Altun, A., & Cakan, M. (2006). Undergraduate Students' Academic Achievement, Field Dependent/Independent Cognitive Styles and Attitude toward Computers. *Educational Technology & Society*, 9 (1), 289-297.

Undergraduate Students' Academic Achievement, Field Dependent/Independent Cognitive Styles and Attitude toward Computers

Arif Altun
Department of Computers and Instructional Technology Education
Hacettepe University, Beytepe Ankara, Turkey
Tel.: +90 312 297 7176
Fax: +90 312 299 2083
altunar@ibu.edu.tr

Mehtap Cakan
Department of Educational Science, Abant Izzet Baysal University, Golkoy-Bolu, Turkey
cakanmehtap@hotmail.com

ABSTRACT

This paper reports an investigation of cognitive styles, achievement scores and attitudes toward computers among university students. Field dependence/field independence is a dimension of cognitive style that has been researched with various student groups as well as with attitudes. Nevertheless, there appears to be a dearth of published research in this area relevant to teacher trainees in an international setting. In this study, the standardised Group Embedded Figures Test was used to assess field dependency among 130 teacher trainees. Overall, it was found that there was no significant relationship between cognitive styles and academic achievement ($r= .14$, $p= .15$); cognitive styles and attitudes toward computers ($r = .01$, $p= .84$); and, cognitive styles and attitudes toward computers when their academic achievement scores were covariated ($F(2,126) = .40$, $p > .05$). The findings indicate that students' attitudes toward computers are not associated with field dependency, even when their achievement levels were controlled. Attitude toward computers is found to function independently from cognitive styles.

Keywords

Cognitive styles, Achievement, Attitudes, Post-secondary education, Pedagogical issues

Introduction

Web-based instruction and the use of information and communication technologies in educational settings are transforming the methods of content delivery and instructional materials. Tomorrow's teachers are now expected to be computer literate and use information and computer technology tools in their teaching profession. Moreover, they are also expected to apply higher cognitive skills, such as collecting, analyzing, evaluating, summarizing, and synthesizing information.

The on-going transformations of educational environments and training future teachers based on those needs make the development of cognitive skills an important indicator of success. Cognitive psychologists and educators have long been interested in understanding the individual differences in cognition and their impact on learning and instruction. Witkin's research (1971), undoubtedly, helped build the field dependency theory to better separate people with one factor from the total visual field.

Providing information and communication technologies (ICT) to schools and teachers are positive steps toward encouraging teachers to take advantage of them. However, research has shown that teachers' attitudes toward computers interfere with their ability to integrate them into their classroom teaching (Chou & Wang, 1999; Tsai, Lin & Tsai, 2001) and the broad diversity of individual differences among potential teacher trainees should be taken into account in teacher training programs (Chou & Wang, 1999; Liu & Reed, 1994). Therefore, it is equally important to equip classroom teachers with appropriate cognitive tools and guide them toward a successful ICT integration. One of the challenges facing educational technologists and instructional designers is in integrating information and communication technologies, which take account of individual differences such as computer use, attitude, and more importantly from an educational perspective, cognitive learning styles. Therefore, one question of specific interest for this study is to investigate the relationship between cognitive styles, academic achievement, and students' attitudes toward computers, described by Lee, Kim, and Lee (1995) as joint contributors to behavior.

Literature Review

Cognitive versus Learning Styles

There apears considerable confusion in the literature concerning the terms cognitive and learning styles. Numerous authors and researchers use the terms interchangeably. However, various authors draw a distinction between cognitive and learning style. Learning styles refer to ways that people learn information, and cognitive styles are more global, referring to the way that people see the world around them and interact with it (Jonassen & Grabowski, 1993).

Ausburn and Ausburn (1978) defined cognitive styles as the "…psychological dimensions that represent the consistencies in an individual's manner of acquiring and processing information (p. 338)". According to Messick (1984), cognitive style deals with the manner in which people prefer to make sense out of their world by collecting, analyzing, evaluating, and interpreting data. These styles are thought to remain consistent preferences throughout life (Jonassen & Grabowski, 1993).

