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ENSURING EFFECTIVE MATHEMATICS INSTRUCTION FOR SECONDARY STUDENTS WITH LEARNING DIFFICULTIES: LET THE STAKES EXTEND

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Introduction

The inclusion of mathematics as a core subject in secondary school system may have been an attempt by the policy makers to solve certain quantitative problems of daily life. Today, the importance of mathematics permeates all aspect of human endeavour. Mathematics as the queen of the sciences cannot be completely separated from sciences because of its application to physical sciences. Increasingly, applicants for the best employment opportunities will need a good grasp of science, mathematics, and computer technology. However, minorities, women, and other disadvantaged groups have not excelled to the same degree as others in these areas. Why this is so, and what can be done to increase their achievement, are important educational concerns now. Successful attempts to teach science and mathematics effectively have been made recently, and a range of educational policies, programs, and methods have been identified and are not now properly in use. Many students fear the subject because some teachers handle it without giving consideration to individual differences (Amoo, 2001). As a school subject that is compulsory it is seen as most difficult to learn by students. Mathematics the terror of school children and worry of teachers has shattered the dream of many ambitious students (Oyedeji, 1987). Secondary students with learning difficulties generally make inadequate progress in mathematics. Their achievement is often limited by a variety of factors, which include prior low achievement, low expectations for success, and inadequate instruction. The body of research on mathematics instruction for secondary students with learning disabilities or learning difficulties is not developed well enough to describe a specific and comprehensive set of well researched practices, (Jones, Wilson, and Bhojwani 1997) but it is sufficient for defining a set of procedures and issues as clearly associated with effective instruction and increased student achievement. This chapter will discuss techniques that have been demonstrated to be effective with secondary students who have learning disabilities or difficulties in mathematics.

Reasons why some Students have Achievement Difficulties

A variety of reasons can be adduced for students have achievement difficulties. These include the following:

Cognitive Differences: Individual students process information and approach problem solving in different ways. Although research has shown that, in general, individuals who are members of certain groups of students (e.g., minorities and women) process information similarly. This is in a way that is different from that defined by educators as the norm. Because it is only this "normal" way of learning that has informed curriculum development, large numbers of students have failed to master science and mathematics coursework even in higher institutions.

Family Stress: Students whose family life is in turmoil often suffered from lack of parental involvement. Further more, the ability of these children to learn is hampered by lowered self-esteem, the result of their internalization of this stress. Prime sources of family stress for children at academic risk are poverty and unemployment, poor leadership and other problems they engender Amoo and Adenle (2001).

Racial and Cultural Bias: Because some teachers believe that certain students cannot excel at science and mathematics, they encourage them to take less challenging, nonacademic courses. Teachers may also believe that, given a history of low minority and female student achievement in technological studies, and possible employment discrimination, it is better to prepare these students for the jobs that will probably be available to them than for jobs usually held only by children of "Big Politicians". Parents also can discourage achievement as a result of beliefs they've come to accept after a lifetime spent in a society, which is often prejudiced, that women education end in the kitchen.

Students whose first language is not English, or is a nonstandard dialect, may have difficulty in understanding not only Standard English, but also the cultural context of the learning material. Bilingual curriculum is frequently limited to the most basic subjects, so students are not exposed to higher-level mathematics and science learning. Other cultural norms, such as the way children are supposed to interact with adults at home, may be at variance with accepted student-teacher interaction; these differences may also hamper students' academic success (Cole and Griffin, 1987).

Disability: Technological literacy is particularly important for improving the lives of the handicapped. Unfortunately disabled people are frequently "tracked" out of technical courses because of a misconception that they cannot function safely in a laboratory or could never work in a science setting.

Tracking: Students who exhibit any kind of learning difficulty, no matter what the reason, may be counselled to take less challenging classes instead of being encouraged to work harder to master the more difficult ones. If tracking begins in the early grades, students never receive the educational building blocks they need for more advanced learning later.

