Visual Basic Programming Impact on Cognitive Style of College Students: Need for Prerequisites

Garry L. White
Gw06@txstate.edu
Department of CIS & QM
Texas State University – San Marcos
San Marcos, TX 78666, U.S.A.

Abstract

This research investigated the impact learning a visual programming language, Visual Basic, has on hemispheric cognitive style, as measured by the Hemispheric Mode Indicator (HMI). The question to be answered is: will a computer programming course help students improve their cognitive abilities in order to perform well?

The cognitive styles for the right hemisphere involve concrete experiences and creativity while the left hemisphere involves abstract and logic thinking. Prior research has shown procedural programming involved a left brain hemispheric style thinking. Object-oriented programming has been found to require neither left nor right hemispheric cognitive style. Even though Visual Basic contains object-oriented components, left brain thinking was found to be required for success in Visual Basic. Prior researches were relational studies, and no cause/effect was established. This study found hemispheric cognitive style remained the same after a semester course in Visual Basic. College age students' cognitive style was not impacted. This may be due to maturation of the brain.

Since left hemispheric cognitive style is required to be successful in Visual Basic and Visual Basic does not create such cognitive style, this research, as well as other research, supports the need for prerequisites for Visual Basic to ensure students' success.

Keywords: cognitive style, cognitive skills, prerequisites, visual programming, curriculum, Visual Basic.

1. INTRODUCTION

Overview

In 1984, computer programming was being taught because the belief was that learning skills would be impacted (Pea & Kurland, 1984). What are the cognitive consequences of learning computer programming? Will learning a programming language impact cognitive style? Or has maturation occurred? A prior study by van Merrienboer (1990) was unable to force a change in thinking style to improve learning outcomes. The approach frustrated the subjects.

Must one have the cognitive style before taking programming? There is a need to understand how people learn as well as the impact of learning. Such understanding may influence productivity in computer programming languages (Myers, J. P. & Brita, M., 1996).

Research has shown cognitive styles (how one learns) based on hemispheric brain dominance are factors in the learning of procedural and object oriented programming languages (Losh, 1984; Monfort et al, 1990; Ott, 1989; White, 2002; White & Ploeger, 2004; White & Sivitanides, 2005). However, most studies focused on relationships between learning style and learning outcomes (Ford & Chen, 2001; Lau & Yuen, 2009; Petty & Holtzman, 1991) instead of cause and effect.

Learning style consists of several related elements, of which, hemispheric brain dominance (cognitive style) is one. Dunn (2000) developed a Learning-Style Model of related elements. These elements composed of 1) Environmental; i.e. lighting, temperature, 2) Emotional; i.e. motivation, persistence, 3) Sociological; i.e. prefer alone or group, authoritative or collegial, 4) Physiological; i.e. auditory, visual, time-of-day, and 5) Psychological; i.e. hemispheric, analytic. Learning style is broader and encompasses both the person and the environment.

Because learning style encompasses the environment, it is easy to see why learning styles are related to geographic locations and cultural values (McPherson & Willis, 2010; Holbrugge & Mohr, 2010). Such elements of learning style can be impacted by the environment. However, cognitive style (hemispheric sides of the brain) is restricted to the physical characteristics of the brain. Cognitive style is defined as how people perceive and process information and experiences (Witkin et al., 1977; Tennant, 1988). Chen (2010) found different cognitive styles had differed in processing the learning. The question is whether computer programming can change cognitive style (how one learns).

As compared to cognitive style (how one learns), cognitive development is what can be learned. Cognitive development is fixed in adulthood (Schwebel, 1972), and not all adults reach the highest level of cognitive development (Bastain, et al. 1973; Griffiths, 1973; Schwebel, 1975). Research has shown visual and procedural programming courses do not improve/change cognitive development (Ignatuk, 1986; Mains, 1997; Owens & Seiler, 1996; Priebe, 1997; White, 2007). Maturation may have occurred. This suggests that cognitive style may also be fixed in adulthood. One college programming course may be too late to alter cognitive style. The belief that curriculum can impact cognitive characteristics maybe misleading.

