The Relationship Between Classroom Environment and the Learning Style Preferences of Gifted Middle School Students and the Impact on Levels of Performance

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ABSTRACT

Inconsistent performance by gifted students has been a source of frustration for both parents and educators for decades. Several studies on gifted underachievement point to a connection between student learning styles and classroom performance. This study examined the learning styles of gifted middle school students, student perceptions of the classroom environment, and possible connections between learning style, classroom environment, and achievement levels. Eighty gifted students from grades 6, 7, and 8 were administered the Learning Style Inventory (LSI) to identify student learning style preferences. They were also administered the Student Perception Inventory (SPI), developed for the study, in order to determine perceptions of these learning style elements in their classroom environments. Results indicated that the LSI elements of persistence and lighting correlated with achievement in all content areas. Additionally, correlations between higher grade point averages (GPA) and LSI preferences for responsibility and teacher motivation were found in science and math classes. Results of the SPI revealed a correlation between higher grade point averages in social studies and science classrooms and the following items: persistence; motivation; and auditory, tactile, and kinesthetic modalities. All subject areas showed a correlation between higher GPA and the students' perceived level of persistence.

Academic underachievement is a national problem according to the U.S. Department of Education (1993) report, *National Excellence: A Case for Developing America's Talent*. The report states that 40% of the top 5% of high school graduates will not graduate from college. Not only is underachievement a problem among gifted students, it also appears to be a problem at all ability levels. A report by the Carnegie Corporation of New York (1996) indicates that by the fourth grade, the performance of most American children has dropped below grade level; it has also dropped below the performance level of fourth graders from other countries, many of which are our economic competitors.

PUTTING THE RESEARCH TO USE

This study suggests that gifted middle school students should participate in many hands-on activities dealing with real-world problems. Because they have a high preference for tactile and kinesthetic learning activities, these students are more likely to remain motivated and engaged when they are active participants in the discovery process. Gifted students in this study also expressed preference for an informal seating design, which indicates a need for an environment that is flexible and allows students to change their seating based on the nature of the learning activity. These learning style preferences should be taken into consideration when designing programs for gifted students. This is especially true for gifted learners who are performing below their potential.

This study also suggests that gifted students will achieve at higher levels when taught by informed teachers who are aware of their learning characteristics and needs. Teachers also need to look at their classrooms and determine how to alter the environment so that students will be more inclined to engage in the learning process. Administering a learning style inventory can provide teachers with valuable information so that learning can be maximized. While most gifted students achieve satisfactorily, many of them will not reach their potential unless the curriculum responds to their needs and stimulates their thinking.

Although gifted students have the ability to perform at the top of their class, some gifted children never reach their potential. In fact, it is estimated that 15–40% of identified gifted students are "at risk" of failing or performing far below their potential (Seeley, 1993). This phenomenon has been a source of frustration for both parents and teachers for many years. Responding to a needs assessment by the National Research Center on the Gifted and Talented, practitioners pinpointed underachievement as a major problem that should be researched (Renzulli, Reid, & Gubbins, 1992). A review of the literature on underachievement by these potentially capable students reveals little success in reversing this unproductive behavior. Thus, despite the interest in this problem, reversal of underachievement by gifted students continues to be unresolved.

Defining underachievement is sometimes as difficult as determining its causes because no one definition has been universally accepted. Some experts refer to underachievement as a discrepancy between predicted potential, as judged by a standardized aptitude test, and actual achievement (Colangelo, Kerr, Christensen, & Maxey, 1993). However, most experts accept the definition as a discrepancy between potential or ability and actual performance in school (Baum, Renzulli, & Hébert, 1995; Emerick, 1992; Whitmore, 1980).

What causes bright students to perform below their potential? The answer to that question is as varied as the definitions for underachievement. During the past 25 years, researchers have uncovered a variety of hypotheses explaining why gifted students do not live up to their potential. Baker, Bridger, and Evans (1998) suggest that the family, the school, and the personal traits of the child all contribute to the problem. Diaz (1998) notes that an elementary school curriculum that is dull and unchallenging does not encourage bright students to develop necessary skills that will be needed later in middle and high school. Other researchers hypothesize that underachievement is the result of a mismatch between a child's learning style and needs and the school environment (Redding, 1990; Whitmore, 1986).

According to Hoekman, McCormick, and Gross (1999), gifted children's need for learning includes their desire to discover opportunities to use their special talents and skills. These researchers note that optimal learning requires optimal challenge. Without appropriately stimulating environments, gifted students become frustrated, bored and unmotivated. It takes challenging and engaging curriculum to motivate bright students (Kaplan, 1990). Without motivation, students may exhibit mild to severe underachievement (Davis & Rimm, 1998). Whitmore (1980) notes that some gifted students may even have a relatively high grade point average when compared to their age peers, while underachieving in one or two content areas.

A key to the problem of underachievement may involve students' individual learning style preferences. One's learning style has been defined as the way an individual processes, interacts with, and retains new or difficult information (Dunn & Dunn, 1993). The combination of various environmental factors (e.g., noise, light, temperature, seating design, etc.) may have a detrimental impact on the learning of some students, while not having any influence on other students. Studies that have identified students' learning style preferences have shown that students tend to show gains in achievement test scores when the identified learning styles are accommodated, while students whose learning characteristics are mismatched with their learning environment tend to do poorly (Andrews, 1990; Dunn, Griggs, Olson, Gorman, & Beasley, 1995; Klavas, 1994). These studies generally recorded student classroom performance and/or achievement test scores prior to accommodation of learning styles and then compared performance and/or test scores after implementation of the specific accommodations.

