JSGE
The Journal of Secondary Gifted Education
Vol. XVII, No. 2, Winter 2006, pp. 112–121.

Effective Teaching Strategies for Gifted/Learning-Disabled Students With Spatial Strengths

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This study sought to determine effective teaching strategies for use with high-ability students who have spatial strengths and sequential weaknesses. Gifted students with spatial strengths and weak verbal skills often struggle in the traditional classroom. Their learning style enables them to grasp complex systems and excel at higher levels of thinking while struggling with material typically considered "easy." Many high-ability students with spatial strengths and verbal weaknesses underachieve and even drop out of school. Teachers must develop effective strategies to help these at-risk students experience success in educational settings. If students with spatial strengths find success in the educational system, then they are more likely to become creative producers in society and less likely to underachieve and be underemployed.

High-ability students with spatial strengths and verbal deficiencies rarely have the opportunity to demonstrate their gifts in American high schools. Many of the tests used to identify gifted students or judge achievement in students value performance speed over the careful and reflective thinking that is characteristic of learners with spatial strengths (Gallagher & Johnson, 1992). For example, college admission tests (such as the Scholastic Aptitude Test [SAT] and the Graduate Record Exam [GRE]) are traditionally used to determine entrance to undergraduate and graduate programs but do not assess spatial ability (Gohm, Humphreys, & Yao, 1998). The emphasis on mathematical and verbal abilities on college admissions tests and other high-stakes testing may cause high school personnel to emphasize these areas when teaching and advising students. As a result, individuals identified as having spatial gifts or talents are disproportionately undereducated and underemployed relative to their ability level when compared with equally gifted individuals with strengths in mathematical and verbal areas (Gohm et al.). Individuals with high spatial abilities are more likely to drop out of school, are working in larger proportions in traditional blue-collar occupations, and hold a smaller proportion of credentials at every educational level beyond high school (Gohm et al.; Humphreys, Lubinski, & Yao, 1993). The underemployment and undereducation of gifted students with spatial strengths is of concern because they are ideal candidates to become America's future engineers, scientists, and innovators. Many occupations associated with cognitively demanding educational tracks rely on spatial reasoning such as engineering, cartography, architecture, physics, chemistry, and medical surgery (Gohm et al.; Humphreys et al.; Shea, Lubinski, & Benbow, 2001).

Spatial ability is closely related to visual thinking but is not a single entity; consequently, there is no one specific pattern of characteristics that will manifest itself in children with spatial gifts (Dixon, 1983; Olson, 1984). Combinations of the traits described vary widely from individual to individual, yet there are some common behaviors that will be seen in these individuals who process information visually. Children who manipulate images in their minds excel at activities such as puzzles, mazes, map

reading, model building, tinkering, and craftwork (Mann, 2001; Olson; Silverman, 1989, 2002). At school, students with spatial strengths may struggle to master material that is typically considered "easy" and requires rote memorization, yet they thrive when engaged in activities that require higher order thinking skills and creative problem solving (Baum, 1984; Silverman, 2002). High spatial students have a holistic approach to learning and benefit from interdisciplinary activities that illustrate how changes in one subject area influence other domains. As a result of their whole-to-part processing style, these students appear to be slow processors when in reality, they are taking in the new information and considering the significance of it and interpreting how this new piece of knowledge fits into the larger system (Mann, 2005; Silverman, 2002; West, 1997).

The sequential structure of many American classrooms may place a burden on the spatial student as he struggles to adapt to the classroom expectations. Despite calls for learner-centered instruction, the typical high school instruction is highly teacher-centered and noninteractive. Activities and assignments are usually subject specific with text-based instruction and an emphasis on step-by-step procedures, lectures, and verbally based assessments. Teachers rarely prepare lessons that are project-based and result in products for real-world audiences. If these opportunities are offered, they are often reserved for students who have mastered the basic skills or the easier material.