There has been no research dealing with the impact on the cognitive style (how one learns) of new languages, such as Visual Basic. Visual Basic requires a left brain thinking style (White & Ploeger, 2004). This research investigated the impact learning a visual programming language, such as Visual Basic, has on cognitive hemispheric thinking style, as measured by the Hemispheric Mode Indicator (HMI).

Scope and Importance of Study

How do people learn? "There is a need to understand how people learn, not just aptitude. Such understanding may influence productivity in various programming languages" (Myers & Brita, 1996). Understanding the impact of cognitive style leads to better cause/effect research, teaching treatment research, curriculum adjustment, teaching methods, and advising of students. Research is needed to improve such understanding of the learning process and identify students' difficulties with programming methods (Myers & Brita, 1996; White, 2002).

Corman, Guynes, and Vanecek (1994-1995) stated that a better understanding of cognitive style and cerebral dominance provide for greater productive information systems. Hudak and Anderson (1990) study regarding computer science courses, emphasized "the need to examine students' cognitive maturity and learning style -- factors often ignored in research aimed at ascertaining the reasons for academic success at the college level." The study "highlighted the need to examine both cognitive maturity and learning style in the studies of academic success at the college level" (Hudak & Anderson, 1990). Such research enhances industry training and academic teaching (Rosson et al, 1990; Scholtz et al., 1993; Sheetz et al., 1997).

Prior cognitive research has been with procedural and object-oriented languages, such as Basic, Pascal, C++, and Java. This research will focus on the cognitive style that is involved with the programming aspects of Visual Basic. The findings and conclusions from this study establish a foundation in the research of programming languages influences on cognitive style.

2. LITERATURE REVIEW

Visual Basic Programming

Visual Basic (VB) is an enhancement of BASIC, a regular procedural language (Pietromonaco, 2002; Shelly, et al, 2003). VB has the added features of visual object-oriented components and the code for the procedural structures of sequence, iteration, and selection. An example of a visual object is a button. It has encapsulated properties and event procedures (Nelson, 1993; Schneider, 1999). VB has "public" and "private" procedures like object-oriented programming languages' public and private methods. Procedural languages lack such characteristics. The literature supports the idea that VB is different from procedural programming. (Buchner, 1999; Grehan, 1996a; Grehan, 1996b; Llewellyn et al, 2002; Spain, 1996). O'Brian (2004) describes VB as an object-oriented programming language, rather than a language like BASIC, C, or COBOL. Kai & McKim (1998) described how object-oriented programming can be performed in VB. Because of its object-oriented methods and procedures, VB requires a different mindset from other programming languages (Shirer, 2000).

Although VB contains object-oriented components, it is not hemispheric independent like other object-oriented languages, like Java and C++ (White, 2001, 2002). Left brain thinking is required for success in VB (White & Ploeger, 2004). Like other studies addressing cognitive development (what can be learned) and programming languages, a semester course of VB does nothing to cognitive development (White, 2007). Is this also true for cognitive style (how one learns)?

Hemispheric Cognitive Style Component

There is a relationship between cognitive style and brain hemisphere dominance (Diehl, 1986; Petty & Holzman, 1991). The right brain functions differently from the left brain (Bryden, 1990; Herrmann, 1982; McCluskey, 1997; Saleh & Iran-Nejad, 1995; Supprian & Hofmann, 1997). This is known as hemisphericity (Andrew, 1999; Losh, 1984).

The right side of the brain seems to handle concrete experiences and the left side of the brain seems to process abstract conceptions (Diehl, 1986). Another study showed the left brain is the logical cognitive side and the right brain is the creative cognitive side (Herrmann, 1981). Other studies have shown that the left side of the brain also deals with logical cognition (Dumas & Morgan, 1975; Lawson & Wollman, 1975), and logical cognition has been found to be related to procedural programming (Folk, 1973; Galton, 1992; Sperschneider & Antoniou, 1991; Myers, 1990; Gibbs & Tucker, 1986).

As expected, procedural programming students are left hemispheric brain dominant (Losh, 1984). A study by Monfort, Martin, & Frederisckson (1990) found music, art, oral communication and journalism students to be right brain dominant while computer science and mathematics students were found to be left brain dominant. Armstrong and Hird (2009) found entrepreneurs tended to be right brain (intuitive and less analytic).