Purpose of the Study

The purpose of the present study was to investigate the degree of compatibility between gifted students' learning styles and their classroom environments, based on student perception, and to determine how the degree of compatibility impacts classroom performance. The research questions explored in this study were as follows:

1. What are the learning style preferences of gifted middle school learners?
2. What is the relationship between students' learning style preferences and levels of academic achievement?
3. What is the relationship between students' perceptions of their classroom environment and their academic achievement?
4. To what degree are students' learning style preferences compatible with their perceptions of their classroom environments?
5. What is the relationship between students' compatibility within the classroom and their level of achievement?

Methods

Participants

The participants for this study included 80 gifted students from two middle schools in a school district in southwest Georgia. The sample consisted of 26 sixth graders, 34 seventh graders, and 20 eighth graders. Male participants slightly outnumbered females, 42 to 38. All of the participants were identified as gifted using criteria established by law in the state, which involves standardized, nationally normed test scores and performance data drawn from the categories of mental ability, achievement, creativity, and motivation.

Placement in a gifted program in Georgia provides two options or methods of identification. Option 1 requires that students in kindergarten through second grade have a mental ability at the 99th percentile and an achievement test score at the 90th percentile in total reading, or total math, or complete composite. Students in grades 3–12 must have a mental ability at the 96th percentile and an achievement test score at the 90th percentile in total reading, total math, or complete composite. While state law allows evaluation of a product or performance in the achievement category, the county in which the research was conducted utilizes only achievement test scores for this category. Students identified in this research were administered the Iowa Test of Basic Skills for the achievement category and the seventh edition of the Otis-Lennon School Ability Test for the mental ability category.

Students not meeting Option 1 can be evaluated based on Option 2. This option mandates that students in kindergarten through 12th grade meet requirements in three out of four categories. Additionally, the law states that at least one of the categories must include a nationally normed, standardized test score. Category 1 is mental ability, which requires a minimum score at the 96th percentile on a nationally normed, standardized mental ability test. Category 2, achievement, requires a minimum score at the 90th percentile on a nationally normed, standardized test in total reading, total math, or the complete composite; a minimum score at the 90th percentile on a standardized achievement rating scale; or a minimum of 90 out of 100 points on a product or performance. Creativity, the third category, requires a minimum score at the 90th percentile on a nationally normed, standardized creativity test, a minimum score at the 90th percentile on a creativity rating scale, or a minimum score of 90 out of 100 points on an evaluation of a product or performance. The county in which the research was conducted utilizes only the Torrance Tests of Creative Thinking in this category. The final category, motivation, provides for a minimum grade point average (GPA) of 3.5 on a 4.0 scale during the previous 2 years, a minimum score at the 90th percentile on a motivational rating scale, or 90 out of 100 points on an evaluation of a product or performance. School districts in the state are allowed to raise the GPA requirement. The county where the research was conducted evaluates students for entry into the gifted program based on a GPA of 3.75, which is equivalent to a numerical average of 88.

The gifted middle school students in this study were enrolled in three gifted academic classes daily. For the majority of the students, the gifted classes were in the content areas of reading, social studies, and math or science. For their nongifted academic classes, the students were mixed in with high-achieving, regular education students. The teachers in the gifted classes were trained in identifying characteristics and needs of gifted students, as well as their curricular needs and appropriate instructional strategies.

While most of the participants performed at expected levels, 16 students were at risk of being placed on probation and removed from the gifted program due to low academic performance. Gifted programs in the state of Georgia must have a school district policy stating academic requirements for students to continue being served. During this study, the continuation policy of this southwest Georgia school district required that students maintain a numerical grade point average (GPA) of 80, which is a 3.0 on a 4.0 scale. Students who were in danger of being removed from the program were of particular interest in this study. Of the 16 students at risk for being removed from the program, 12 students were identified as gifted based on mental ability test scores above the 96th percentile and achievement test scores above the 90th percentile. The remaining four students were identified through the multiple criteria option qualifying in achievement, creativity, and motivation. However, all four students had mental ability test scores ranging from the 90th percentile to the 95th percentile. It should be noted that students who are qualified for gifted services are not evaluated further to determine strengths and weaknesses in specific academic areas. Therefore, the at-risk students may not be gifted in all content areas.

While the struggling students performed lower than expected in most content areas, their achievement in at least one classroom was satisfactory. Achievement for all participants was examined separately in each content

area, which included gifted classes and regular education classes.

Measures

The Learning Style Inventory. Three categories of data were analyzed for each participant. The first category of data involved learning style preferences of the students. The Learning Style Inventory (LSI; Dunn, Dunn, & Price, 2000) was administered to participants to determine their specific preferences in four areas. The LSI indicates student preferences in the areas of environment (sound, temperature, light, and seating design); emotionality (motivation, responsibility, persistence, and the need for either structure or flexibility); sociological needs (learning alone or with peers and/or in several ways, need for presence of authority figures, parent motivation, and teacher motivation); and physical needs (auditory learning, visual learning, tactile learning, kinesthetic learning, evening or morning, late morning, afternoon, intake of food or drink, and mobility).