Gifted youth with spatial strengths and verbal deficiencies must have their strengths recognized and nurtured (Baum, 1984; Dixon, 1983; Mann, 2001; Olenchak & Reis, 2002, Robinson, 1999). Minimizing the amount of time spent in their areas of deficiency and maximizing the time spent in their area of passion has been shown to have a positive effect on improving the child's weaknesses (Baum & Owen, 1988). Rather than insisting that basic skills be mastered prior to engaging in higher level activities, educators should give the gifted spatial learner opportunities to work with complex material that requires creativity and higher order thinking skills (Baum & Owen; Silverman, 1989, 2002). Developing skills in areas of weakness should be approached through the student's identified strengths and passions (Mann, 2001; National Association for Gifted Children, 1998; Robinson). This is best accomplished by differentiating the curriculum to focus on areas of strengths rather than remediating weaknesses. For example, working toward a conceptual understanding of mathematics, rather than emphasizing specific algorithms or recall of math facts, is an effective strategy for gifted children with spatial strengths. Once the child understands the relationships between numbers and how to create changes within the number system, working with the basic math facts becomes more meaningful, and therefore easier. Addressing skills development through strengths not only leads to academic gains but also to social and emotional improvement (Olenchak & Reis). Society needs the talents of spatially gifted children at the highest levels of the professional world (Gohm et al., 1998) and to achieve this, the educational system must alter the current, predominantly sequential style of teaching.

Teaching strategies that appear to be unsuccessful in teaching gifted students with spatial strengths and verbal deficiencies include rote memorization, forced oral reading, text-based instruction, and use of teacher-directed activities (Weinfeld, Barnes-Robinson, Jeweler, & Shevitz, 2002). Researchers and teachers working with spatially gifted students advocate a curriculum that concentrates on higher level thinking through the use of inductive learning strategies, a holistic approach, and interdisciplinary units (Baum, 1984; Silverman, 2002; Weinfeld et al.). To assist these learners with their organizational, writing, and memory difficulties accommodations such as graphic organizers, spell checkers, word processors, mnemonics, tape recorders, speech-to-text software, and audio-recorded literature and textbooks have all been used successfully by educators (Howard, 1994; Nielsen, Higgins, Hammond, & Williams, 1993; Silverman, 2002; Weinfeld et al.).

Purpose

The purpose of this qualitative study was to examine and understand teaching strategies that were effective for students with spatial strengths and verbal weaknesses. Students and teachers were observed in classrooms and teachers were interviewed about the strategies that they believe lead to student achievement.

Methods

Participants

Sampling Procedures. The students observed for this study are typically labeled as having learning disabilities. The staff of the participating school feel strongly that these students may only be disabled by the structure of the educational system and have identified them as having learning differences; therefore, that is the term that will be used to identify the subjects of this research.

Teachers from a private high school in the Northeast that specializes in educating students with learning differ-

ences were purposively selected for this study for several reasons. The school has a reputation for successfully working with students who have previously struggled in traditional educational settings. The struggles exhibited by many of these students, difficulty with language acquisition in spelling, writing, and reading, as well as problems with organizational skills and rote memorization, mirror those of students with spatial strengths and verbal deficiencies. The faculty and staff at the school are accustomed to adapting their teaching strategies to meet the diverse needs of the students. In making these adaptations, they place emphasis on experiential learning in an academically challenging atmosphere that, according to research, is a key element in effective instruction for students with spatial strengths (Mann, 2001, 2005; Silverman 1989, 2002). Five of the 57 classroom teachers were selected to participate in the interview process based on the recommendation of administrators at the school who were familiar with the characteristics of spatial learners and were cognizant of the strategies used by the individual instructors. One administrator, the Dean of Academic Affairs, was also interviewed.

