Relationships of Learning Styles, Grades, and Instructional Preferences

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Abstract

This study tested purported relationships between Gregorc learning styles and self-reported instructional preferences of college students. Answers on an instructional preference survey were also compared to the grades achieved by the participating students in an introductory biology course. Many of the long-assumed correlations between learning style and instructional preferences were not found in this study. Only the trends for the concrete sequential learning style were largely in agreement with previous literature. Compared to other learning styles, concrete sequential learners reported a significantly higher preference for organized and structured lectures, the use of workbooks and lab manuals, and projects with well-defined instructions. Irrespective of learning style, some instructional methods were rated as highly favorable by most students. The highest preferences were indicated for active learning techniques, for organized lectures with visual aids, and for multiple choice test questions. High overall course grades were significantly correlated to preferences for studying and working alone and for a dislike of group projects and computer-assisted studying modules.

Introduction

Many learning style models have been proposed to explain differences in how students perceive, process, interpret, and retain information. The classic literature (e.g., Dunn and Dunn, 1979; Gregorc, 1979) suggests that students with different learning styles should have distinct preferences for different instructional activities. However, the purported instructional preferences are largely only assumptions based on the described characteristics of people from different learning style groups. Few studies have attempted to provide data for self-reported instructional preferences, particularly for contemporary college students.

Bohn et al. (2004) found no significant differences in the most preferred instructional tools between students with different learning styles. However, in that study, definitive conclusions may be limited by the small sample size (N=44) and the specific focus on instructional methods as utilized within one particular course. Seidel and England (1999) found some agreement of purported learning style preferences with self-reported learning suc-cess/performance. However, preferences for several teaching methods and testing techniques were similar among all students, regardless of learning style. This study may also suffer from small sample sizes because the total sample was split into a large number of learning style categories, resulting in a maximum sample size per category of only 18 students.

One of the most widely-cited and well-established learning style models is that of Gregorc (1979), which uses two types of learning orientations (concrete and abstract) and two types of ordering orientations (sequential and random). These orientations are then combined to form four learning styles: Concrete Sequential (CS), Abstract Sequential (AS), Abstract Random (AR), and Concrete Random (CR). Most people show a preference for one or two of the learning styles and the Gregorc Style Delineator can be used as a self-administered test to determine learning style preferences (Gregorc, 1982a).

Instructional preferences for each of the four Gregorc learning styles have been postulated (Gregorc and Butler, 1984; Kaplan and Kies, 1993), based largely on the attributes described in Gregorc's original study (1979). Concrete Sequential learners reportedly prefer step-by-step directions, hands-on learning materials, and clearly organized lectures. Abstract Sequential learners have been described as being skilled at written, verbal, and image translation, preferring presentations with order and substance, and favoring abstractions and simulated experiences. Abstract Random learners purportedly are attuned to atmosphere and mood, prefer unstructured information and busy environments, and favor abstract, subjective experiences. Concrete Random learners are described as intuitively successful in unstructured problem-solving experiences, and show preferences for trial-and-error, concrete examples, and practice.

The main objective of this study was to compare the long-assumed instructional preferences of Gregorc learning styles with the self-reported instructional preferences of college students. Specifically, this three-year study, involving 173 students, compared Gregorc learning styles to self-reported instructional preferences of students enrolled in an introductory biology course.

This study was also designed to further investigate trends from a previous study that suggested a

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relationship between grades and satisfaction with a cooperative learning project (Lehman, 2007). The previous study suggested that the high-achieving students tended to dislike group projects, fearing that their grades might be compromised by the work of others. Several survey questions were specifically included in the present study to attempt to distinguish between a dislike for group activities themselves versus a dislike for the potentially negative effects of group work on the grades received. Other relationships between academic achievement and instructional preferences were also investigated.

Because studies suggest that dominant learning styles may differ for students majoring in agriculture, life sciences, or other natural sciences as compared to students majoring in the humanities or social sciences (Cano, 1999; Roberts, 2006; Seidel and England, 1999), it is important to understanding the validity of purported instructional preferences that correspond to these learning styles. Likewise, understanding the relationships between instructional preferences and achievement levels can aid in the selection of methods that best enhance teaching and learning for students in these disciplines.