The Dunn Model of learning style preferences has evolved over the years since its initial development in 1972. The 2000 version used in this study contains 104 statements with Likert-type responses of *Strongly Disagree*, *Disagree*, *Uncertain*, *Agree*, and *Strongly Agree*. One form of the LSI was developed for grades 3 and 4 and another for grades 5–12. The latter form was used in this study. Once a student has completed the inventory, *T* scores are reported to indicate the strength of the preference in each of 22 elements. As noted by the LSI developers, students usually have six to eight preferences that are significant in their ability to learn new or difficult information (Price & Dunn, 1997).

Scoring for the LSI preferences ranges from 20 to 80, with 50 established as the mean and 10 as the standard deviation. A score between 20 and 40 or between 60 and 80 indicates a definite preference. For example, in the category of lighting, a student scoring between 20 and 40 would indicate a strong need for dim lighting, but a student scoring between 60 and 80 would indicate a strong preference for bright lighting. A score between 40 and 60 indicates that the element may not be particularly important to the individual's learning process, but will vary depending on the student's interest in what is being learned and the difficulty level of the activity (Price & Dunn, 1997).

Past research (Price & Dunn, 1997) has indicated that 95% (21 of 22 preferences) of the reliabilities are equal to or greater than .66 for the LSI in grades 5–12. The LSI factor that had the lowest reliability (.56) is late morning preference.

The Student Perception Inventory. The second category of data collection required development of the Student Perception Inventory (SPI) in order to determine student perceptions of their learning environment. Initial development of this instrument began with an examination of the LSI preferences. Whereas LSI statements require students to indicate their preferences, the SPI was designed to obtain information from students to determine how they perceived various learning style factors in the classroom. A panel of education experts from the areas of curriculum, psychology and counseling, middle grades education, research, and gifted education established the content-related validity for the SPI. These experts determined the SPI should follow the same format as the LSI, with each statement followed by the same five Likert-type responses.

The SPI required students to respond to statements that revealed how they perceived classroom factors that correspond to 15 of the 22 LSI preferences. The SPI factors included noise level, lighting, temperature, seating design, motivation, persistence, structure of assignments, learning alone or with peers, presence of authority figures, auditory learning, visual learning, tactile learning, kinesthetic learning, mobility, and teacher motivation. Seven LSI elements not incorporated into the SPI were learning during various times of the day (morning vs. evening and afternoon), eating and drinking while learning, parent motivation, responsibility (nonconformity), and variety in learning. Because students do not have a choice in the time of day they are assigned to a particular class or the option of eating or drinking in the classroom, these areas were not applicable to determine student perceptions of their classroom environment. References to parents were also omitted from the SPI as parents are not present in the classroom. Because responsibility relates to conformity in the classroom, this element was omitted, as it is not a classroom condition. Learning in a variety of ways was also omitted because questions were already included that revealed different ways of learning. See the Appendix for a detailed description of the LSI preferences used in this study.

Students responded to SPI statements with one of the following choices: *Strongly Disagree*, *Disagree*, *Uncertain*, *Agree*, or *Strongly Agree*. An example of one of the SPI statements for the perception of mobility was, "When I am in my ____ class, I usually stay in my seat." The student's response to this statement helped to identify how the student perceived the ability to move around the room in a particular classroom. Another example

included on the SPI that indicated a student's perception of the seating design was, "When I am in my ____ class, my teacher requires me to sit in my desk or at a table."

The SPI contains two statements related to each of the 15 LSI preference elements, resulting in 30 statements. A raw score of one to five was assigned to each response. Combining the raw scores on the two SPI statements produced a possible raw score range of 2 to 10 for each SPI element. The SPI scoring followed the LSI convention of combining scores on statements relating to the same learning styles, which was based on the content of the statement. As previously mentioned, the SPI raw scores were converted to *T* scores, just as the LSI raw scores, for consistency between the two instruments and to conduct statistical analyses. A complete description of the SPI instrument and the scoring may be found in Rayneri and Gerber (2004).

Prior to the field research, the SPI was pilot-tested with 45 nongifted middle school students to assess validity and to determine reliability by conducting a split-half analysis. After the SPI was administered to the pilot group, the 30 statements were divided into two comparable halves because there are two statements for each of the 15 LSI elements. All of the raw scores were entered into SPSS version 9.0 and a correlation was performed on each pair of elements. The Pearson correlation coefficients ranged from .662 to .868 at the .01 significance level, thereby establishing internal consistency reliability. The Spearman-Brown correction was also calculated for each of the 15 correlation coefficients; this produced coefficients that ranged from .796 to .929.

Classroom Performance. The third and final category of data analyzed for each participant included students' classroom performance for each of the five academic content areas of reading, language arts, social studies, science, and math. For example, for each student, five numerical grades were obtained for the previous five grading periods in each content area. These five numerical grades for each specific content area were then averaged, producing the student's numerical average for that subject. These five subject averages were then averaged to produce the student's numerical GPA. While students might be performing at expected levels in some content areas, their performance might also be unsatisfactory in one or more classes. Using information on participants' preferences (LSI) and perceptions (SPI), the researcher hoped to find possible explanations for students' low performance.

Procedure

During the winter of the 2000–2001 school year, letters were sent to parents of gifted middle school students seeking permission to involve their children in the research study. From the 88 parents of gifted middle school students receiving letters, 80 consent forms were returned in this southwest Georgia school district. Of the 80 participants, 16 gifted students were in danger of being placed on probation due to low grades in their academic classes. Failure to maintain an overall 80 numerical GPA after a probationary period results in removal from the gifted program.