Even though the school did not formally identify students as gifted or twice exceptional (gifted and learning disabled), the individual teachers were aware of their students' strengths and were quick to informally identify specific students who they were certain had superior spatial abilities, exceptional creativity, and advanced problem-solving abilities. The seniors who participated in the Rain Forest Ecology class had been required to submit an application prior to enrolling in the class and had been assessed on their abilities to problem solve and think creatively and critically, characteristics of gifted learners. The students who the teacher had informally identified as having spatial strengths and verbal deficiencies were the focus of this research.

Context. Students from all regions of the United States and many countries overseas, including Germany and Hong Kong, comprise the population at the school, a private high school for students who have been identified as having learning differences. The approximately 170 students who attend this school do so because they have not succeeded in the public school system. A social studies teacher commented that of the students who come to her school, "all have some horror story from their educational past." Class sizes range from 6 to 11 students with boys outnumbering girls by a 3 to 1 margin. Attendance is split between students who have their tuition paid for by their school district after having determined their the public school program is not meeting the child's needs, students who receive partial funding through financial aid, and students who have parental support for tuition.

All faculty at the school have earned bachelor's degrees and 52% have advanced degrees. Teaching experience ranges from first-year teachers to more than 20 years in the field with the average faculty tenure being 10 years.

As the faculty and staff of the school prepare students to transition to postsecondary educational experiences, they work not only to develop the academic skills of their students, but also to nurture the students' social and emotional development. As she stated that 94% of their graduates continue on to postsecondary education, the Dean of Academic Affairs talked excitedly about an alumnus who is now a doctor studying dyslexia and the student who initially struggled with writing assignments but is now a successful journalist. The atmosphere of caring, the personal interest in each student, and the use of effective teaching strategies help transform these struggling students into high school seniors about to begin their higher education at institutions such as Syracuse University, the University of Colorado, and Tulane University.

Design

This research employed a qualitative approach and used grounded theory methods of data analysis (Glaser & Strauss, 1967; Strauss & Corbin, 1990). Strauss and Corbin defined a grounded theory as one that is

> . . . inductively derived from the study of the phenomenon it represents. That is, it is discovered, developed and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon. Therefore, data collection, analysis and theory stand in reciprocal relationship with each other. (p. 23)

The goal of qualitative research is to find meaning not by interpreting the outcomes, but through the process (Creswell, 1994). It focuses on examining and understanding what individuals are doing and on interpretation of the social situation by searching for patterns and themes.

The use of qualitative research methods in this study provided the opportunity to examine and interpret patterns of instruction used by teachers at a school for students with learning differences. Qualitative research techniques that included observing students and teachers, conducting semistructured interviews of teachers, and reviewing documents were used to examine the teaching strategies and their effectiveness with students with spatial strengths. Teachers were asked about their impressions of

these students in terms of which learning situations are most effective for them and what proves to be frustrating for these learners. To assure that the teachers were familiar with the characteristics of spatial learners, an article, *Eye to Eye: Connecting With Gifted Visual Spatial Learners* (Mann, 2001), and a list of characteristics was sent to each participant prior to the commencement of the study. Teachers were briefed again at the beginning of the interview and given the opportunity to ask questions about the traits of spatial learners.

Classroom observations were made to assess the academic environment, determine the engagement level of the students and capture student reactions to different learning situations. The physical environment was observed in terms of the types of behavior the physical space promotes or prevents. The activities and interactions between the teachers and students and interactions between groups of students were studied. Nonverbal communication between staff and students was monitored.

Trends, commonalities, and themes were analyzed when the interviews and observations were complete. These are the basis of the written analysis.

Data Collection

Data were collected from multiple sources, including interviews with five teachers and the Dean of Academic Affairs, field notes from observations, and policy statements from the school. Data were triangulated among participants, observations, and document review to assure credibility. Teachers who were interviewed and observed were asked to review a summary of the final results of the inquiry and all confirmed the credibility of the information.

Interviews. The goal of the qualitative research interview is to understand the world from the subject's point of view and to interpret the meaning of their experiences (Kvale, 1996). The interview questions were developed from a literature review and professional experience as sources of theoretical sensitivity.