Effectiveness of Mathematics Instruction for Secondary Students with learning Difficulties

In this article, data- based investigations of procedures that have evaluated the effectiveness of mathematics instruction with secondary students with learning difficulties are discussed. This discussion considers some factors that predictably confound efforts to increase the effectiveness of instruction. Each of the factors is particularly relevant in the case of instruction for secondary students with learning difficulties. These factors among others are (a) students' prior achievement, (b) students' perceptions of self-efficacy, (c) the content of instruction, (d) Effective management of instruction, and (e) Evaluation of Instruction

Students' Prior Achievement

Although students with learning difficulties spend a substantial portion of their academic time working on mathematics (Carpenter, 1985), severe deficits in mathematics achievement are apparent and persistent. Although secondary students with learning difficulties continue to make progress in learning more complex mathematical concepts and skills, Nigerian students inclusive, it appears that their progress is very gradual (Cawley and Miller, 1989). McLeod and Armstrong (1982) surveyed junior high, middle school, and high school mathematics teachers regarding mathematics achievement. The teachers reported that skill deficits in basic computation and numeration were common. Specifically, McLeod and Armstrong found that secondary students with learning disabilities had difficulty with basic operations, percentages, decimals, measurement, and the language of mathematics. A similar study conducted by (Amoo, 2002) on some topics in mathematics which, Junior secondary students found difficult to learn, discovered that teachers deliberately skip some topics they were unable to teach especially where the students lack necessary materials to learn the concepts.

Algozzine, O'Shea, Crews, and Stoddard (1987) examined the results of 10th graders who took Florida's minimum competency test of mathematics skills. Compared to their general class peers, the adolescents with learning difficulties demonstrated substantially lower levels of mastery across all subtests. Algozzine et al. reported that the students with learning difficulties consistently scored higher on items requiring the literal use of arithmetic skills than on items requiring applications of concepts. Similarly, the results of the National Assessment of Educational Progress (cited in Carpenter, Mathews, Linquist, and Silver, 1984) clearly indicated that too many students in the elementary grades failed to acquire sufficient skills in operations and applications of mathematics. These persistent skill deficits, combined with limited fluency of basic fact recall (i.e., lack of automaticity), will hinder the development of higher level mathematics skills and will compromise later achievement (Hasselbring, Coin, and Bransford, 1988). For secondary students with disabilities, the adequacy of instruction in mathematics will be judged not merely on how quickly basic skills can be learned. Students must also acquire generalizable skills in the application of mathematical concepts and problem solving. The task of designing instructional programmes that result in adequate levels of acquisition and generalization for students who have experienced seriously low levels of achievement for a large proportion of their academic careers is indeed a challenging one.

Students' Perceptions of Self-Efficacy Attributes for Failure or Success

Individual differences in cognitive development certainly affect the achievement of academic skills. In earlier years, many professionals readily accepted that individual psychological differences accounted for failure to learn in school. Currently, a more parsimonious explanation is that many students fail as a result of ineffective instruction (Engelmann and Carnine,1982; Kameenui and Simmons, 1990; Amoo, 2000). Students' expectations for failure frequently develop as a result of prolonged experiences with instruction that fails to result in successful performance.

By the time students with learning difficulties become adolescents, they have typically endured many years of failure and frustration. They are fully aware of their failure to achieve functional skills in the operations and applications of mathematics. Although research supports the argument that perceptions of self-efficacy are task specific and fairly accurate, it does not reveal that learning disabilities are consistently associated with lower general self-concepts (Chapman, 1988). Chapman concluded that students who come to doubt their abilities (a) tend to blame their academic failures on those deficits, (b) generally consider their low abilities to be unchangeable, (c) generally expect to fail in the future, and (d) give up readily when confronted with difficult tasks. Unless interrupted by successful experiences, continued failure tends to confirm low expectations of achievement, which in turn sets the occasion for additional failure.