The LSI was administered to the participants in March 2001. The results, tabulated by the manufacturer of the LSI, Price Systems, consisted of *T* scores for each of the 22 preferences. Over the next 4 weeks, students were administered five SPI instruments, one for each of their academic classes: reading, language arts, social studies, science, and math. Prior to statistical analysis, student SPI raw scores were converted to *T* scores. *T* scores for the SPI data analysis were used in order to be consistent with the *T* scores found in the LSI.

To determine compatibility of the students' learning preferences and their perceptions, a compatibility index was calculated for each learning style element. This was determined by subtracting SPI *T* scores from LSI *T* scores for each of the learning style elements. A small difference or low compatibility index score would mean that there was a relatively high level of compatibility.

As previously noted, students' classroom performance in each content area provided a numerical average in five subject areas for each student. All *T* scores from the LSI and the SPI, as well as five content area numerical averages for each student, were entered into SPSS.

Results

LSI Descriptive Statistics

A descriptive statistical analysis was conducted on the *T* scores for the LSI. Means and standard deviations are found in Table 1. As noted previously, *T* scores between 20 and 40 and between 60 and 80 indicate preferences that are important to learning new or difficult material. Scores falling between 40 and 60 indicate that the learning may vary in importance based on the student's interest in what is being learned and the difficulty level of the activity. Table 1 reveals mean *T* scores showing the greatest difference from the established mean of 50 with

Table 1

Descriptive Statistics for the LSI (N=80)

LSI elements	Range	*M*	*SD*
Noise level	31–74	50.39	11.26
Light	9–66	44.69	11.06
Temperature	20–71	49.60	12.80
Seating Design	33–73	44.40	8.65
Motivation	20–69	50.06	10.66
Persistence	20–65	48.74	10.23
Responsibility	24–72	52.28	11.57
Structure	31–73	51.40	9.85
Learning alone or with peers	27–77	51.21	12.55
Authority figures present	25–74	47.68	10.70
Learning in several ways	20–69	49.78	11.86
Parent motivated	22–62	53.25	8.64
Teacher motivated	25–68	51.59	9.22
Auditory learning	20–69	48.18	11.77
Visual learning	26–71	50.30	11.01
Tactile learning	34–69	57.98	8.94
Kinesthetic learning	26–75	56.45	9.41
Mobility	22–65	52.56	11.83
Intake of food or drinks	25–66	55.49	8.16
Evening versus morning	29–70	46.25	11.16
Late morning	29–73	46.14	9.80
Afternoon	21–76	54.91	11.27

a preference for tactile learning (57.98) and informal seating design (44.40).

LSI Frequencies

A frequency analysis was performed to determine the learning style preferences of the gifted middle school learners (see Table 2). It indicated that many of the participants had a preference or a tendency toward dim lighting, an informal seating design, responsibility (conformity), tactile and kinesthetic modalities, mobility, eating and or drinking while learning, and evening and/or afternoon learning times.

Thirty-five percent of the gifted participants indicated a preference for dim lighting with scores below 40, while more than 71% of them scored below the mean (50). A total of 85% of these students scored below the mean on the seating design element, indicating a preference for informal seating arrangements in the classroom. Thirty-five percent of the students scored between 20 and 40, indicating a high preference for informal seating. For these two LSI elements, the lower the *T* score, the greater the preferences for dim lighting and informal seating. The opposite was true for tactile and kinesthetic modalities and for mobility, because the higher the *T* score, the stronger the preference for these elements. Frequency scores indicated that tactile learning was preferred by participants with nearly 44% scoring above 60 and almost 84% of them scoring above the mean. Often coupled with tactile learning, the kinesthetic modality was also highly preferred by 35% of the students, with more than 71% scoring above the mean. As might be predicted for students preferring kinesthetic activities, the need for mobility in the classroom was also highly desired by 37.5% of the students, with 70% of the participants scoring above the mean.

Time of day was another important feature of learning for the participants. Students scoring below the mean on

Table 2

Student Preference Percentages for the LSI Elements (N=80)

LSI elements	% of *T* scores 20 to 40	% of *T* scores 41 to 50	% of *T* scores 51 to 59	% of *T* scores 60 to 80
Noise level	Prefers quiet–28.8	23.7	22.5	Prefers sound–25
Light	Prefers dim–35	36.3	17.7	Prefers bright–11
Temperature	Prefers cool–25	16.3	33.7	Prefers warm–25
Seating design	Prefers informal–35	50	9	Prefers formal–6
Motivation	Low–15	30	36	High–19
Persistence	Low–19	43.5	22.5	High–15
Responsibility	Low–16.3	22.5	22.5	High–38.7
Structure	Does not like–17.5	33.7	26.3	Wants–22.5
Learning alone/Peers	Prefers alone–26.3	22.5	18.7	Prefers with peers–32.5
Authority figures present	Does not want present–22.5	38.75	25	Wants present–13.75
Learning in several ways	Does not learn in–21.25	21.25	35	Prefers variety–22.5
Auditory learning	Does not prefer–28.75	23.75	31.25	Prefers–16.25
Visual learning	Does not prefer–16.25	37.5	20	Prefers–26.25
Tactile learning	Does not prefer–6.25	10	40	Prefers–43.75
Kinesthetic learning	Does not prefer–5	23.75	36.25	Prefers–35
Food/Drink	Does not prefer–5	13.75	46.25	Prefers–35
Evening/Morning	Prefers evening–35	26.25	25	Prefers morning–13.75
Late morning	Does not prefer–31.25	42.5	12.5	Prefers–13.75
Afternoon	Does not prefer–11.25	22.5	31.25	Prefers–35
Mobility	Does not prefer–15	15	32.5	Prefers–37.5
Parent motivated	Low–10	30	32.5	High–27.5
Teacher motivated	Low–11.25	31.25	38.75	High–18.75