> Theoretical sensitivity refers to a personal quality of the researcher. It indicates an awareness of the subtleties of meaning of data. . . . [It] refers to the attribute of having insight, the ability to give meaning to data, the capacity to understand, and capability to separate the pertinent from that which isn't (Strauss & Corbin, 1990, p. 42).

Theoretical sensitivity comes from a variety of sources, including professional literature, professional experiences, and personal experiences. The professional and personal experiences of the researcher include 11 years as a gifted resource teacher focusing on students with spatial strengths, parenting a child with spatial strengths and verbal weaknesses, and a doctorate in educational psychology with emphases in gifted and talented development and special education.

One-on-one interviews were conducted using a semistructured interview format. An interview guide was prepared and the same guiding questions were asked of each of the five participating teachers and the administrator. The order in which the questions were asked varied, as did the wording of the question, depending on the responses by the participant to previous questions. The questions were developed to make efficient use of the teachers' time, but the teachers were also free to and encouraged to talk about any topic they deemed relevant to the subject at hand. A handwritten account of each interview was recorded for analysis.

Observations. Observations can lead to a deeper understanding and provide knowledge of the context in which events occur, and may provide the researcher with the opportunity to view actions on the part of the participants that they themselves are not aware of, or that they are unwilling to discuss (Patton, 1990). Observation is utilized to understand everyday activities more fully through a process of description, analysis, and interpretation (Smith, 1978). The researcher took the role of a nonparticipant and maintained a passive presence during the classroom observations. Classes were visited for their entirety and field notes were taken. Information recorded included teaching strategies, student behavior and reactions to the activities, verbal and nonverbal cues given by students and the teacher, and classroom layout. The observations were unstructured and the researcher recorded all relevant behaviors.

Data Analysis

Qualitative data analysis involves "working with data, organizing it, breaking it into manageable units, synthesizing it, searching for patterns, discovering what is important and what is to be learned, and deciding what you will tell others" (Bogdan & Biklen, 1982, p. 145).

Grounded theory is a constant comparative method based on a progression of three types of coding procedures to analyze data: open, axial, and selective coding (Strauss & Corbin, 1990) and the use of inductive analysis of the data results in the emergence of significant themes (Patton, 1990). Data were coded according to this three-step process, beginning with open coding to categorize the data and determine what each discrete piece of information represented. Open coding techniques involve a process

of labeling the events and ideas represented in the data (Baskerville & Pries-Heje, 1999). In this study teachers were asked to describe teaching strategies that they found effective with students with spatial strengths and verbal weaknesses and they were observed using these strategies in the classroom. Data at the open coding level included observation and discussion of specific strategies that teachers felt were particularly effective and salient points regarding their school community including hands-on activities, teaching advocacy skills, discovery learning, individualized instruction, varying instructional strategies, real-world application, math phobia, English anxiety, higher order questioning, Socratic dialogue, choice, teaching to student strengths, and teacher accessibility.

Axial coding involves searching for commonalities and making connections between data that were open coded (Strauss & Corbin, 1990). The open codes were compared across situations and participants to determine connections between the conceptual codes and were collapsed into axial codes. Findings were integrated from the information obtained during the interviews and observations to describe the phenomena surrounding the events and actions thus creating a connective web of description. Analysis of the open codes revealed axial codes related to an environment of individual caring, positive reinforcement, teaching to student strengths, and opportunities to learn in real-world settings.

Selective coding is "the process of selecting the central or core category, systematically relating it to other categories, validating those relationships, and filling in categories that need further refinement and development" (Strauss & Corbin, 1990, p. 116). At this level no new relationships emerge as the data is translated into a story line that pulls together categories into a narrative discourse. The foundation built through open and axial coding efforts revealed three selective codes.