Pajares and Miller's (1994) study of self-efficacy and mathematics has implications for teachers who attempt to remedy low mathematics achievement. They found that students' judgments of their ability to solve specific types of mathematics problems were useful predictors of their actual ability to solve those problems. Specific student estimates of self-efficacy were more accurate predictors of performance than prior experience in mathematics. Extending the results suggests three important issues. First, judgments of self-efficacy are task specific and generally accurate. Second, student judgment of self-efficacy may provide insights that will be valuable supplements to teacher assessments of performance skills. Third, negative expectations and motivational problems may be reduced by interventions to eliminate deficits in specific mathematics skills. The fact that student ratings of self-efficacy are accurate (for both successful and unsuccessful students) suggests that this is not a chicken-or-the-egg-type issue. Instead, it suggests that initially there is a fairly direct path from instruction to performance and, subsequently, to perceptions of self-efficacy. When instruction is effective (i.e., when students master targeted competencies), performance is enhanced and an accurate and positive perception of self-efficacy results. Conversely, ineffective instruction leads to poor performance (Amoo, 2000) and an accurate but negative estimate of self-efficacy.

Quality of Content of Instruction

Secondary school system in Nigeria is a transition between elementary and tertiary institutions and the period is very crucial, hence, the need for quality instruction. With high-quality instruction, students will acquire skills in less time and make more adaptive generalizations than they would with lower quality instruction. Quality of instruction is dependent on two elements of curriculum design: organization of content and presentation of content. Secondary students are expected to master skills in numeration and mathematical operations and to be able to apply those skills across a broad range of problem solving contexts. Adolescents with learning difficulties are not likely to acquire adequate level of competence unless the content of their instruction is carefully selected and organized. Woodward (1991) identified three empirically supported principles related to curriculum content that contribute to the quality of instruction: the nature of examples, explicitness, and parsimony.

Nature of Examples

Students learn from examples therefore, enough examples should be discussed in the class. An important part of the business of education is selecting and organizing examples to use in instruction such that students will be able to solve problems they encounter outside of instruction. Unfortunately, commercial mathematics curricula frequently do not adequately manage the selection or organization of instructional examples. Two deficiencies that contribute to inefficient instruction and chronic error patterns in the management of instructional examples are common to commercial mathematics curricula. First, the number of instructional examples and the organization of practice activities are frequently insufficient for students to achieve mastery (Silbert, Carnine, and Stein, 1990). As a result, although high-achieving students may quickly attain near-perfect performance, low-achieving students (including students with a variety of learning difficulties) fail to master the same math skills before teachers move on to new instructional tasks.

Empirical studies of two types support the validity of this phenomenon. First, classroom observations of teacher behaviour indicate that teachers tend to direct their instruction (in terms of the difficulty of the material) to students of high-average achievement. Second, classroom observation indicates that when students with learning difficulties are taught in mainstream settings with students without disabilities, they average only 60% correct (Chow, 1981), a figure considerably below the performance levels of 90% to 100% correct that most educational experts require for task mastery. A second deficiency is an inadequate sampling of the range of examples that define a given concept. If some instances of a concept are under represented in instruction or simply not included in instruction, students with learning difficulties will predictably fail to learn that concept adequately. The direct connection between the range of examples and task mastery has been demonstrated in instructional areas including teaching fractions (Kelly, Gersten, and Carnine, 1990) and test taking (McLoone, Scruggs, Mastropieri, and Zucker, 1986). The adequacy of a selection of examples depends on several factors, including (a) possible variations of the concept, (b) the likelihood that irrelevant or misleading variables will be erroneously associated with the concept, (c) the complexity of the concept being taught, and (d) the variety of potential applications of the concept. Inadequate selections of instructional examples should be avoided and the range of concepts should be illustrated so that students do not form limited or erroneous conceptualizations.

Silbert et al. (1990) provided an example of instruction in the analysis of fractions that predictably contributes to limited understanding of fractions: Generally, students are taught that fractions represent equal divisions of one whole, and during the elementary grades, considerable instruction focuses on teaching the concept of a fraction, with examples such as 1/2,1/4, 1/8, and so forth. This representation of the concept of a fraction is inadequate, however, because not all fractions are less than one whole unit. Some fractions are equal to or greater than 1 (e.g., all improper fractions, such as, 6/5, where the numerator is larger than the denominator). Representing the concept of fraction as a quantity less than one whole limits students understanding has the wider range of possible fraction concepts. An inadequate conceptualization of fractions contributes to inadequate understanding of computation with fractions and, thus, severely limits problem-solving skills.