this element prefer to learn in the evening, while *T* scores above the mean indicate preference for morning learning. Evening was highly preferred by 35% of the students with more than 61% scoring below the mean. Learning in the afternoon was revealed to be a high preference by 35% of the participants with 66% of the students scoring above the mean. Conversely, 31% of the students indicated a strong dislike for learning in late morning with more than 73% of them scoring below the mean, indicating a strong dislike for learning at that time of day.

The desire to eat and/or drink while learning was also strongly preferred by 35% of the participants, and 81% of the students scored above the mean. In the area of responsibility, or conforming to teachers' directions, some participants revealed a high preference with 39% scoring above 60 and a total of 61% scoring above the mean.

LSI and Student Grades

A correlation of the LSI elements and students' grades in each content area indicated some significant correlations between student learning style preferences and academic achievement (see Table 3). Grades in all content areas (reading, language arts, social studies, science, and math) showed positive correlation with persistence and light. Math grades revealed the greatest number of significant positive correlations with LSI elements including responsibility and teacher motivation, in addition to persistence and light. Science grades showed positive correlations for persistence, light, and teacher motiva-

Table 3

Correlations Between Students' Grades and LSI

LSI elements	Social studies grades	Language arts grades	Math grades	Science grades	Reading grades
Noise level	.051	-.080	-.126	-.086	.021
Light	.301**	.299*	.245*	.300**	.338**
Temperature	-.180	-.169	.029	.020	-.070
Seating design	-.028	-.014	.035	.039	-.089
Motivation	.077	.047	.176	.117	-.009
Persistence	.313**	.465**	.232*	.406**	.422**
Responsibility	.251*	.169	.205	.081	.213
Structure	.099	-.110	-.073	-.063	-.137
Learning alone/Peers	.020	.054	.025	.068	.008
Authority figures present	.118	.040	.175	.114	.074
Learning in several ways	-.093	.044	.050	.076	-.051
Auditory learning	.026	-.054	.040	.017	-.051
Visual learning	-.035	-.060	-.134	-.142	-.109
Tactile learning	.009	-.145	-.063	-.173	-.059
Kinesthetic learning	.048	-.086	.039	-.117	-.091
Food/Drink	-.149	-.131	-.171	-.094	-.121
Evening/Morning	-.002	-.068	-.001	-.049	.052
Late morning	-.023	.019	.035	-.112	.057
Afternoon	.086	.087	.141	.184	-.037
Mobility	.021	.010	.031	.074	-.056
Parent motivated	.126	.176	.082	.137	.130
Teacher motivated	.241*	.134	.280*	.188	.080

* *Correlation is significant at the 0.05 level (two-tailed).*
** *Correlation is significant at the 0.01 level (two-tailed).*

tion. Social studies, language arts, and math grades correlated significantly with light and persistence. No other significant correlations existed between LSI elements and students' academic averages.

SPI and Student Grades

Correlation of the SPI and students' GPA revealed some relationships significant at the .05 level and the .01 level. Table 4 displays significant relationships between students' GPA in each content area and student perceptions of their classroom environment. The greatest number of significant correlations existed within the social studies classrooms. In that content area, positive correlations were found between students' averages and their perceptions in the classroom for motivation; persistence; auditory, tactile, and kinesthetic learning; and teacher motivation. There were negative correlations between students' grade averages in social studies and reading classes and students' perception of the seating design.

Science averages showed the next highest number of significant correlations with students' perceptions of their environment in six areas. These positive correlations were for motivation, persistence, learning with peers, and auditory, tactile, and kinesthetic learning. In the reading classrooms, students' averages correlated with their perceptions of an informal seating design, persistence, tactile learning, and teacher motivation. When math averages were correlated with the SPI, the results indicated that students' achievement had a positive relationship with perceptions

Table 4

Correlations Between Students' Grades and the SPI

SPI elements	Social studies grades	Language arts grades	Math grades	Science grades	Reading grades
Noise	-.055	.019	.133	.120	.079
Light	-.008	-.059	.099	-.126	.026
Temperature	.138	-.027	-.017	.109	-.010
Design	-.249*	-.020	-.133	-.168	-.343**
Motivation	.408**	.175	.228*	.266*	.214
Persistence	.408**	.324**	.230*	.245*	.260*
Structure	.184	-.043	-.022	.006	-.099
Learning with peers	.088	.202	.014	.246*	.120
Authority figures	.212	.068	.104	.092	.026
Auditory learning	.336**	-.078	.181	.324**	.172
Visual learning	.205	-.083	.116	-.014	.051
Tactile learning	.234*	.042	.185	.243*	.276*
Kinesthetic learning	.313**	-.128	.215	.282*	-.150
Mobility	.101	-.026	.149	.110	.118
Teacher motivation	.302**	.218	.193	.141	.266*

* *Correlation is significant at the 0.05 level.*
** *Correlation is significant at the 0.01 level.*

of motivation and persistence. Language arts averages showed only one correlation with students' perceptions, evidenced by a positive correlation for persistence.