Ott (1988) supports the above findings: left brain dominance in high school students correlated with the procedural programming grades. However, math scores of the Scholastic Aptitude Test (SAT-M) correlated much higher with procedural programming grades. Math is a left brain characteristic (Rotenberg & Arshavsky, 1997).

It is easy to see why left hemispheric brain thinkers make good computer programmers. As the above research findings indicated, procedural programming involves logical thinking and logical thinking is a function of the left hemispheric brain. There is a relationship between hemispheric styles and computer programming.

However, unlike procedural programming and VB, object-oriented languages are hemispheric independent (White, 2001, 2002). There is no relation between object-oriented languages and cognitive style based on hemisphericity.

3. METHODOLOGY

Null Hypotheses

Based on the literature review and prior research, the following hypotheses were established.

H1: A Visual Basic programming course does not change cognitive style, as measured by Pre- and Post-HMI scores. This is the main focus of this study.

H2: Those that did not take the post-Hemispheric Mode Indicator (HMI) had Pre- HMI scores equal to the Pre-HMI scores of those that took the post-HMI. This was to resolve the question that those who dropped out did so independent of cognitive style.

Instruments

The **Hemispheric Mode Indicator (HMI)** deals with the cognitive aspects of hemispheric dominance. The HMI has been used to study academic performance and learning styles in business and accounting courses (Carthey, 1993).

The 1999 HMI from EXCEL, Inc. defines left hemispheric dominate as tending to be analytic readers, preferring multiple choice tests, seeing cause and effect. Such thinking style tends to organize information. Right hemispheric dominant cognitive style tends to synthesize, prefer open-ended questions, are analogical, and draw on unbounded qualitative patterns. Characteristics for Left/Right Hemispheric cognitive styles include: rational vs. intuitive, logical vs. hunches, differences vs. similarities, and objective vs. subjective judgments (Lieberman, 1986; Learning, Inc. 2000; White, 2002).

The time to administer the HMI is 15 minutes. The subject is able to evaluate his/her responses to determine hemispheric characteristics and cognitive style (Learning, Inc. 2000; White, 2002) through 32 self-reporting questions in the HMI. A score, between +60 to -60, is calculated. This determines if the subject is right (> +8), left (< -8), or whole brain (between +8 and -8) dominant (Lieberman, 1986). Carthey (1993) cited Lieberman's (1986) study that showed the HMI has validity (Carthey, 1993). The content validity from Lieberman (1986) was based on a review of the literature themes in the area of brain hemisphere dominance (Lieberman, 1986).

A Cronbach's Alpha, which measures the internal consistency reliability, is 0.90, and a test-retest reliability had a Pearson Product Moment Correlation coefficient of 0.904 (Lieberman, 1986). Content validity was based on correlations with the Torrance measure, "Your Style of Learning and Thinking," Form C. The Spearman rank correlation coefficient was 0.819. The Pearson Product-moment correlation was 0.659 (Lieberman, 1986).

Hartman and Hylton (1997) showed HMI's validity and reliability. Correlations for two groups of subjects (r = .61 and r= .69) were found with the Human Information Processing Survey (Hartman & Hyton, 1997). Acceptable concurrent validity was established. A reliability coefficient correlation of r = .74 came from test-retests methods. All correlations were statistically significant.

Subjects

HMI forms and release/survey forms were provided to 87 college students in two sections of a first programming course in Visual Basic v6 at a central Texas university. The course covered visual objects, controls, events, data types, and procedures. Procedures included logical operations, repetition, and arrays. Six programming assignments were required. The prerequisite for this Visual Basic v6 course was a computer literacy course dealing with word processing, spreadsheets, and web browsers. Participation was voluntary and anonymous. Course content, instructor, and test were kept constant in an effort to reduce statistical error variance. The data collected were Pre and Post HMI scores ranging from -60 to +60.

Data collection and recording

Release and HMI forms were distributed at the beginning of the semester to two course sections of Visual Basic. Data was obtained only from those in class who signed the release. At the end of the semester, post-treatment scores were obtained. Of the 87 subjects who signed the release forms, 51 completed both the Pre-HMI forms and the Post-HMI forms.

4. DATA ANALYSIS

The SPSS package was used for data analysis. Means, standard deviations, a t-Test, and a paired samples correlations were performed on the Pre- and Post-HMI scores.