To learn correct conceptualizations, students must be taught which attributes are relevant and which are irrelevant. If sets of instructional examples consistently contain attributes that are irrelevant to a concept, then students will predictably learn misconceptualizations that may seriously hinder achievement. It is not uncommon to find that presentations of misleading variables have inhibited mathematics achievement. Although so-called key words frequently appear in story problems and often indicate the solution, they are not relevant per se to the solution of the problems. Unfortunately, many low achieving students learn to depend on key words instead of attending to the more critical information presented in the problem. Consequently, they are apt to experience difficulty-solving problems that do not have key words, or that use key words in ways that are irrelevant to any mathematical solution. Such misconceptualizations will confuse students unless their exposure to potentially misleading cues is carefully managed. Initial sets of instructional examples should not contain key words. As students become proficient with those examples, problems that contain relevant key words can be included in instructional sets, juxtaposed with examples in which the key words are irrelevant to the solution.

Secondary students must learn to deal with complex notations, operations, and problem solving strategies. Complexity is sometimes related to the level of abstraction the student must deal with; it may also be related to understanding the relationships between associated concepts. Thus, instructional examples should provide for the systematic progression from concrete to more abstract representations (Mercer and Miller, 1992) and from simpler to more involved relationships among concepts and rules. Students with learning disabilities have difficulty with complex tasks because they do not receive sufficient opportunities to work with complex instructional examples. Although instruction on simple forms of concepts or strategies does not façilitate generalization to more complex forms without additional instruction, Rivera and Smith (1988) demonstrated that carefully managed instruction for solving more complicated forms of division problems facilitated students' independent solutions of simpler division problems.

Explicit Curriculum Design

Explicitness of curriculum design refers to the unambiguous presentation of important concepts and skills and the relationships among them (Woodward, 1991). The explicitness of a curriculum is affected by the quality of teacher decisions made and actions taken at the following five stages of instructional design process: determining the concepts and skills that must be learned; Identifying the important relationships among concepts and skills; organizing facts, concepts, and skills into logical hierarchies; developing sets of instructional examples that unambiguously illustrate the range of concepts and skills that must be mastered; presenting the instructional examples to the student. Engelmann (1993) acknowledged that it is logically impossible to have universal hierarchies of instructional skills, but contended that curricula must be organised around explicit instructional priorities. If hierarchical sequences are not developed around explicit instructional priorities, it is unlikely that students with learning difficulties will progress.

Parsimony

Effective curricula provide for an economical or parsimonious use of time and resources. Woodward (1991) contended that emphasis should be given to mastery of concepts, relationships, and skills that are essential for the subsequent acquisition and functional generalization of math skills. Curricula should be organized so that instruction of specific skills and concepts is tightly interwoven around critical concepts. Woodward's test for the parsimony of an instructional programme is whether or not what is learned at one time will be used later. In general, practitioners are well aware of the need for functional instruction, because they must frequently answer questions such as, "Which is more important to the students, a unit on metric conversion or one on checking account management?" or "How often in life will students with learning difficulties be required to divide fractions?" However, it is not enough to identify information and skills that take the highest priority. The curriculum must be organized so that the greatest amounts of high-priority information and skills can be mastered as efficiently as possible.
However, the content of instruction and its organization play critical roles in determining its quality and outcomes. Unfortunately, worded mathematics curricula frequently stop well short of providing adequate opportunities to learn to solve mathematics problems that involve the contexts of work and everyday situations. Successful student performance on algorithms and abstracted word problems does not always result in competent real, life mathematical problem solving. Cognition and Technology Group at Vanderbilt University, (1991) and Hasselbring et al., (1991) have been conducting innovative research on teaching adolescents with learning difficulties to solve contextualized mathematical problems. They use videodisks and direct instruction techniques to present complex mathematical problems that are embedded in portrayals of real-life situations. The results of their studies are encouraging and clearly demonstrate that adolescents with LD can be taught to solve more complex problems than their teachers generally expect from them. On the other hand, those studies also demonstrate that unless students are guided in solving complex mathematical problems and are also given sufficient opportunities

to independently attempt to solve such problems, they usually will not learn adequate generalized problem solving skills.