Methods

This study was conducted at Longwood University (Farmville, VA) in a second-semester freshman introductory biology course during the spring semesters of 2006-2008. Nearly all students enrolled in the course were biology majors. A total of 173 students (47 males and 126 females) were included in the utilized portion of the data set for this three-year study. Because this study was conducted in regularly scheduled class meetings within the investigator's own classes, it was exempt from review by the institutional Human and Animal Subjects Research Review Committee. Nevertheless, students were told that participation was optional.

At the beginning of the semester, the Gregorc Style Delineator (Gregorc, 1982a) was used to determine the dominant learning style of each student. Gregorc (1982b) reports validity and reliability ranges for this instrument as 0.85-0.88 and 0.89-0.93, respectively. Gregorc (1982b) identified a score of ≥ 27 as an indication of a high preference for that learning style. In this study, the highest score (if ≥ 27) was used to place each student in a dominant learning style category. On the rare occasion when a student did not have any dominant learning style (score < 27 on all four scales) or had tie scores for two or more categories, the student was excluded from the data set.

After the completion of the Gregorc Style Delineator, each student completed a 19-question survey to rate their preferences for various instructional techniques. The first section of the survey consisted of 15 techniques to be assessed on a five-point Likert-type scale as follows: 1=strongly favor, 2=slightly favor, 3=neutral, 4=slightly dislike, and 5=strongly dislike. The second part of the survey consisted of four questions where student where asked to indicate their preference among two contrasting choices. For the purpose of some statistical analyses, the first choice was designated as "1" and the second choice was designated as "2." Percentages of the students' choices were also examined and reported.

Data were analyzed using JMP, Version 6 and SPSS, Version 14, with a p-value <0.05 indicating statistical significance. One-way analysis of variance (ANOVA) and Tukey HSD post-hoc tests were used to test for differences in grades and survey responses of students with different dominant learning styles. Further explorations of the data used ANOVA and correlation analyses to assess differences based on grades, gender, and numerical scores for the four learning style scales.

Results and Discussion
Learning Styles, Gender, and Grades

Using combined data from all three years, the distribution of Gregorc learning styles (Gregorc, 1979) in the course was as follows: 39% Concrete Sequential (CS), 12% Abstract Sequential (AS), 21% Abstract Random (AR), and 28% Concrete Random (CR). These percentages are similar to those found for this course during previous years in another study (Lehman, 2007).