Because of the possibility that the 36 students, who took the Pre-HMI and not the Post-HMI, may have had different Pre-HMI scores with those who did both Pre- & Post-HMI, a t-test on the Pre-HMI scores was performed. The purpose was to determine if the 36 were significantly different in cognitive style.

5. RESULTS

Table 1 indicates no significant difference between the 51 pairs of Pre and Post-HMI scores. Table 2 shows the responses were consistent between the administrations of the HMI. The first null hypothesis (H1) is tenable. A one semester VB programming course does not change cognitive style, as measured by Pre- and Post-HMI scores. Since there was no effect, a control group is unnecessary to confirm an effect.

Students, who did not complete the treatment, may have dropped because the course did not fit their cognitive style. When van Merrienboer (1990) tried to change thinking style to improve learning outcomes, subjects were frustrated. Table 3 shows the group statistics of those who completed HMI forms and those who did not. There was a wide range of scores for each group, as indicated by the standard deviation. To see if there was a difference between groups, a variance assumed t-Test on the Pre-HMI inventory was performed. It showed no significant difference between the two groups ($t= 1.009$, $df = 85$, $p< .366$ two-tail). The second null hypothesis (H2) is tenable. Those that did not take the post-Hemispheric Mode Indicator (HMI) had Pre- HMI scores equal to the Pre-HMI scores of those that took the post-HMI.

6. DISCUSSION

Matching cognitive styles affects learning outcomes (Ford & Chen, 2001). Students placed in classes that best fit their cognitive characteristics (style and level) have a higher probability of success (White, 2002). Research has shown cognitive development/abilities (what can be learned), cognitive styles (how one learns) based on hemispheric brain dominance, and prior experiences are factors in the learning of procedural programming languages (Cafolla, 1987; Evans & Simkin, 1989; Fletcher, 1984; Gibbons, 1995; Ignatuk, 1986; Little, 1984; Losh, 1984; Monfort et al, 1990; Ott, 1989; Wu, 1993). White (2002) showed VB as left hemispheric thinking style even though the language contains object-oriented components. Left hemispheric dominance style is an important indicator of success for VB (White & Ploeger, 2004). However, can learning impact students' cognitive style?

Like cognitive development (what can be learned), cognitive style (how one learns) is also most likely fixed in adulthood. van Merrienboer (1990) study was unable to force a change in thinking style to improve learning outcomes. Like cognitive development, cognitive style in adulthood may have reached maturation or such non-impact was possibility due to a short treatment period.

Limitations:

A presumption is that if the course did have a positive impact on cognitive style, the students would most likely complete the Post-HMI forms. However, 31 subjects did not complete the Post-HMI forms. The reasons could have dropping out as a result to frustration due to thinking style conflict, poor time management, poor study habits, absent on the day Post-HMI was given, and/or a lack of motivation. Since there was no statistical significance difference between Pre-HMI scores of those that completed the post-HMI forms and those that did not, the presumption of frustration due to thinking style conflict is not supported. The second null hypothesis (H2) addressing this issue was found to be tenable.

The length of treatment was only a one semester course. Improvement may occur after years of constant treatment. Such a possibility could be hidden from the results due to sample size. A larger sample size may indicate such an effect, although small. However, if full maturation occurred, there will be no improvement or change. Most students, who were over the age of 18, in this study may have reached maturation while a few may not have.

7. CONCLUSION

This study indicates students need to have the correct cognitive style in order to succeed in a VB programming course. Such a course does not change cognition to the correct thinking style. To argue that allowing any student into programming, because they will develop the cognitive style needed, is a mistake. Students must already have the needed cognitive style to succeed in programming. Students placed in classes that best fit their cognitive style have a higher probability of success (White, 2002). As stated in White (2007), "the implication is that programming courses need prerequisites."

8. FUTURE RESEARCH

Based on prior research over the decades and this research, it is clear that certain cognitive abilities are needed to learn programming. Future research needs to look at what prerequisites are needed to ensure success in computer programming.

9. REFERENCES

Andrew, A. W. (1999). The differential roles of right and left sides of the brain in memory formation. *Behavoiural Brain Research, 98*(2), 289-295.