Jonassen and Grabowski (1993) propose a transition from cognitive abilities to learning styles (See, Figure 1). Cognitive abilities covers the content and refers to the level of cognitive activity whereas styles indicate the manner and form of learning. According to the authors, abilities are stated in terms of maximal performance; therefore, they are unipolar (i.e., less ability..... more ability) and value directional measures (having more is better than having less), whereas styles are bipolar (visual....verbal) and value differentiated (neither pole is necessarily better). Jonassen and Grabowski (1993) conclude that abilities enable learners to perform tasks whereas styles control the ways in which tasks are performed.

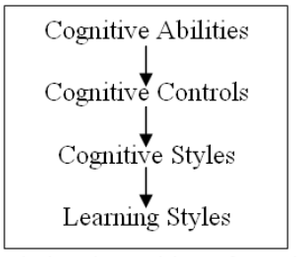

Figure 1. The relational transition of cognitive processes

To conclude, learning styles are less specific than cognitive styles, which are less specific than cognitive controls. Because learning styles are based on self-report measures, validity is one of the most articulated problems. Moreover, as speculated by some researchers, "...learning styles may not be legitimate research tools, ... they are useful methods for eliciting self-reflection and an understanding of the learning process" (Jonassen & Grabowski, 1993; p. 234). Therefore, this study utilized cognitive styles as a research tool, which defined cognitive processing characteristics based on task-relevant measures.

Field Dependent/Independent Cognitive Styles

There are various recognized cognitive styles available in the literature, among which are visual/haptic, visualizer/verbalizer, leveling/sharpening, serialist/holist, and field dependent/independent (See, Jonassen & Grabowski, 1993 for an extensive overview and the synthesis of related research).

Although various forms of cognitive styles have been introduced and different instruments have been developed to assess them, Witkin et al.'s (1971) Group Embedded Figures Test has been applied most commonly. There are two reasons for choosing GEFT in this study. First, the instrument is a non-verbal test and requires only a minimum level of language skill for performing the tasks (Cakan, 2003). Another reason is that psychometrical properties of the instrument have been investigated in cross-cultural settings and accepted as quite reasonable.

According to Witkin and Goodenough (1981), people are termed field independent (FI) if they are able to abstract an element from its context, or background field. In that case, they tend to be more analytic and approach problems in a more analytical way. Field dependent (FD) people, on the other hand, are more likely to be better at recalling social information such as conversation and relationships. They approach problems in a more global way by perceiving the total picture in a given context.

Daniels (1996) summarizes the general tendencies of field dependent and independent learners as follows:

Field-dependents:

- • Rely on the surrounding perceptual field.
- • Have difficulty attending to, extracting, and using non salient cues.
- • Have difficulty providing structure to ambiguous information.
- • Have difficulty restructuring new information and forging links with prior knowledge.
- • Have difficulty retrieving information from long-term memory.

Conversely, field-independents:

- • Perceive objects as separate from the field.
- • Can disembed relevant items from non-relevant items within the field.
- • Provide structure when it is not inherent in the presented information.
- • Reorganize information to provide a context for prior knowledge.
- • Tend to be more efficient at retrieving items from memory (p. 38)

In the following sections, research findings on cognitive field dependency, academic achievement, and attitude studies are discussed and synthesized.

Field Dependency and Academic Achievement

Cognitive style has been reported to be one of the significant factors that may impact students' achievement on various school subjects (see, Murphy, Casey, Day, & Young, 1997; Cakan, 2000). In a research study, Dwyer and Moore (1995) investigated the effect of cognitive style on achievement with 179 students who enrolled in an introductory education course at two universities in the United States. They found the field independent learners to be superior to field dependent learners on tests measuring different educational objectives. The researchers concluded that cognitive style had a significant association with students' academic achievement.

Tinajero and Paramo (1997) investigated the relationship between cognitive styles and student achievement in several subject domains (English, mathematics, natural science, social science, Spanish, and Galician). With the sample of 408 middle school students, the researchers asserted that cognitive style was a significant source of variation in overall performance of students. That is, field independent subjects outperformed their field dependent counterparts.