When analyzed by gender, CS was the most common learning style among both males and females (though tied with CR in males). The predominance of other learning styles varied in males and females (Figure 1). This is largely consistent with gender differences seen in previous studies where Gregorc scores were analyzed (Lehman, 2007; O'Brien, 1991), though the percentages among males was more heavily skewed toward CR and CS in this study. When analyzed by numerical scores along the four cognitive style scales, only the AR score varied significantly with gender. Females scored significantly higher on the AR scale, as compared to males (mean S.E. for females and males, respectively: 26.2 0.5 and 23.1 0.6). O'Brien (1991, 1994) also observed this gender difference in both college and high school students, though he also found significant gender differences for AS and CR scores in college students (O'Brien, 1991), which were not detected in this study.
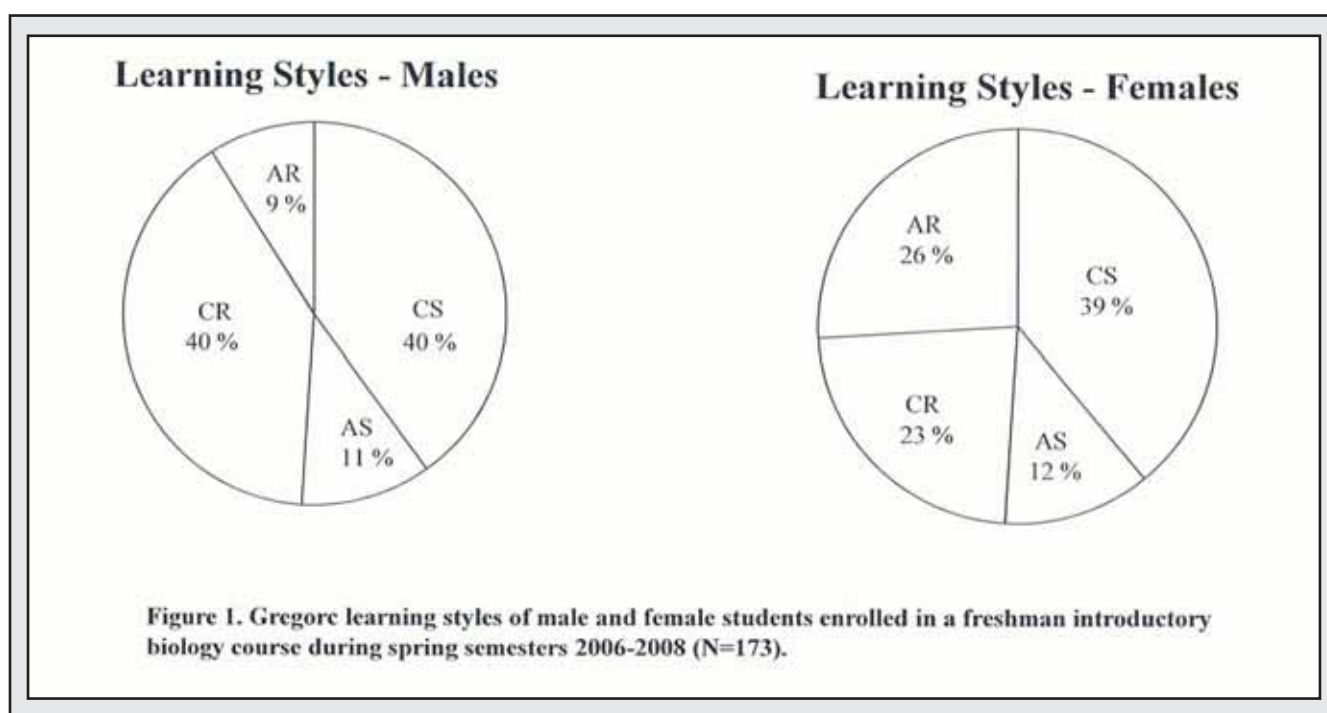
The final grade received in the course was not significantly correlated to gender. The course grade also was not significantly different between the four Gregorc style categories, although the numerical score on the AR scale was significantly negatively correlated to grade in the course. This finding may be course and instructor specific. The instructor's AR score is the lowest of the four Gregorc delineator scores, indicating that students with an AR learning style are the most distant from the instructor's natural learning style (which might be reflected in

teaching style). Also, the course involves a substantial amount of hands-on, concrete learning through laboratory instruction. Both lecture and lab are highly structured and organized. These features may put AR learning styles at a disadvantage in this course.

Previous studies of correlations between grades and learning style have mixed results. Some studies have found no relationship (Harasym et al., 1995), while others have reported a significant correlation (Cano, 1999; O'Brien, 1994) between learning style and course grades or GPA. Interestingly, O'Brien (1994) also found evidence to suggest that the AR learning style may be at a disadvantage, especially as compared to the CS learning style which showed significantly higher academic achievement in a high school student population.

Some of the purported instructional preferences for CS learners were observed in this study. Students with the dominant learning style of CS reported a significantly higher preference (p=0.0287) for "clearly organized and structured lectures" as compared to AR, with means ± SE of 1.39 ± 0.12 and 1.95 ± 0.16, respectively. Numerical scores on the CS scale were correlated to two survey questions (Table 2). As predicted by the literature, higher CS scores were correlated with a higher preference for the "use of workbooks or lab manuals." The sequential learning style preference for "structured activities" (which included structured lectures and workbooks) was also found by Seidel and England (1999). When given a choice between "projects with well-defined step-by-step instructions and clear expectations" or "projects without well-defined instructions to allow

Figure 1. Gregorc learning styles of male and female students enrolled in a freshman introductory biology course during spring semesters 2006-2008 (N=173).