Armstrong, S. J. & Hird, A. (2009). Cognitive Style and Entrepreneurial Drive of New and Mature Business Owner-Managers. *Journal of Business Psychology, 24, 419-430.*

Bastian, S., Frees, J., Gruber, L., Johnson, J., Landes, B., Morton, L., Rozgony, S., & Stewart, J. (1973). Are I.S.U. Freshman Students Operating at a Formal level of thought Processes? *Contemporary Education, 44*, 358-362.

Bryden, M. P. (1990). Choosing sides: the left and right of the normal brain. *Canadian Psychology, 31*(4), 297-309.

Buchner, M. (1999). Visual tools: Pros and cons. *Midrange Systems, 12(6), 18.*

Cafolla, R. (1987). The Relationship of Piagetian formal Operations and other cognitive factors to computer programming ability (Development). *Dissertations Abstracts, A47*(7), 2506.

Carthey, J. H. (1993). Relationship between Learning Styles and Academic Achievement and Brain Hemispheric Dominance and Academic Performance in Business and Accounting Courses. *ERIC, ED374412*.

Chen, L. (2010). Web Based Learning Programs: Used by learners with various cognitive style. *Computer & Education, 54(4), 1028-1035.*

Corman, L. and Guynes, C. and Vanecek, M. (1994-1995). A Study of Laterality and Cognitive Style in Information Systems and Liberal Arts Students. *Journal of Computer Information Systems, 35(2), 26-34.*

Diehl, H. L. (1986 Nov). Learning Style and Brain Hemisphere Dominance: Interrelationships and Influences on Organizational Role Selection. *Dissertation Abstracts, 50*(5), 1363.

Dumas, R., & Morgan, A. (1975). EEG Asymmetry as a Function of Occupation, Task and Task Difficulty. *Neuropsychologia, 13*, 219-228.

Dunn, R. (2000). *Teaching students through their individual learning styles: A practical approach.* St. John's University, Jamaica, NY.

Evans, G. E., & Simkin, M. G. (Nov 1989). What best predicts computer proficiency? *Communications of the ACM, 32*(11), 1322-1327.

Fletcher, S. H. (1984). Cognitive Abilities and Computer Programming. *EDRS*(ED259700).

Folk, M. J. (1973). Influences of Developmental Level on a Child's Ability to Learn Concepts of Computer Programming. *Dissertation Abstracts International, 34*(3), 1125a.

Ford, N. & Chen, S. Y. (2001). Matching/mismatching revisited: an empirical study of learning and teaching styles. *British Journal of Educational Technology*, 32(1), 5-22.

Galton, A. (1992). Logic as a Formal Method. *The Computer Journal, 35*(5), 431-440.

Gibbons, P. (1995). A cognitive processing account of individual differences in novice Logo programmers' conceptualisation and use of recursion. *Journal of Educatinoal Computing Research, 13*(3), 211-226.

Gibbs, H., & Tucker, A. B. (1986). A Model Curriculum for a Liberal Arts degree in Computer Science. *C ommunications of the ACM, 29*(3), 202-210.

Grehan, R. (1996a). A Complete Trilogy of Visual Basic tools: Code Complete from MicroHelp. *Byte, 21, 32.*

Grehan, R. (1996b). Visual programming for Science: Visual Science from acroScience. *Byte, 21, 208.*

Griffiths, D. H. (1973). the Study of the Cognitive Development of Science Students in Introductory Level Courses,. *ERIC*(ED096108).

Hartman, S. & Hyton, J. (1997). Estimates of Validity and Reliability for the Hemispheric Mode Indicator. *Perceptual and Motor Skills, 85(3, part 2), 1355-1364.*

Herrmann, N. (1981 Oct). The Creative Brain. *Training & Development Journal, 35*(10), 10-16.

Herrmann, N. (1982). The Creative Brain. *NASSP Bulletin, 66*(455), 31-46.

Holbrugge, D. & Mohr, A. T. (2010). Cultural Determinants of Learning Style Preferences. *Academy of Management Learning & Education, 9(4), 622.*

Hudak, M. A. & Anderson, D. E. (1990) Formal Operations and Learning Style Predict Success in Statistics and Computer Science Courses. *Teaching of Psychology*. 17(4) 231-234.