Findings

Based on the selective coding, atmosphere of caring, strength-oriented accommodations, and student centered learning emerged as predominant themes in this research. Following, each of these themes is discussed in the context of the data from which it emerged.

Atmosphere of Caring

When students first enrolled in this high school for students with learning differences, the mathematics teacher estimated that "80% are math phobic" and a social studies teacher commented that they have "a lot of English anxiety." The teachers used strategies designed to alleviate this anxiety while giving the students the academic and advocacy skills they need to be successful in their chosen careers.

Caring about the student as an individual was an important factor in the approach taken at this school. Student interests were explored and encouraged as teachers and other staff members interacted with the students at meals, in the dorms, and in class. Commenting on which teaching strategies were most effective, a mathematics teacher advised, "Don't get caught up in techniques, get caught up in the student."

Teaching advocacy skills was also a critical component of the educational program. The Dean of Academic Affairs commented that in this school of underdogs, the first year was spent building trust. That trust was developed by the faculty and staff by gaining a thorough understanding of each student's learning differences and interests. To be an effective advocate, each student must understand how those learning differences impact cognition and the faculty worked to help each student develop an awareness of his academic needs. Students were encouraged to make decisions based on their needs such as whether or not they need to tape record a lecture or use a scribe for an exam. The ultimate goal was to develop in the students the skills needed to successfully manage their postsecondary educational experience.

A large stately gray home with white trim nestled in the trees had been transformed into the Learning Center. This was the heart of individualized services for the students who benefit from additional academic support. Relating information to the student's world is an objective of the Learning Center. The Learning Center teachers met with students individually or in small groups to help them develop study skills and compensation strategies. Stressing the purpose behind the lesson, the Learning Center teachers encouraged students to develop their own ideas for projects to give them ownership. A compete set of strategies-based methods was used and each strategy, whether it was test taking, memorization, self-advocacy, or decoding, had a mnemonic. For example, a picture of old lady named Auntie Katie represented the term antiquated. The teachers assisted students with organizational skills through the vigilant use of planners and by helping students maintain some semblance of order in their binders and backpacks. When exams were approaching, they coordinated assigning scribes for students who would benefit from the assistance.

The enthusiasm of the students for the teachers at the center was evidenced when an upperclassman who no

longer required the one-on-one services of the Learning Center dropped by with a cheerful salutation for the teacher, "Hey, how's it going? I just wanted to say hi! I'll let you go now."

Strength Oriented Accommodations

The goal of the Learning Center as the teachers work directly with students was to make learning stimulating, fun, and applicable. A freshman in suit coat and tie, expected attire at the school, walked into the cozy wallpapered room with hardwood floors. Sitting down across the room from the marble mantled fireplace, he told his teacher that he e-mailed her an essay he wrote during study hall. As he read his essay aloud, he noticed an abundance of errors that resulted from his dysgraphia, misspellings and poor grammar; the content, however, was profound. In writing about the respect he had for his English teacher he said, "If he were president he would be the next Caesar, but with one difference, he would not look for power but for respect and knowledge." The teacher laughed about the grammar and spelling and then complimented him on specific phrases that demonstrated his profound thinking abilities. The young man who claimed he did not like to write had already submitted two entries to the student literary magazine.

Upstairs in another room, a sophomore was reading a mystery novel that incorporates vocabulary from the Scholastic Aptitude Test throughout the story. As the student and teacher took turns reading aloud, the teacher asked questions related to synonyms, context, summarizing, and comprehension. "What do you see, what movie is playing in your head?" asked the teacher as she encouraged her student to use his visualization skills.