Learning Styles and Instructional Preferences

Learning style numerical scores were not correlated to most self-reported instructional preferences on the survey. Likewise, no significant ANOVA results were found for the four dominant learning style categories with these purported instructional preferences (Table 1). Some other studies comparing Gregorc learning styles to instructional preferences of college students have also found no significant agreement (Bohn et al., 2004) or only partial agreement (Seidel and England, 1999) with the relationships originally proposed (Gregorc, 1979; Gregorc and Butler, 1984; Kaplan and Kies, 1993). Though these other studies had small sample sizes, they are in agreement with this study's finding that the long-assumed instructional preferences may not be entirely applicable to contemporary college students.

for the freedom to be creative," a higher CS score was significantly correlated to the former choice. For students with the dominant learning style of CS, 76% selected this choice. The CR learning style numerical scores showed the opposite significant trends, compared to the CS trends, with the CR learning style expressing a dislike for workbooks, lab manuals, and projects with well-defined instructions.

Significant numerical score correlations for the AR and AS scales showed that "problem-solving activities" were disliked by AR and favored by AS learners (Table 2). The classic literature seems to suggest that the preference for problem-solving activities should be related to the CR learning scale instead (Gregorc 1979; Gregorc and Butler, 1984; Kaplan and Kies, 1993).

Following the suggestion of Seidel and England (1999), student learning styles were re-classified to allow for dual or multiple dominance categories, such

Table 1. Purported educational preferences that were not significantly related to learning study. Dominant Gregorc learning styles categorgories (ANOVA) and learning style numerical scores (correlation analysis) were compared to survey answers for instuctional preferences of 173 students enrolled in an introductory biology course. Purported correlations are based on Gregorc 1979, Gregorc and Butler 1984, & Kaplan and Kies 1993.

No significant correlation with learning style in this study:	Purported learning style correlation:
Hands-on activities (labs, models, etc.)	Concrete Sequential
Field trips	Concrete Sequential
Computer-assisted studying modules	Concrete Sequential
Group projects	Concrete Random
Independent study projects	Concrete Random
Educational games and simulations	Concrete Random
Lectures with a lot of information	Abstract Sequential
Reading assignments	Abstract Sequential
Video tapes/movies	Abstract Random
Group discussions	Abstract Random

as "dual sequential" for a student who scored above the cut-off point of 27 on both the concrete sequential and the abstract sequential dimensions. However, analysis of the data with this new classification structure did not yield any new meaningful trends that were not already apparent with the original "highest score only" categorization, as used by Gregorc (1982a) or by the use of the actual numbers on the four dimensional scales. Overall, use of the actual numerical scores provided the highest ability to detect trends and was superior to either methods of attempting to establish discrete learning style categories.

Regardless of learning style, some instructional methods were more highly favored than others. The instructional methods with the highest overall preference scores were for active learning techniques, such as field trips and hands-on activities, and for lectures that were organized and included visual aids (Table 3). A strong overall preference for multiple choice questions (78% of students) was also indicated, as opposed to essay questions.

Grade Correlations

The overall course grade of individual students (a possible indicator of a student's ability level) was significantly correlated to their responses to several survey questions, with trends for students with higher grades reporting a dislike of group projects and a preference for studying and working alone (Table 4). This is in agreement with a previous study (Lehman, 2007), where the high-achievers reported dissatisfaction with the group project used in the course at that time. A relationship between high achievement level and preferences for methods involving independent study has been found in some studies (Stewart, 1981), but not in others (Ristow and Edeburn, 1983, 1984). One study (Skipper, 1993) implied that high ability students disliked independent study, but this may simply be a reflection of the way the question was asked ("best course develops independent learners") and

Table 2. Significant Correlations between Student Survey Answers and the Corresponding Learning Style Numerical Scores

Survey Question	Concrete Sequential r^z	Concrete Random r	Abstract Sequential r	Abstract Random r
Use of workbooks or lab manuals[y]	-.198**	.161*	.118	.024
Prefer: project with well-defined step-by-step instructions and clear expectations OR projects without well-defined instructions to allow for the freedom to be creative[x]	-.195*	.165*	.044	.019
Problem-solving activities[y]	-.056	.041	-.196**	.179*