Ignatuk, N. (1986). An Analysis of the Effects of Computer Programming on Analytical and Mathematical skills of high school students. *Dissertation Abstracts, A47*(3), 854.

Kai, J. and McKim, J. (1998). Object-oriented capabilities of Visual Basic. *Journal of Object-Oriented Programming 11(6), 46-57.*

Lau, W. W. F. & Yuen, A. H. K. (2009). Promoting conceptual change of learning sorting algorithm through the diagnosis of mental models: The effects of gender and learning styles. *Computers & Education*, 54, 275-288.

Lawson, A. E., & Wollman, W. T. (1975a). Hemispheric Dominance, Conservation Reasoning and the Dominant Eye. *EDRS, ED130778*.

Learning Inc. (2000). *Hemispheric Mode Indicator (HMI): Right and Left Brain Approaches to Learning.* Learning, Inc, Wauconda, Il.

Lieberman, M. G. (1986). The Hemnispheric Mode Indicator Technical Notes. EXCEL, Inc, Barrington, Il.

Little, L. F. (1984). The Influence of Structured Programming, Gender, Cognitive Development and Engagement on the Computer Programming Achievement and Logical Thinking Skills of Secondary Students. *Dissertation Abstracts, A45*(6), 1708.

Llewellyn, E. and Stanton, M. and Roberts, G. (2002). Nine-step approach to designing successful visual programming applications. *Computing & Control Engineering Journal, 13(2), 82-86.*

Losh, C. L. (1984) the relationship of student hemisphericity to performance in computer programming courses. *Dissertation Abstracts A44(7), 2127.*

Nelson, R. (1993). *Running Visual Basic for Windows*. Microsoft Press, Redmond, WA.

Mains, M. G. (1997) The Effects of Learning a Programming Language on Logical Thinking Skills. Unpublished Thesis, University of Nevada, Las Vegas, Nevada.

McCluskey, J. J. (1997). An exploratory study of the possible impact of cerebral hemisphericity on the performance of select linear, non-linear, and spatial computer tasks. *Journal of Educational Computing Research, 16*(3), 269-279.

McPherson, B. & Willis, L. (2010). Learning Styles among International and American Business Students. *Journal of International Business and Cultural Studies, 2, 1-14.*

Monfort, M., Martin, S. A., & Frederickson, W. (1990). Information-processing differences and laterality of students from different colleges and disciplines. *Perceptual & Motor Skills, 70*(1), 163-172.

Myers, J., J. P. (1990). The central role of mathematical logic in computer science. *SIGCSE Bulletin, 22*(1), 22-26.

Myers, J. P. & Brita , M. (1996). "Cognitive Style and Achievement in Imperative and Functional Programming Language Courses." *ERIC* ED398892 (1996).

O'Brian, J. (2004). *Management Information Systems: Managing Information Technology in the Business Enterprise, 6th Ed*. McGraw Hill, Boston.

Ott, C. F. P. (1989). Predicting achievement in computer science through selected academic, cognitive and deographic variables. *Dissertation Abstracts, A49*(10), 2988.

Owens, B. and Seiler, J. (1996). A study of the relationship between performance in propositional logic and computer science. Proceedings of the Seventh Annual south Central Small College Computing Conference, The Journal of Computing in Small Colleges, 11(7), pp.90-93.

Pea, R. D. & Kurland, D. M., (1984). On the cognitive effects of learning computer programming: a critical look. Technical Report No. 9, Bank Street College of Education, New York.

Petty, G. C. & Holtzman, F.(1991). Learning styles and brain hemisphericity of Technical Institute Students. *Journal of Studies in Technical Careers*, 13(1), 79-91.

Pietromonaco, P. (2002). The Versatile Visual Basic. *Poptronics, 3(7), 16-18.*

Priebe, Roger L. (1997). *The Effects of Cooperative Learning on Content Comprehension and Logical Reasoning in a Second-Semester University Computer Science Course*. Unpublished Doctoral Dissertation, University of Texas, Austin, Texas.

Rosson, M.B.; Carrol, J.M.; and Bellamy, R.K.E.(1990). "A case study in minimalist instruction." *Human Factos in Computing Systems,* CHI '90 Converence, p. 423-429.