In another study, Murphy, Casey, Day, & Young (1997) sought to determine the relationship between academic achievement and cognitive style of 63 undergraduate Canadian students in information management program. They found that field independent students performed better than field dependent subjects only on one of the technical courses. For the other three courses the two groups performed similarly.

Although considereable research has been conducted on the impact of field dependence/ independence and academic achievement, the relationships between FD/FI cognitive style and learning, including the ability to learn from social environments (Summerville, 1999), and the impact of cognitive styles on the use of learning strategies (Jonassen, 1988; Liu & Reed, 1994), few studies have considered affective variables and cognitive styles together in teacher training programs.

Field Dependency and Attitude toward Computers

The studies investigating the correlations between attitudes toward computers and field dependency is limited area of research with contradictory results. In an earlier research study, Abouserie and Moss (1992) investigated 143 undergraduate freshman students' attitudes toward computer-assisted learning (CAL). They examined the relationship between students' attitude toward using CAL and their cognitive style (field dependent and field independent FD/FI) as they relate to gender. They found a significant correlation between students' attitudes and their field dependency. The findings showed that male students preferred using CAL more than female students did. In addition, FD students relied more on CAL than FI students did. This can be explained by FD students` tendency to prefer to learn specific and detailed information and use the existing organization of material as given instead of re-organizing it (Thompson, 1988, Witkin, Moore, Goodenough & Cox, 1977).

On the other hand, some researchers claim that no correlation exists between attitudes toward computers and cognitive styles (see, Hart, 1995). In a research study, Jones (1994) explored the existence of such a relationship with 140 undergraduate and graduate students by using the Myers-Briggs Type Indicator (MBTI). Jones (1994) found a small but insignificant correlations between the variables (between r = .-03 and r = .12).

In a more recent study, Altun (2003) also investigated the relationship between attitudes toward computers and cognitive styles by using Group Embedded Figures Test, with 67 undergraduate university students. The results indicated small but not significant correlations (between r= -.006 and r= .309) between these variables. Alomyan and Au (2004) conducted a research study with undergraduate university students to investigate the effect of students' cognitive styles, achievement motivation, prior knowledge, and attitudes on achievement in a web-based environment. In their findings, they have found no differences between students' attitudes toward web-based learning and their field dependencies.

One explanation for these contradictory findings in the literature may be that academic achievement has significant association with cognitive style (Murphy, Casey, Day, & Young, 1997; Tinajero and Paramo, 1997; Cakan, 2000, Dwyer and Moore, 2001). Therefore, academic achievement might intervene with and contribute to the relationship between cognitive style and attitudes toward computers.

Daniels (1996) examined cognitive style field dependence/independence based on the learner control of presentation mode within an educational hypermedia environment. Having problem-solving and recall rates as independent variables, he also explored the causal relationship between field dependency and the provision of control (i.e., program or learner) over presentation mode in hypermedia environments. He found no correlation between field dependency and frequency of multimedia selections, nor a predictive relationship between field dependency and selection of presentation mode. Daniels (1996) concludes that learner control of presentation mode does not offer any significant benefit to users of hypermedia, nor does it accommodate the perceptive and cognitive differences associated with the cognitive style field dependence/independence. Based on these findings, Daniels (1996) speculates that affective factors might have involved in the decision making process and confesses that examining the cognitive and affective variables that influence how learners interact in hypermedia environments may be more illuminating than post test measures of how much they learned.

To conclude, the construct of cognitive style has been treated as a promising variable which may explain differences observed among students' academic achievements on various subjects and provide us a better understanding of student achievement by investigating the interactional and casual effects of affective variables. The current findings would help instructional designers and practitioners develop better quality instructional delivery methods, another component to consider when designing web-based learning environments. Moreover, the findings might prove more solid theoretical understanding of the cognitive issues from the standpoint of cognitive styles and attitudes toward computers.

Research Hypothesis

H1. There will be no significant relationship between cognitive style scores and achievement scores of the participants.
H2. There will be no significant relationship between cognitive style scores and attitude scores toward computers.
H3. There will be no difference between attitude scores of the field dependent and field independent students when the effect of achievement scores is removed.