Listening to the responses of students provided more evidence that many had strengths in spatial and visual thinking. During the discussion of a book, the teacher described a scarab to a student; he nodded and replied, "I *see* what you are saying." As he commented, his eyes looked up toward the ceiling visualizing the scarab. While brainstorming ideas for creating an insect trap in science class, another young man was at a loss for words to describe his thinking. He blurted out in frustration while pointing to his head, "I have the whole picture here in my head!" A social studies teacher talked about being able to see some of the kids processing the information by watching their eyes. During her class, not one of the freshman students in attendance was taking notes despite the fact that they were reviewing for an exam. One student played with the cord from the curtains while another drew elaborate illustrations on his notebook. Despite this seeming lack of attention, every student was engaged in the discussion, focused on the topic, and answering higher order questions. The teacher commented that the students many not be able to list five causes of the Civil War, but they could explain everything that revolved around those causes. As thinkers, these students may not have been able to express themselves quickly or succinctly, but as a science teacher noted, "These are the minds that are getting us places."

The teachers emphasized understanding individual student strengths and developing an awareness of their current level of functioning. "Each student is his own person," was the phrase used by a social studies teacher when she explained her grading procedure. She graded student work based on each student's current skill level. Rather than issuing grades based on an arbitrary standard, she looked for growth in the individual and used that as her benchmark.

Every teacher interviewed commented on the variety of instructional strategies used in their classrooms. There was consensus among all of the participants that no one strategy was sufficient because there were a wide range of learning styles in their student body and that it was essential to teach to each student's area of strength.

Student Centered Learning

A walk down the hill behind the Learning Center house revealed a beige clapboard three-story building that housed the classrooms. A social studies room equipped with two large whiteboards, a LCD projector for computer-generated material, and an overhead projector allowed the teacher to use extensive visual aids and minimize lecture. Variety and choice were key elements used to keep the students involved in the class. While working on a unit on the Middle East, students were given a choice of how they would like to convey their first impressions of the region. During class, a student's PowerPoint presentation with elaborate animation of computer-drawn graphics was shared. Moving on, the class of freshman carried on a student-centered discussion about the history of Israel. Throughout the discussion, the instructor asked higher order questions of the students, asking them to interpret and evaluate what they were discussing. "What would Israel need to be a self-supporting nation?" The question quickly led to a discussion about the need for a country to grow its own food so it would not have to rely on imports and risk depending on someone else who could arbitrarily raise prices. The discussion moved on to the topography of the region and the concern over desertification of the arable land in Israel. As was the practice in this social stud-

ies class where the students guided the discussion, Socratic dialogue was standard practice in many of the classrooms.

As the subject shifted from Israel to the upcoming exam, the atmosphere in the classroom moved from one of scholarly debate to one of anxious anticipation. The test-taking anxiety was apparent as the teacher explained the format of the assessment and the accommodations that were in place. Instructions were given verbally, in writing in color on the whiteboard, as a handout, and as an e-mail message. Students were also given a study guide for the exam that, when completed, could be turned in for extra credit. A review session was scheduled for the evening before the exam. The test included multiple choice, short-answer questions, and an essay. Students were given a hard copy of the essay, and it was e-mailed to each student, as well as to their learning center teacher. On the day before the exam, students were to turn in an idea diagram for the essay, which they could use during the exam. The high-ability level was obvious as these first-year students cleverly attempted to negotiate the elements of the exam with the teacher.

Downstairs in a classroom with a large wooden case containing a python and a fish tank, and a large bulletin board covered with newspaper and magazine articles about research carried out by previous students, experiential learning was exemplified. The Rain Forest Ecology course being held in this room was a premiere example of hands-on learning with real-world applications. It was a unique arrangement because the class was comprised of students from the private high school for students with learning differences *and* students from local public high schools working collaboratively in teams. To take the course during their senior year, interested students went through an application process with selection based on problem-solving capabilities, community awareness, and dedication to the planet's health. The goal of the course was to research alternative career possibilities for cattle farmers in the rainforest of Costa Rica in an effort to slow down tropical deforestation and provide alternatives to slashing and burning rain forests.