Degree of Compatibility

The LSI *T* scores and SPI *T* scores were correlated to determine the degree to which student learning style preferences were compatible with their perceptions of their classroom environments. This analysis established the degree of compatibility for each element of student learning styles and perceptions. The greatest degree of compatibility between preferences and perceptions was for persistence in all content area classrooms (see Table 5).

Student perceptions of their ability to move about the classroom had the highest correlation with their preference for mobility in math classes. Other positive correlations for mobility preference and perception were found in social studies, language arts, and science classes. The degree of compatibility between the LSI motivation element and student perceptions of motivation in the classrooms was found to be greatest in reading classes, followed by language arts and math classes. The students' LSI preference for teacher motivation correlated with their perceptions of teacher motivation in both science and math classes, with science showing a stronger relationship. Math classes revealed significant correlations between student perception in the classroom and the preference for learning with peers, as well as student perception and the preference for kinesthetic learning.

Many students' LSI *T* scores showed they did not prefer authority figures present in the classroom, whereas their SPI scores revealed they perceived authority figures to be present. When this element was correlated, their preference and their perception revealed a negative correlation in the social studies classes. No other significant correlations for this element were found in any of the other classes.

Compatibility Index

The compatibility index indicates the degree to which the students' perception of specific classroom elements (SPI) coincided with the students' learning preferences (LSI) for the same elements. The index score created by subtracting the SPI *T* scores from the LSI *T* scores is indicative of the discrepancy between the two.

A correlation between the compatibility index and students' achievement revealed the impact of classroom

Table 5

Degree of Compatibility Between the LSI and the SPI

LSI/SPI compatibility	Social studies class	Language arts class	Math class	Science class	Reading class
Noise	.160	.035	.170	.171	.119
Light	.093	.093	-.049	.048	.099
Temperature	-.037	-.028	-.123	-.100	-.131
Design	.120	.046	.099	-.097	-.068
Motivation	.263*	.352**	.245*	.190	.075
Persistence	.554**	.510**	.270*	.554**	.390**
Structure	.165	.090	.114	.196	.049
Learning with peers	.180	.159	.461**	.186	.196
Authority figures	-.166	-.112	.049	.097	-.279*
Auditory learning	.047	-.190	-.069	-.163	-.163
Visual learning	-.066	.043	.038	-.014	.095
Tactile learning	.213	.106	.202	-.089	-.072
Kinesthetic learning	.008	.004	.247*	.159	-.141
Mobility	.243*	.123	.397**	.231*	.257*
Teacher motivation	.118	.150	.348**	.283*	-.042

* *Correlation is significant at the 0.05 level.*
** *Correlation is significant at the 0.01 level.*

compatibility on students' averages in some areas. All significant correlations were negative, which revealed that as averages increased, the compatibility index decreased. As noted earlier, the compatibility index (CI) is the difference between the SPI *T* scores and the LSI *T* scores; therefore a low CI would mean students' preferences and perceptions were similar. This calculated index, or difference, negatively correlated with student averages in reading, social studies, and math. In social studies classes, the analysis revealed significant negative correlations between averages and the compatibility indexes for learning alone or with peers, tactile and kinesthetic learning, and teacher motivation. Students' reading grades showed significant negative correlations with compatibility indexes in seating design, the presence of authority figures, and tactile learning. One negative correlation was found between math averages and the compatibility index for structure of assignments. The impact of classroom compatibility on students' averages might be considered minimal because only 8 significant correlations were found out of a possible 75 (see Table 6). However, the fact that 57 (out of 75) negative coefficients were found would indicate that compatibility has some impact on averages, because as grades increased, compatibility index *T* scores decreased, showing that students' preferences and perceptions were similar.

It should be noted that even though a number of correlations reached statistical significance at the .01 and the .05 level, the relative effect sizes (measured by r^2) were relatively small. Correlations ranged from .240 to .371 and accounted for 6% and 14% of the variance, respectively. Additional research needs to be conducted to identify other variables that account for more variability.

Discussion

This study examined the learning styles of gifted middle school students and student perceptions of their classroom environments. A major issue explored was the compatibility between gifted students' learning style preferences and their classroom environments, based on the students' perceptions. Various connections were investigated to further determine if compatibility had an impact on classroom academic averages.

As noted in the results, the gifted students in this study tended toward learning styles that included preferences for dim lighting, informal seating designs, responsibility, tactile and kinesthetic learning, mobility, eating and/or drinking while learning, and learning during the evening and/or afternoon. Students, based on their responses on the LSI, also revealed they judged themselves to have

Table 6

Correlations Between the Compatibility Index and Students' Grades

Compatibility index for:	Social studies grades	Language arts grades	Math grades	Science grades	Reading grades
Design	-.118	-.084	-.055	-.217	-.245*
Motivation	-.131	-.043	-.040	-.195	.014
Persistence	-.042	.211	-.180	-.147	-.139
Structure	-.035	-.038	-.310**	.191	-.085
Alone/Peers	-.371**	-.182	-.150	.002	-.142
Authority fig. present	-.078	-.194	-.058	-.117	-.240*
Auditory learning	-.105	-.089	.060	-.034	.001
Visual learning	.172	-.038	.107	-.171	.071
Tactile learning	-.331**	-.144	-.130	-.151	-.275*
Kinesthetic learning	-.231*	-.031	-.002	-.049	-.075
Mobility	-.098	.025	-.145	-.095	-.023
Teacher motivation	-.257*	-.025	-.070	-.177	-.201

* *Correlation is significant at the 0.05 level.*
** *Correlation is significant at the 0.01 level.*

low preferences for motivation, persistence, and teacher motivation.