[z]r=Pearson product moment correlation coefficient
[y]survey answer scale: 1=strongly favor, 2=slightly favor, 3=neutral, 4=slightly dislike, and 5=strongly dislike
[x]survey answer scale: 1=first choice (step-by-step instructions), 2=second choice (without well-defined instructions)
* or** - significant at p=0.05 or 0.01, respectively

Table 3. Instructional Techniques with the Highest Overall Preference, Regardless of Learning Style

Survey Question[z]	Mean ± SE	% Favored[y]
Hands-on activities (labs, models, etc.)	1.42 ± 0.07	92
Field Trips	1.48 ± 0.07	88
Clearly organized and structured lectures	1.63 ± 0.07	81
Lectures that include a lot of pictures, maps, and/or diagrams	1.88 ± 0.08	81
Educational games and simulations	1.94 ± 0.07	78

[z]Scale: 1=strongly favor, 2=slightly favor, 3=neutral, 4=slightly dislike, and 5=strongly dislike
[y]% Favored = percentage of students answering 1 (strongly favor) or 2 (slightly favor)

the student's view of this relative to other possible course goals. Lehman (2007) suggested that informal written and verbal feedback from students indicated that the highest achievers tended to dislike group projects, because they feared that their grades might be compromised by the work of others. The lack of a correlation between grades and two other survey questions supports this suggestion, since high-achievers did not report a dislike of ungraded group work and discussions.

Unexpectedly, the preference for "computer-assisted studying modules" was also correlated to the overall course grade, indicating that low-achievers tended to report a stronger preference for this instructional technique. Some studies suggest that computer-assisted instruction (CAI) has the greatest benefits for low-achievers (Deignan et al., 1980; Nordstrom, 1988). However, it should also be noted that CAI and student familiarity with computers may have changed greatly since this was studied in the 1980's. Therefore, more recent studies are needed to further investigate this suggested relationship between achievement level and CAI.

Future Study Directions

The next important question is whether the self-reported preferences found in this study are an accurate reflection of the instructional methods that are most beneficial for students of particular learning styles and ability levels. In other words, do instructional preferences necessarily correlate to the best methods for learning and achievement? Using Felder and Silverman's (1988) learning style classifications, Johnson and Johnson (2006) found some correlations between college student instructional preferences and achievement. Though the sample size of that study (N=48) limited definitive conclusions, it does suggest a possible awareness among college students of activities that are beneficial for their own learning. Whether or not each individual's optimal learning conditions can be categorized into discrete learning style categories that relate to particular instructional preferences remains under investigation.

Summary

Overall, this study found that traditionally classified learning styles were not correlated to most self-reported educational preferences. Only the trends for the concrete sequential learning style were largely in agreement with previous literature, suggesting that many purported learning preferences may not be evident among contemporary college students. Students of all learning styles

Table 4. Significant Correlations between Survey Answers and Course Grades

Survey Question	Course Grade r^z
Group projects where all members of the group get the same grade[y]	.311**
Independent study projects[y]	-.175*
Computer-assisted studying modules[y]	.203**
Prefer: studying with other people OR studying by yourself[x]	.165*
Prefer: working on a graded project by yourself OR working with a group (where all members of the group get the same grade)[x]	-.200**

[z]r =Pearson product moment correlation coefficient
[y]survey answer scale: 1=strongly favor, 2=slightly favor, 3=neutral, 4=slightly dislike, and 5=strongly dislike
[x]survey answer scale: 1=first choice (step-by-step instructions), 2=second choice (without well-defined instructions)
* or ** = significant at p≤ 0.05 or 0.01, respectively

indicated a preference for active learning techniques, organized lectures, and multiple choice test questions. Preferences for working independently were linked to high-achieving students and preferences for computer-assisted instruction were linked to low-achieving students. All of these findings are particularly true for the agricultural and life science college student population upon which this study is based. Additional studies of this nature for other academic disciplines in the humanities and social sciences and at other levels of education would help to further clarify how widely these findings can be generalized to current populations of students.