The students were busy preparing for their upcoming 2-week trip to the Costa Rican rain forest. As they worked in teams to make their preparations, it was impossible to distinguish the learning-disabled students from the non-learning-disabled students. All students were confident as they prepared to gather field data that would be used by scientists at major universities and research institutes. The teams were identifying foraging routes of specific mammals, researching the pharmaceutical aspects of a species of poisonous ant, banding migratory birds to establish fly routes, and exploring alternatives for cattle ranching through butterfly farming, propagation of orchids, and the use of spider silk as a sustainable resource. This was a class with a purpose. Students excitedly built cages out of wood and screen, ant traps out of Nalgene bottles and Dustbusters, discussed the merits of different kinds of hummingbird feeders, examined a new bat detector that has just arrived, and tried out the backpack for their portable energy source, a car gel battery and converter. The level of knowledge about rain forest flora and fauna far exceeded that of many college students majoring in botany and zoology. Their enthusiasm was contagious and best expressed by a young man with wide eyes who exclaimed, "Scientists are using our research around the world! That is so cool!"

Their contact with professionals in the field reinforced the idea that high school students can make a global difference. It also taught them tact and diplomatic skills as they were encouraged to speak their minds and were taught how to do it thoughtfully. When they arrived in Costa Rica, they would identify habitats and behaviors of their species, select appropriate study plots, inventory the flora and fauna, and make correlations among the different species in the habitats. Their work in the classroom and the field had already led to advances in the scientific world as evidenced by scientists writing up their research on salamanders for publication in journals and the patent they secured for the strongest spider silk known to humankind.

A month after returning from Costa Rica the students held Dissertation Day. Each team of students presented their findings and shared about their experience in the rain forest using descriptors such as: "breathtaking," "unbelievable," "doing really good things," "fascinating," "beautiful," "exciting," and "everyone should go to the rain forest, they will never be the same again." In a converted dining hall with a massive granite fireplace as a backdrop, the teams of students took turns at the podium showing slides and explaining the details of their research. Again, it was impossible to tell which students excelled in public school and which students have come to this private school because of their academic difficulties; all of the students were poised and confident. They talked about having to make split second decisions while tracking and trapping tapir, rice rats, and coati. A group discussed the procedure used to extract spider silk from the *nephila clavipes*, the strongest natural fiber known, and its potential uses: sutures, artificial ligaments and tendons, and bulletproof vests. Listening to these teenagers talk provided insights into what incredible thinking and work high school students can do given opportunities and effective leadership. They were learning with enthusiasm due to the nature of

their curriculum; it had real-world applications and the potential to improve lives.

Discussion

The structure of the classroom activities and the support system at the high school for students with learning differences promotes productivity and a sense of accomplishment in gifted students with spatial strengths and verbal weaknesses. A variety of methods are used to present the course content at a higher academic level and students are encouraged to choose to demonstrate their knowledge of the subject matter in a manner aligned with their preferred mode of learning (Coleman, 2001; Maker & Udall, 1985; Weinfeld et al., 2002). The curriculum focuses on creative and critical thinking skills and teaches problem-solving strategies (Howard, 1994; Maker & Udall; Nielsen et al., 1993; Weinfeld et al.).

Reasonable accommodations are made to allow students to minimize their weaknesses and capitalize on their strength areas. Academic pressure is eased through the use of computers, calculators, tape recorders and audio literature, and digital textbooks (Coleman, 2001; Maker & Udall, 1985; Nielsen et al., 1993; Weinfeld et al., 2002). Mnemonic techniques are utilized to compensate for memory deficits and the use of graphic organizers is encouraged to assist students as they organize their newly acquired information (Howard, 1994; Weinfeld et al.).

The rain forest ecology project is a premiere example of students involved in real-life investigations where they have the opportunity to share their research with an authentic audience. This authentic learning raises the level of challenge in the classroom while minimizing the deficit areas often evident in gifted students with spatial strengths and verbal deficiencies. This environment extends beyond the science classroom because these highly capable students are challenged to become self-advocates, learn academic skills necessary to provide them with a successful college experience, and to become productive members of society.