Examination of the results points to participants having global/right brain tendencies that are exhibited through a cluster of learning styles that include tolerance for sound, dim lighting, informal seating, learning with peers, tactile stimulation, and lack of motivation and persistence (Dunn, Cavanaugh, Eberle, & Zenhausern, 1982). Indeed, the majority of participants seemed to prefer six out of seven of these elements. Many gifted students are considered global/right brain enhanced processors because of their superior abilities in dealing with novelty, visual-spatial construction, deductive reasoning, and simultaneous processing (O'Boyle & Benbow, 1990). What is interesting is that most underachieving students are also considered to be global learners. The difference, however, between gifted students who achieve in the school setting and those who do not seems to be directly related to persistence to stick with and complete assignments.

Persistence, as defined by the LSI, refers to one's commitment to complete tasks or assignments. Statements on the LSI relating to persistence asked students to agree or disagree with phrases like, "I often have trouble finishing things I should do" or "I often want to start something new rather than finish what I've started." Students who agreed with these statements showed a lack of motivation to persist with assignments. This tendency, however, is not surprising because some gifted students prefer to focus on the process rather than the product, to be spontaneous and flexible, and to avoid closure (VanTassel-Baska, 1998). Unfortunately for the student with these tendencies, success in the classroom is largely based on completion of a product or assignment and not just engaging in the process. These students who resist closure may perform better with short-term, limited assignments with frequent logs to monitor progress.

One possible reason why student LSI scores did not indicate a preference for persistent learning styles is that many of these self-critical students possess the gifted characteristic of perfectionism and hold themselves up to excessively high standards (VanTassel-Baska, 1998). However, Tables 3 and 4 show that there was a significant connection between students' academic averages and a persistent learning style, indicating that greater persistence was related to greater achievement. The participants did not see themselves as persistent in a general sense, but they did perceive persistence within specific classes. It was not surprising that low persistence was associated with lower achievement in this study. Gifted students who underachieve often advanced through elementary school without ever being forced to develop appropriate effort levels and study skills needed for challenging curriculum (Hoekman et al., 1999). Unfortunately, underachievement can accelerate during middle school with students suspecting they are no longer gifted. This lack

of confidence often translates into even lower effort levels and soon the student is removed from gifted academic classes.

When examining the results of the LSI, it was not an unusual finding that most of these gifted middle school students preferred an informal seating arrangement. This outcome was expected after years of observing this age group and working with gifted students. This preference fits with a more flexible environment, which is a hallmark of gifted education. Mobility in the classroom is another aspect of a flexible environment that was preferred by the participants and also perceived by them to be part of their experience in most content area classrooms.

Students in this research study preferred learning new and difficult content through tactile activities. Experience with gifted students also supports this finding. Curriculum for the gifted should include many hands-on opportunities with "real-life" problems so that students have the opportunity to function much like professionals. The participants also preferred kinesthetic modalities, which means taking students out of the classroom on field trips and providing "active" workshops or opportunities to work with mentors. Through working with gifted students, it has become apparent that these learners need both mental and physical stimulation in order to maximize their learning.

The results of the LSI did not reveal any significant preference for or against auditory learning; however, a positive correlation between students' perceptions (SPI) of the use of discussions in their social studies and science classes and achievement was obtained. Almost 68% of the students had gifted trained teachers for social studies and 40% of them had a gifted trained science teacher. Past experience in these particular classes shows them to be student-centered and employing high-level questioning techniques that partially explain the relationship between high averages and the perceptions of auditory learning in the classroom.

An unexpected finding of this study was that these gifted students did not have a preference for learning alone as has been reported in some research studies (Griggs & Price, 1980; Ricca, 1984). Often when gifted students are faced with working in a mixed ability group of agemates, they tend to express a desire to work alone. Unfortunately, a review of literature did not indicate if "peers" referred to age peers or intellectual peers. The students in this study received most of their academic instruction in self-contained gifted classes, which could have slanted their responses on the LSI statements in favor of working in a group, because "group" meant working with their intellectual peers.

Time of day for studying was found to be an important learning style preference for some participants. However, it did not seem to have any relationship with students' academic performances or their perceptions in the classroom. It appears that the gifted participants in this study are much like regular students, with the majority of their age group experiencing their strongest energy levels after 10:00 a.m. (Dunn & Dunn, 1993). It would be interesting to see whether achievement test scores might increase if students were tested according to their time preference as some research has suggested (Andrews, 1990; Dunn et al., 1995; Klavas, 1994).

Students in this study did not reveal a learning style preference for teacher motivation or for having an authority figure present. However, it is obvious that teacher motivation had an impact on grades when examining Tables 3, 4, and 6. It is significant that in the classes where teacher motivation correlated with high averages, the majority of the students had teachers who were trained in gifted education. While gifted students are often internally motivated, the results of this study suggest that these achieving gifted students were still motivated by their teachers. It is even more important for underachieving gifted students to have teachers who know how to motivate them because these learners are more often externally motivated. Emerick (1992) investigated important factors in reversing underachievement and found that "it was the actions of and respect for a particular teacher that had the greatest positive impact" (p. 144) on students.