Research Method

Design and Participants

This study undertook a correlation design to explore the hypotheses. Due to the nature of correlational research, no causal relationship is sought. The design tells us about the bivariate relations between the variables. This limits the findings as to speculate about the existence of any cause and effect relationship between field dependency and attitudes.

The sample of the study consisted of 130 undergraduate students ranging from freshman to senior levels at a teacher training program at Abant Izzet Baysal University in Turkey. The program aims at training English

language teachers for primary and secondary level schools after their four-year of study. The first and second year mainly focuses on developing trainees' English language and basic computer skills (such as, speaking, writing, listening, computer operations, and reading skills). Starting from the third year, teacher training courses (i.e., classroom management, methods, lesson plans etc.) are provided. The last year of the program emphasizes the practicum approach in school settings; where trainees are taken to schools to (co) teach lessons and understand the daily routines at schools. The participants in the study were 22 males (16.9 %) and 108 females (83.1 %). This imbalance between genders may be attributed to the occupational preference of females in Turkey. This study, therefore, is limited to the data from predominantly female students.

Instruments

The Group Embedded Figures Test (GEFT)
Therefore, the Group Embedded Figures Test (Witkin et al. 1971) was used to determine the participants' cognitive styles. The instrument has been translated and validated into Turkish by Cakan (2003). The test consisted of 3 sections. The first section was given for practice purposes and included 7 items. Both the second and third sections contained 9 items. The total time for completing the test was 12 minutes. The instrument required each individual to trace a specified simple figure that was embedded within a complex design. A subject's total score was formed by a number of simple figures correctly traced in section 2 and 3 of the test. The possible score that one could make ranged from 0 to 18. Although Witkin et al. (1971) do not specify a clear cut off score for determining field dependent and independent individuals, the 27% rule created by Cureton (1957) is applied for classification purposes. Thus, based on the raw scores of the subjects on the GEFT, upper 27 % are identified as field independent (FI) and the lower 27 % as field dependent (FD). During the administration of the GEFT, the exact procedures set out in the technical manual (Witkin, et al., 1971) regarding time limits and directions were closely followed.

Computer Attitude Scale (CAS)
The computer attitude scale (CAS), originally developed by Loyd and Gressard (1984), was used in this study. CAS is a Likert-type instrument consisting of 30 items in three dimensions: computer anxiety (10 items); computer liking (10 items); and, computer confidence in ability to use computers (10 items). The coefficient alpha reliabilities were .75, .70, and .73 for the subscales respectively with accounting 53 % of the total variation. The total score reliability was also reported to be .89. Since the participants were proficient enough to understand the English statements, the items were not translated into Turkish.

Background Questionnaire
In addition to GEFT and CAS, the participants were asked to complete a form which included some moderating variables, such as gender, grade level, the number of computer courses taken, and ownership of a computer. This information was used both to display general demographic information and to be moderating variables. These moderating variables are also considered to be a kind of independent variable with a possible significant contributory effect on the independent-dependent relationship.

Data collection procedure

The data was collected during the fall term of 2001-2003. At the end of the fall semester, participants were asked to participate in this study on a volunteer base. The students were first administered the cognitive style test. After a week, they were administered the computer attitude scale with the background questionnaire. Also, students' GPA scores were obtained from school records.

Statistical Techniques

Pearson's product moment correlation coefficient was used to determine if the correlation is either equal or not equal to zero by using the 5 % significant level of committing a Type I error. A correlation analysis and the analysis of covariance (ANCOVA) procedures were used to analyze data. The ANCOVA procedure was used to remove the potential sources of variations from various achievement levels. In order to check that the assumption of equality of variance was not violated, Levene's Test of Equality of Error Variances was calculated.

In this study, participants' achievement scores were chosen as covariate when attitude score differences were investigated depending upon the cognitive styles. For testing hypothesis 2, grade level is included because it may

have a significant contributory or contingent effect on the correlation between attitude toward computers and cognitive style.