Effective Management of Instruction

Amoo (2000) reports that qualification and experience contribute to teaching effectiveness, this at times is a function of how teachers manage the instruction in the class to produce successful learning outcome in mathematics. However, there are many roles that mathematics teachers can play in achieving effectiveness, these can be broadly categorised into three. According to Oyedeji, (1998) they include:

> Instructional expert: planning the classroom activities, assembling of needed materials, readiness to apply method suitable to teach selected content based on level, and how to evaluate the intended learning. Students will expect an effective teacher instructional expert to have all answers not only to the topic being treated but also to all topics.
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> Manager: structuring your environment according to experts is very important. Included in these broad roles are the actions required in maintaining order in the classroom, such as laying down rules and procedure for learning activities. At this level, the teacher can be effective and can be described as a disciplinarian. The students should be seen as complying with school rules and regulation. They are to be seen operating the guided limits that will make them learn. Classroom management involves modelling a positive attitude towards the curriculum. Mathematics teachers who reveal caring attitudes towards learning and the learning environment help to instill and reinforce similar attitudes in their students. As a manager, teachers are to manage attendance records of students, tests. e.t.c.
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> Counsellor: As a Counsellor, mathematics teachers' effectiveness relies on being able to respond constructively when behavioural problems get in the way

> of students learning and development. In the class, there are students who will look for teachers' guidance; teacher must be prepared to render assistance. As an effective mathematics teacher you need to understand yourself, your own motivations, hopes, prejudices and desires - all of which will affect your ability to relate to others.

Archer and Isaacson (1989) listed three variables that can be measured to evaluate quality of instruction at any grade level: time on task, level of success, and content coverage. According to their perspective, good teachers manage instruction so that students (a) spend the major portion of instructional time actively engaged in learning, (b) work with high levels of success, and (c) proceed through the curriculum while acquiring increasingly more complex skills and important generalizations. Thus, good teaching is indicated by students' responses to instruction. Obtaining high levels of achievement requires effective management of instruction.

Zigmond (1990) reported data from observational studies indicating that too many teachers of secondary students with learning difficulties may not be managing instruction effectively. She reported that during their class periods, resource room teachers spent slightly less than 40% of class time in instructional interactions. Teachers spent 28% of their time "telling students what to do, but not teaching them how to do it, and another 23% of the time not interacting with students at all" (p. 6). Although students were observed to be on task for about three quarters of the class period, they were often completing worksheets. Worksheets may be appropriate for practice, but they are not useful for introducing new information and skills. The lecture format of instruction that often occurs in general secondary mathematics classes often is not effective, either. Zigmond observed that many large classes are not managed well-students who have difficulty understanding what the teacher is talking about tend to be off task, and misunderstandings often go undetected.

Alternatives to worksheet instruction and didactic lectures have been investigated in empirical studies. The approaches to managing instruction are direct instruction, interactive instruction, peer-mediated instruction, and strategy instruction only direct instruction is discussed here. The effectiveness of the first three of these approaches has been documented across a variety of curriculum areas with secondary students in general, remedial, and special education programmes.

Direct Instruction

There are a variety of interpretations of the term direct instruction. In some discussions it refers to a model for both curriculum organization and presentation procedures. Other descriptions of direct instruction refer to a set of procedures for actively involving students in academic learning .In both discussions, instruction is teacher-led and characterized by (a) explicit performance expectations, (b) systematic prompting, (c) structured practice, (d) monitoring of achievement, and (e) reinforcement and corrective feedback.

Archer and Isaacson (1989) provided a structure for teacher led instruction that is divided into three phases: the lesson opening, the body of instruction, and the closing of the lesson (see Table 1). During each phase the teacher works to maintain high levels of active student involvement, successful acquisition, and progress through the curriculum.