Conclusions

This study has demonstrated that learning style plays a role in classroom performance and the way gifted middle school students respond to their classroom environments. However, generalizations to other populations of gifted students should not be made due to the small number of participants in this study and the relatively low, though significant, correlations. Also, having the students in this investigation in two different schools was a limitation that could not be factored. While students' strengths and preferences in specific content could also impact their performance, these above-average learners are expected to achieve at levels beyond their average classmates. Further research into learning style preferences, perceptions of the classroom environment, and the relationship to achievement levels is still needed.

Determining students' overall learning styles through instruments like the LSI tells only part of the story. To

fully understand the dynamics between environment and learning style, student perceptions must also be taken into consideration. It is not surprising that compatibility with the classroom is an important factor in student achievement. Student compatibility or comfort level in the classroom shapes their attitudes toward learning and therefore influences students' performance.

An interesting finding of this study was that high performance most often correlated with learning style factors in the classes where gifted students had gifted trained teachers in self-contained settings. This study demonstrated that knowledgeable teachers make a difference for gifted students by providing an appropriately stimulating and flexible learning environment that meets their needs.

One of the most interesting results of this study was that gifted middle school students did not perceive many classroom factors to be highly compatible with their learning style preferences. However, in spite of many perceived incompatibilities, the majority of these gifted students' maintained high performance. The environment they operated within did not seem to matter as much as their personal will to consistently achieve and complete assignments, regardless of the level of challenge. On the other hand, an incompatible environment for the low achievers along with low persistence may have resulted in a negative impact on their level of achievement. The low-performing students in this study did not develop a preference for persistence (task commitment) when faced with assignments and projects—the one learning style element that could have made the greatest impact on their performance. Unfortunately, persistence is a quality that some students may never acquire without special assistance and appropriate learning environments.

While we can speculate that certain learning style preferences are more prevalent among underachieving gifted students, we must continue to "explore the relationship between classroom practices and academic underachievement" (Reis & McCoach, 2000, p. 166). If the environment we are providing results in underachievement, then we must put more effort into researching what kind of environments will stimulate students' interests and learning needs. Further research should also focus on how to cultivate and nurture task completion in students during the elementary years when crucial learning patterns and effort levels are established.

Through observation of low-achieving students in the past, patterns of underachievement are not likely to be broken at the secondary school level unless environments and instruction are compatible with students' needs. Additionally, students must also be able to identify with and be influenced by positive role models. Teachers can serve as powerful role models and mentors. Until teachers understand the needs and learning styles of gifted children and make efforts to appropriately differentiate the curriculum, underachievement and unfulfilled potential will continue to be a problem in classrooms across America.

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Appendix

The LSI surveys an individual's preferences in each of 22 different elements. Fifteen of the LSI preferences used in this study are detailed below as stated in the LSI manual (Dunn, Dunn, & Price, 1997, pp. 5–7).

Noise Level. Quiet or Sound. Some people need quiet when they are learning, while others notice neither noise or movement once they begin to concentrate; they can "block out" sound. Some people need sound; they invariably turn on a radio, stereo, or television whenever they study as a screen against random noise distractions.

Light. Low or Bright. Some people work best under bright light whereas others need dim, indirect, or low light.

Temperature. Cool or Warm. Many students can't "think" when they feel hot, and others can't "think" when they feel cold; some concentrate better in either a warm or cool environment.

Design. Informal or Formal. Many students think best in a formal environment seated on wooden, steel, or plastic chairs like those found in conventional classrooms, a library, or a kitchen. However, some learn better in an informal environment—on a lounge chair, a bed, the floor, pillows, or on carpeting.

Unmotivated/Self-Motivated. Self-motivation is the desire to achieve academically, to please oneself.

Not Persistent/Persistent. This element involves a person's inclination either to complete tasks that are begun or to take intermittent "breaks" and return to assignments of learning activities later.

Structure. Wants or Does Not Want Structure. This element involves a student's preference for specific directions or explanations prior to undertaking or completing an assignment versus the student's preference for doing an assignment his/her way.

Learning Alone/Peer-Oriented Learner. Some individuals prefer to study by themselves while others prefer to learn with a friend or colleague; in the latter situation, discussion and interaction facilitate learning. Sometimes students prefer to study alone but in close proximity to others. The factor analysis does not differentiate among those individuals who want to learn with just one other person or with several individuals.

Authority Figures Present. Some people feel better or more comfortable when someone with authority or recognized special knowledge is present.

Auditory Preferences. This perceptual area describes people who can learn best when initially listening to verbal instruction such as a lecture, discussion, or recording.

Visual Preferences. A learner whose primary perceptual strength is visual can recall what has been read or observed; such people, when asked for information from printed or diagrammatic material, often can close their eyes and visually recall what they have read or seen earlier.

Tactile Preferences. Students with tactile perceptual strengths need to underline as they read, take notes when they listen, and keep their hands busy particularly if they also have low auditory ability.

Kinesthetic Preferences. Learners with kinesthetic preferences require whole-body movement and/or real-life experiences to absorb and retain material to be learned. These learners learn most easily when they are totally involved. Acting, puppetry, and drama are excellent examples of kinesthetic learning; other examples include building, designing, visiting, interviewing, and playing.

Mobility. How still can the person sit and for how long. Some people need frequent "breaks" and must move about the instructional environment. Others can sit for hours while engaged in learning particularly if they are interested in the task.

Teacher Motivated. These individuals want to learn and complete assignments because their teacher will be pleased with their efforts.