should occur in the United States. The National Council of Teachers of Mathematics is the national organization of mathematics teachers in the United States, and most nationally available curricula, texts, and assessments are based on the principles and standards within this document.

National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Advisory Panel.* Washington, DC: U.S. Department of Education. Retrieved June 17, 2010, from http://www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf

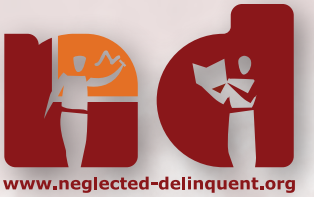
This report of mathematics and education experts in the United States examines the critical gaps in U.S. mathematics education and provides recommendations under seven elements: (1) curricular content; (2) learning processes; (3) teachers and teacher education; (4) instructional practices; (5) instructional materials; (6) assessment; and (7) research policies and mechanisms.

National Research Council. (2001). *Adding it up: Helping children learn mathematics.* Washington, DC: National Academies Press.

The editors of this book identify the gaps and successes in mathematics learning in the classroom. They examine five components of mathematics proficiency and the research that supports the teaching and learning of mathematics. There is a call for policy to promote mathematics proficiency through the coordination of instructional materials, curriculum, assessment, instruction, professional development, and school organization.

Salvia, J., Ysseldyke, J. E., & Bolt, S. (2010). *Assessment in special and inclusive education* (11th Ed.). Boston: Wadsworth Publishing Company.

This textbook provides an overview of a variety of assessment strategies, including formal and informal, screening, diagnostic, curriculum-based assessment, and behavioral assessment. In addition, it provides in-depth discussion of characteristics of assessment including technical adequacy, types of scores, and uses and misuses of testing.



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