Implications for Educational Policy

The success in educating students at the high school for students with learning differences has implications for educational policy. The strategies used with a student body comprised of a population of students who were not successful in traditional educational settings are effective in transforming attitudes and achievement as evidenced by the fact that 94% of the students pursue postsecondary educational opportunities. Although difficult to replicate in the public school setting due to the low student/teacher ratio and residential status, there are philosophies and strategies that can be utilized in any setting. In this era of the No Child Left Behind Act, many schools have adopted standardized instruction and assessment. School personnel must be responsive to the diverse academic needs and interests of their students. The present study supports the inclusion of four specific strategies for use with all students and especially for use with learners with spatial strengths and verbal weaknesses.

1. Students should be offered choices. Students should have choices for both the means by which they access information and the methods in which they communicate their findings. The students in this study had a variety of methods to obtain information and the opportunity to choose those methods that worked best for them. Student products were assessed based on the content they contained rather then the venue in which they were developed.

2. Student interests should be explored. Knowledge of individual student's interests, strengths, and weaknesses are essential for the teacher to be able to offer meaningful choices and provide opportunities for students to be successful. Similarly, classroom instruction should focus on student strengths rather than dwell on weaknesses. In an environment where remediation is the principal goal, students are constantly focused on what is perceived as "wrong" with them rather than areas in which they can be successful. While core knowledge and skills are important, the present study illustrates how such information can be more effectively acquired in an environment that looks to student strengths.

3. Opportunities for authentic and experiential learning are necessary for students to find value in the tasks in which they are asked to perform. As the students in this study prepared for their trip to Costa Rica, they encountered a variety of skills and information they needed to acquire to be successful. Their efforts where much more focused and successful than one would expect from students who only a few years before were labeled at risk.

4. Instruction should emphasize conceptual understandings with a whole-to-part approach. Students with spatial strengths process information holistically and benefit from instruction that provides them with the big picture. Once they have a vision of the organizational framework, they are able to evaluate how the individual concepts fit into that picture. A focus on conceptual understandings rather than recall of specific facts allows these students to build their own web of interconnected ideas and to make connections to concepts in a wide variety of disciplines.

Limitations

The scope of this research was limited to an adult perspective of the students who attend a private high school for learning-disabled students in the Northeast. Although some students were receiving financial support from their school districts or scholarships, many of these students are from families in the higher socioeconomic levels who have the resources to pay private school tuition.

The research is dependent on the knowledge of the teachers who were interviewed. Teachers were given a brief description of students with spatial strengths and verbal deficiencies but their interpretation of that information, and whether or not they had any prior exposure to research in this area, undoubtedly influenced their answers to interview questions. Teachers were aware of the purpose of the study and what the researcher was looking for during the classroom observations. This knowledge could have affected teacher performance in the classroom.

Suggestions for Future Research

The teachers interviewed for this study focused not only on instructional strategies, but also on personal skill development. Further research should focus on whether the personal connection and interest of the staff, the specific teaching strategies used in class, or the interaction of the two are factors in student success. This study focused on the perceptions of the teachers. While teacher perceptions are an important factor in the learning environment, obtaining student input would help to clarify the effect of the different classroom practices and personal interventions.

Research is also needed into the effect of allowing students to choose the process through which they gather information and the products that reflect their achievements. Further investigations into the effectiveness of student-centered/interest-based learning programs such as Enrichment Clusters (Renzulli, Gentry, & Reis, 2003) or Academies of Inquiry and Talent Development (Renzulli, 2000) for students with verbal weaknesses and spatial strengths should be considered.

The success of the high school for students with learning differences represented in this study shows that students with high spatial abilities and verbal weaknesses can overcome their difficulties and continue on to postsecondary education and successful careers. Additional research will help us gain the knowledge necessary to help them develop their exceptional abilities prior to the need for the services of a private institution.

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