Results

Figure 2 displays the descriptive statistics for participants' cognitive styles and grade levels.

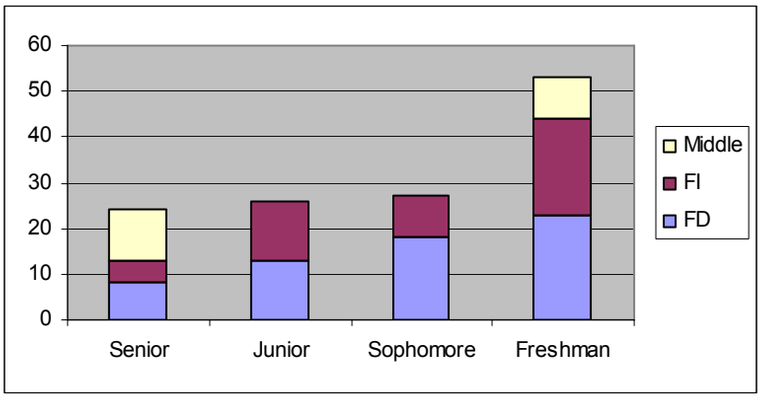

Figure 2. Participants and their cognitive styles

As Figure 2 indicates, more than a half of the participants were field dependent (% 47.7). Of the participants, 36.9 % were field independent whereas % 15.4 of them were in the middle group meaning that they did not have certain tendency to either pole of the style.

Cognitive Styles and Achievement Scores

A correlation analysis was conducted to test the first hypothesis. Contrary to expectations, the results revealed insignificant correlation between participants' academic achievement and their cognitive styles ($r = .14$, $p = .15$). The results suggested that cognitive style had insignificant relationship with the participants' achievement scores. In other words, participants' cognitive styles did not depend on their achievement scores.

This result did not support the previous studies which emphasized an association between the type of cognitive style and academic achievement (i.e., Dwyer and Moore, 2001). This may be due to the variation in the course subjects that students had taken from the first year through the fourth year and/or instructors' teaching preferences in those classes.

Cognitive Styles and Attitudes

The result of the correlation analysis between cognitive style scores and attitude scores toward computer revealed a negative correlation close to zero level ($r = .01$, $p = .84$). Correlation between cognitive style and attitude scores by grade levels were presented in Table 1.

*Table .1*Correlation between cognitive style and attitude scores across grades

	N	r	p
Freshman	53	-.005	.97
Sophomore	27	.35	.07
Junior	26	.009	.97
Senior	24	.20	.37
Overall	130	.14	.15

As seen from the table, cognitive style has a negative and low relationship with attitude scores for the first year students. Attitude has the greatest correlation value for sophomores. This may simply due the fact that computer

literacy course is offered at the sophomore level. Yet, this correlation is not significant. Overall, the association between cognitive styles and attitudes do not change among participants as their grade levels change.

Table 2 displays the correlations between GEFT scores and three subgroups in the attitude scale across gender. There are some positive and negative correlations between subgroups; however, most of them were found to be significant. Male students' GEFT scores were found to be significantly correlated with their attitudes at the anxiety subgroup. To put it another way, males get more anxious across cognitive styles whereas females do not differ in both cognitive styles.

Table 2.Correlation between cognitive style and attitude subgroup scores across gender

	Male (n= 22)		Female (n= 83)		Overall (n= 130)	
	r	p	r	p	r	p
Liking	.40	.07	-.07	.49	- .02	.87
Confidence	.33	.14	-.05	.60	.04	.65
Anxiety	- .01	.009*	- .02	.84	- .04	.65

* $p < .05$

Cognitive Styles and Attitudes: Academic achievement as a covariate

In order to test the hypothesis an ANCOVA (attitude scores by cognitive style groups while GPA is taken as a covariate variable) was applied. Achievement scores of the students were used as a covariate to test the difference between FD and FI participants' computer attitude scores. After adjusting achievement scores, there was no significant effect of the between subjects cognitive style groups ($F(2,126) = .40$, $p < .05$). The finding reveal that even when we remove the effect of GPA on attitude scores, field dependent and independent students demonstrate similar attitudes toward computers ($F = .62$; $p = .43$).