TABLE 1: Phases of Structured Academic Presentations *

Opening	Gain the students' attention Review pertinent achievements from previous instruction. State the goal of the lesson.
Body	Model performance of the skill. Prompt the students to perform the skill along with you. Check the students' acquisition as they perform the skill independently.
Close	Review the accomplishments of the lesson. Preview the goals for the next lessons. Assign independent work.

Source: Adapted Archer and Isaacson (1989)

The Opening of the Lesson

The teacher first gains the attention of the students. A brief statement such as, "Look up here", "We are going to begin," is generally adequate. The teacher reminds the students of what was accomplished in the previous lesson and sets the goal for the current session. For example, "Yesterday we learned how to calculate the area of squares and rectangles. Today we are going to learn how these calculations are used in the home to lay carpet, paint walls, and tile floors." Lengthy reviews or previews of upcoming lessons are unnecessary. If this part of the lesson is not brief, students are likely to start attending to other things.

The Body of the Lesson

It may be necessary to cue the students' attention again with a gesture or brief comment before beginning, but immediately after opening the lesson the teacher should begin instruction with the first example. With the first phase of instruction the teacher models the task. For example, if the students are learning a problem-solving strategy, the teacher first models the strategy by saying, "If I wanted to determine how many 1m by 1m of tiles could fill 10m by 12m room".

The literature on direct instruction of students with learning difficulties identifies five recommendations in the delivery of instruction that contribute to the effectiveness of that instruction: (a) obtain frequent active responses from all students, (b) maintain a lively pace of instruction, (c) monitor individual students' attention and accuracy, (d) provide feedback and positive reinforcement for correct responding, and (e) correct errors as they occur. Each recommendation makes an important contribution, but achievement will be highest when all five are part of the delivery of instruction (Becker and Carnine, 1981).

The Close of the Lesson

Typically, the teacher closes a lesson with three brief steps. First, he or she reviews what was learned during the current lesson, where there may have been difficulty, and where performance may have been particularly good. The review may also include a brief statement of how learning in the current session extended what was already known. Second, the teacher provides a brief preview of the instructional objectives for the next session. Third, she or he assigns independent work. Independent seatwork and homework provide important opportunities for students to apply knowledge and practice skills that they have already learned, thus increasing fluency and retention. Independent practice should, therefore, be carefully selected so that students can actually complete it successfully without assistance from a teacher or parent.

Principles for Designing and Evaluating Practice Activities for Students with Learning Difficulties

Practice activities are essential components of mathematics instructional programs as a result, Students with learning difficulties will generally need more practice and practice that is better designed than students without learning difficulties, if they are to achieve adequate levels of fluency and retention. Table 2 provides a list of principles for designing and evaluating practice activities for students with learning difficulties.

TABLE 2: Principles for Designing Practice Activities *

1. Avoid memory overload by assigning manageable amounts of practice work as skills are learned.

2. Build retention by providing review within a day or two of the initial learning of difficult skills, and by providing supervised practice to prevent students from practicing misconceptions and "misrules."

3. Reduce interference between concepts or applications of rules and strategies by separating practice opportunities until the discriminations between them are learned.

4. Make new learning meaningful by relating practice of sub skills to the performance of the whole task, and by relating what the student has learned about mathematical relationships to what the student will learn about mathematical relationships.

5. Reduce processing demands by pre-teaching component skills of algorithms and strategies, and by teaching easier knowledge and skills before teaching difficult knowledge and skills.

6. Require fluent responses.

7. Ensure that skills to be practiced can be completed independently with high levels of success.

Source Adapted from Carnine (1989)

There is empirical evidence in the professional literature that direct instruction procedures have been effectively used to teach mathematical skills to older students with Learning Difficulties (Perkins and Cullinan, 1985, Rivera and Smith, 1988). Many principles of programmes that successfully teach mathematics are also aspects of the more general effective schooling principles and achievements in mathematics, while others respond specifically to the needs of minorities and women. A few of the principles are these:

High Quality and Long-Term Programmes: Programmes should emphasize: enrichment, rather than remediation; the personal importance of learning mathematics; and hands-on experience. They should begin early and continue throughout the schooling of the targeted groups, drawing on the cooperative efforts of universities, businesses, and the community. They should be evaluated frequently, and altered accordingly; and should have a diversified funding base to ensure uninterrupted operation.