Literature Cited

Bohn, D.M., C.N. Rasmussen, and S.J. Schmidt. 2004. Identifying the learning styles and instructional tool preferences of beginning food science and human nutrition majors. Jour. of Food Science Education 3:41-46.

Cano, J. 1999. The relationship between learning style, academic major, and academic performance of college students. Jour. of Agr. Education 40(1): 30-37.

Deignan, G.M., B.R. Seager, M. Kimball, and N.S. Horowitz. 1980. Computer-assisted, programmed text, and lecture modes of instruction in three medical training courses: Comparative evaluation. Final report. Lowry AFB, Colorado: Air Force Human Resources Lab.

Dunn, R.S. and K.J. Dunn. 1979. Learning styles/teaching styles: Should they . . . can they . . . be matched? Educational Leadership 36: 238-244.

Felder, R.M. and L.K. Silverman. 1988. Learning and teaching styles in engineering education. Engineering Education 78: 674-681.

Gregorc, A.F. 1979. Learning/teaching styles: Their nature and effects. In: Student Learning Styles: Diagnosing and Prescribing Programs. Reston, VA: National Association of Secondary School Principals.

Gregorc, A.F. 1982a. Gregorc style delineator: A self-assessment instrument for Adults. Columbia, CT: Gregorc Associates, Inc.

Gregorc, A.F. 1982b. Gregorc style delineator: Development, technical and administration manual. Columbia, CT: Gregorc Associates, Inc.

Gregorc, A.F. and K.A. Butler. 1984. Learning is a matter of style. VocEd 59(3):27-29.

Harasym, P.H., E.J. Leong, G.E. Lucier, and F.L. Lorscheider. 1995. Gregorc learning styles and achievement in anatomy and physiology. Advances in Physiology Education 13(1): S56-S60.

Johnson, G.M. and J.A. Johnson. 2006. Learning style and preference for online learning support: Individual quizzes versus study groups. In: Proc. at the Annu. World Conference on Educational Multimedia, Hypermedia, and Telecommunications, Orlando, FL, June 26.

Kaplan, E.J. and D.A. Kies. 1993. Together: Teaching styles and learning styles improving college instruction. College Student Jour. 27:509-513.

Lehman, M.E. 2007. Influence of learning style heterogeneity on cooperative learning. NACTA Jour. 51(4): 17-22.

Nordstrom, B.H. 1988. Computer-assisted-instruction: A review of research on the effectiveness of CAI. Retrieved from ERIC database (ED 301 409).

O'Brien, T.P. 1991. Relationships among selected characteristics of college students and cognitive style preferences. College Student Jour. 25: 492-500.

O'Brien, T.P. 1994. Cognitive learning styles and academic achievement in secondary education. Jour. of Research and Development in Education 28(1): 11-21.

Ristow, R.S. and C.E. Edeburn. 1983. An inventory approach to assessing the learning styles of college students. In: Proc. at the Annu. Mtg. of the Northern Rocky Mountain Educational Research Association, Jackson Hole, Wyoming, October 15.

Ristow, R.S. and C.E. Edeburn. 1984. An inventory approach to assessing the learning styles of college students: continued exploration. In: Proc. at the Annu. Mtg. of the Northern Rocky Mountain Educational Research Association, Jackson Hole, Wyoming, October 5.

Roberts, T.G. 2006. The influence of student learning experience level and learning style on achievement. Jour. of Agr. Education 47(4): 112-122.

Seidel, L.E. and E.M. England. 1999. Gregorc's cognitive styles: College students' preferences for teaching methods and testing techniques. Perceptual and Motor Skills 88:859-875.

Skipper, C.E. 1993. Instructional preferences of pre-service teachers at three different levels of academic aptitude. In: Proc. at the Annu. Mtg. of the Mid-western Educational Research Association. Chicago, Illinois. October 15.

Stewart, E.D. 1981. Learning styles among gifted/talented students: Instructional technique preferences. Exceptional Children 48(2): 134-138.