This finding suggests that students' attitudes toward computers are not associated with cognitive style, even when their achievement levels were controlled. Attitude toward computers is found to function independently from cognitive styles.

Conclusions

Earlier research suggested a significant association between cognitive styles and academic achievement (Dwyer and Moore, 2001; Lynch, Woelfl, Hanssen & Steele, 1998). Yet, unlike previous studies, this study revealed no significant association between academic achievement of the students and their cognitive styles. Prior studies (Witkin, Moore, Goodenough & Cox, 1977; Cakan, 2000) have shown that field-independent and field-dependent students do not differ in learning ability but may respond differently to the content being presented as well as the learning environment. Therefore, this result may be due to variation in the contents of courses students took from their first year through the fourth year. Another reason can simply be the fact that the participants in this study included females predominantly, and there were no one in the middle cognitive style group. This distribution might have led this conclusion.

In the current study, students' GPAs included all their courses across all grade levels. Regardless of grade level, students' attitudes toward computers seem to be independent of cognitive style. As far as gender is considered, the only significant correlation between GEFT scores and attitudes was at the anxiety level. Yet, the number of male participants was considerably low for correlational studies. Therefore, this may not be valid if more male participants were included. These findings are consistent with previous studies (Abouserie & Moss, 1992; Altun, 2003). Moreover, no significant relationship was observed between males and females. Both female and male teacher trainees are inclined to using computers regardless of their grade level or gender.

Even when the effect of achievement was removed from students' attitude scores toward computers, attitude scores was not related to the cognitive style scores of the students. When dealing with student attitudes toward computer use, educators do not need to take the cognitive style of the students into account. This gives freedom to educators to act without concerning cognitive style variables in the process of understanding and dealing with the affective domain.

Recommendations for future research

A number of limitations need to be considered in interpreting the findings of this study. First, this study included only the students from the department of English Language Teaching. A more comprehensive study including the other disciplines and /or across disciplines will contribute to our understanding of the relationship between cognitive styles and attitudes as well as their main effect on achievement. It is possible that a different type of training program would yield different results. Secondly, this study predominantly included female students. Another study with a more gender-equal sample is encouraged. As with any scientific finding, replication is needed in different settings with diverse populations to increase the external validity. It also needs to be emphasized that this study used only Witkin et. al.'s (1971) FD/FI as an indicator of cognitive style. Other cognitive style inventories could be applied to explore the interrelationship between academic achievement and attitudes in a broader context. Finally, this study did not include any data about participants' self-reflections about their learning preferences. Therefore, this study can be extended to further explore the associations between learning styles and attitudes from a qualitative paradigm.

References

Abouserie, R., & Moss, D. (1992). Cognitive style, gender, attitude toward computer assisted learning. *Educational Studies, 18* (2), 151-161.

Alomyan, H., & Au, W. (2004). Exploration of Instructional Strategies and Individual Difference within the Context of Web-Based Learning. *International Education Journal, 4* (4), 86-91.

Altun, A. (2003). The relationship between teacher trainees' attitudes toward computers and their cognitive styles. *Turkish Online Journal of Educational Technology, 2* (1), retrieved October 21, 2005 from http://www.tojet.sakarya.edu.tr/archive/v1i2/arif3.htm.

Ausburn, L. J., & Ausburn, F. B. (1978). Cognitive styles: Some information and implications for instructional design. *Educational Communications and Technology Journal, 26*, 337-354.

Cakan, M. (2000). Interaction between cognitive styles and assessment approaches. *Unpublished doctoral dissertation*, Louisiana State University, USA. Baton Rouge.

Cakan, M. (2003). Psychometric data on the Group Embedded Figures Test for Turkish undergraduate students. *Perceptual and Motor Skills, 96*, 993-1004.

Chou, H. W., & Wang, Y. F. (1999). The effects of learning style and training method on computer attitude and performance in WWW page design training. *Journal of Educational Computing Research, 21* (3), 323–342.