High Quality and Diverse Staff: It is essential to have a strong principal, and competent teachers who all believe in students' ability to learn and are committed to removing educational inequities related to sex, race, ethnic background, and disability. Staff members should be recruited from target populations so they can serve as role models, and they should introduce students to other role models of both sexes with backgrounds similar to theirs.

Recontextualization: Learning tasks should be created that allow students to master them through use of their innate ways of understanding information. Information to be taught, and problems to be solved, should be embedded in familiar contexts, and should reflect students' cultural and ethnic diversity, so they can make immediate and practical use of what they learn. Relating mathematics learning to future careers also enhances student attention, and thus, comprehension and retention.

Cultural and Language Sensitivity: Teachers should respect the style of students with a nonstandard way of communicating, and with a culturally different way of interacting in group situations. They should be sure that students comprehend their teacher's speech. Bilingual advanced science and mathematics classes should be available.

Anxiety-Reducing Strategies: A competitive classroom atmosphere can provoke student anxiety. An alternative learning environment--where cooperation, rather than being first with the correct answer, is rewarded--eliminates the stress of competition and the value conflict of some females and minorities who value cooperative social interaction. Instilling in students the belief that they can succeed also helps reduce anxiety.

Improved Programming: Smaller classes, where students can interact more closely with teachers, enhance learning. Increased time on task is also beneficial; developing learning activities that take less time to master, and recontextualization, which often results in more rapid learning, allow more time for mastery of additional material.

Cooperative Student Groupings: A hands-on, inquiry-oriented science curriculum, with students divided into small mixed ability cooperative groupings, has been shown to be more effective than traditional teaching methods. Students learn to solve problems independently, and help each other develop skills. It has also been shown that cross-sex and mixed ability pairings result in more effective learning than do random pairings.

Extracurricular Learning: Mathematics achievement can be enhanced through after-school programmes run by institutions that provide educational enrichment. Parents can encourage students to take advantage of these, and of the public library, by accompanying them. Finally, the use of increasing numbers of phone-in services, which answer students' academic questions, can be supported.

Evaluation of Instruction

It is essential that instructional interventions be evaluated frequently. The academic difficulties of secondary students with learning difficulties are diverse and complex; Current research on mathematics instruction for students with learning difficulties is not sufficiently developed to provide teachers with precise prescriptions for improving instruction. Therefore, the best educators' best efforts will frequently be based on reasonable extrapolations. Unless instructional assessments are conducted frequently and with reference to the students' performance on specific tasks, it will not be possible to use the information to make rational decisions for improving instruction. To an increasing extent, educators have come to the conclusion that traditional standardized achievement testing does not provide adequate information for solving instructional problems, and that a greater emphasis should be placed on data from functional or curriculum-based measurements.

Conclusion

This chapter discussed Effective Mathematics Instruction for Secondary students with Learning Difficulties. Secondary students with learning difficulties spend the bulk of their instructional time on very simple mathematical skills. As a result of frequent failure, and of prolonged instruction on such simple skills, it is generally difficult to motivate them to attempt complex tasks or to persist in independent work. By the time the students graduate or drop out of school, they will have made only the most rudimentary achievements. Few will have acquired the levels of application and problem-solving skills necessary to function independently. To a great extent, improvement in mathematics education for secondary students with learning difficulties will depend on their receiving better mathematics education while they are in the elementary grades.

We are also advising that teachers must have at hand effective instructional procedures, materials, and other resources. At the present time they must do much of the work of improving mathematics education themselves and the government and its related agents should give enabling environment, make teaching a real profession, improve the mathematics teachers pay. Educational practices that are derived from ideologies must be critically evaluated and not merely for their fit with the political sensibilities of any particular ideology, but for their effect on the achievement of children and youth. The whole world is a global village. Let the stakes extend!

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