Cureton, E. E. (1957). The upper and lower twenty-seven percent rule. *Psychometrika, 22*, 293-296.

Daniels, H. L. (1996). Interaction of cognitive style and learner control of presentation mode in a hypermedia environment, retrieved on October 21, 2005 from: http://scholar.lib.vt.edu/theses/available/etd-3132141279612241/.

Dwyer, F. M., & Moore, D. M. (1995). *Effect of color coding and test type (visual/ Verbal) on students identified as possessing different field dependence level*, ERIC Document No. Ed 380 078.

Hart, G. (1995). Learning styles and hypertext: Exploring user attitude. *Paper presented at the ASCILITE 1995 Conference*, December 4-6, 1995, Melbourne, Australia.

Jonassen, D. H. (1988). Integrating learning strategies into courseware to facilitate deeper processing. In D. Jonassen (Ed.), *Instructional Designs for Microcomputer Courseware*, Hillsdale, NJ: Lawrence Erlbaum, 151-181.

Jonassen, D. H., & Grabowski, B. L. (1993). *Handbook of Individual Differences, Learning, and Instruction*, Hillsdale, NJ: Lawrence Erlbaum.

Jones, W. P. (1994). Computer Use and Cognitive Style. *Journal of Research on Computing in Education, 26* (4), 514-522.

Lee, S. M., Kim, Y. R., & Lee, J. (1995).An emperical study of the relationship among end-user information systems acceptance, training, and effectiveness. *Journal of Management Information Systems, 12* (2), 189-202.

Liu, M., & Reed, W. M. (1994). The relationship between the learning strategies and learning styles in a hypermedia environment. *Computers in Human Behavior, 10* (4), 419-434.

Loyd, B. H., & Gressard, C. P. (1984). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement, 44* (2), 501-505.

Lynch, T. G., Woelf, N. N., Hanssen, C. S., & Steele, D. J. (1998). Learning style influences student examination performance. *American Journal of Surgery, 176*, 62-66.

Messick, S. (1984). The nature of cognitive styles: Problems and promise in educational practice. *Educational Psychologist, 19*, 59-74.

Moore, D. M., & Dwyer, F. M. (2001). The relationship of field dependence and color-coding to female students' achievement. *Perceptual and Motor Skills, 93*, 81-85.

Murphy, H. J., Casey, B., Day, D. A., & Young, J. D. (1997). Scores on the Group Embedded Figures Test by undergraduates in information management. *Perceptual and Motor Skills, 84*, 1135-1138.

Myers, I. B. (1962). *The Myers-Briggs Type Indicator manual*, Educational Testing Service, Princeton, NJ.

Riding, R., & Agrell, T. (1997). The effect of cognitive style and cognitive skills on school subject performance. *Educational Studies, 23*, 311-323.

Summerville, J. (1999). Role of awareness of cognitive style in hypermedia. *International Journal of Educational Technology, 1* (1), retrieved October 25, 2005 from http://smi.curtin.edu.au/ijet/v1n1/summerville/.

Thompson, M. E. (1988). Field Articulation and the Design of Information for Microcomputers. In R. A. Braden, D. G. Beauchamp, L. Miller, ve D. M. Moore (Eds.), *About Visuals: Research, Teaching and Applications*, Corsicana, TX: International Visual Literacy Association, 429-434.

Tinajero, C., & Paramo, M. F. (1997). Field dependence-independence and academic achievement: A re-examination of their relationship. *British Journal of Educational Psychology, 67* (2), 199-212.

Tsai, C., Lin, S. J., & Tsai, M. (2001). Developing an Internet attitude scale for high school students. *Computers & Education, 37*, 41-51.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A. (1971). *A Manual for the Embedded Figures Test*, Palo Alto, CA: Consulting Psychological Press.

Witkin, H., Moore, C., Goodenough, D., & Cox, P. (1977). Field-dependent and field-independent cognitive styles and their educational implications. *Review of Educational Research, 47* (1), 1-64.

Witkin, H. A., & Goodenough, D. R. (1981). *Cognitive styles: Essence and origins*, NY: International University Press.