Rotenberg, V. S., & Arshavsky, V. V. (1997). Right and left brain hemispheres activation in the representatives of two different cultures. *Homeostasis in Health & Disease, 38*(2), 49-57.

Saleh, A., & Iran-Nejad, A. (1995). Wholetheme constructivism and Whole Brain Education: Educatinoal Implications of the Research on Left and Right Brain Hemispheres. *ERIC, ED393896*.

Scholtz, J. Chidamber, S.; Glass, R.; Goemer, A.; Rosson, M.B.; Stark, M.; and Vessey, I.(1993). "Object-oriented programming: the promise and the reality." *Journal of Systems Software*, 23, p.199-204.

Schneider, D. (1999). *An Introduction to Programming using Visual Basic 6.0, 4th Ed*. Prentice Hall, Upper Saddle River, NJ.

Schwebel, M. (1972). Logical Thinking in College Freshman: Final Report. *ERIC*(ED 110896).

Schwebel, M. (1975). Formal operations in first year college students. *Journal of Psychology, 91*, 133-141.

Sheetz, S. & Irwin, G. & Tegarden, D. & Nelson, H. J. & Monarchhi, D. E. (1997). "Exploring the difficulties of learning object-oriented technique." *Journal of management Information Systems.* 14(2) 103-131.

Shelly, G. and Cashman, T. and Quasney, J. (2003). *Microsoft Visual Basic.NET Complete Concepts and Techniques*. Thomson Course Technology, Boston, Mass.

Shirer, D. (2000). Basic: The Little Language that wouldn't Die. *Computing in Science & Engineering, 2(2), 6-10.*

Spain, W. (1996). Visual Basic. *Computerworld 30(44), 102.*

Sperschneider, V., & Antoniou, G. (1991). *Logic: A foundation for Computer Science*. Reading, MA: Addison-Wesley.

SPSS Base 10.0 Application Guide. SPSS, Inc. Chicago, Il; p. 28 (1999).

Supprian, T., & Hofmann, E. (1997). The fornix of the human brain: Evidence of left/right asymmetry on axial MRI scans. *Surgical and Radiologic Anatomy, 19*(2), 105.

Tennant, M. (1988). *Psychology and adult learning*. Routledge, London.

van Merrienboer, J. (1990). Instructional strategies for teaching computer programming: Interactions with the cognitive style reflection and impulsivity. *Journal of Research on Computing in Education,* 23(1), 45-52.

White, G. (2001). Cognitive Characteristics for Learning Java, an Object Oriented Programming Language. Unpublished Dissertation, University of Texas at Austin, Texas.

White, G. (2002). Cognitive Characteristics for Learning C++. *Journal of Computer Information Systems, 42(3), p51-55.*

White, G. (2007). Visual Basic programming impact on cognitive development of college students. *Journal of Information Systems Education, 17(4), p421-428.*

White, G. & Ploeger, F. (2004). Cognitive Characteristics for Learning Visual Basic. *Journal of Computer Information Systems, 44(3), p58-66.*

White, G. and Sivitanides M. (2002). A Theory of the Relationships between Cognitive Requirements of Computer Programming Languages and Programmers' Cognitive Characteristics. *Journal of Information Systems Education, 13(1), p59-66.*

Witkin, H. A., Moore, C. A., Oltman, P.K., Goodeenought, D. R., Friedman, F., Owen, D. R., et al. (1977). Role of the field dependent and filed independent cognitive styles in academic evolution: A longitudinal study. *Journal of Educational Psychology, 69(3), 197-211.*

Wu, C.-C. (1993). *Conceptual Models and Individual Cognitive learning Styles in Teaching Recursion to Novices.* Unpublished Dissertation, University of Texas, Austin

Editor's Note:

This paper was selected for inclusion in the journal as a ISECON 2011 Meritorious Paper. The acceptance rate is typically 15% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2011.

Appendix

Tables

Table 1. Score means, Standard Deviations, Paired Sample t-Test N = 51

	Pre Mean	Pre SD	Post Mean	Post SD	t	df	Sig. (2-tail)
HMI	-3.6275	12.0083	-1.8627	12.2148	-1.060	50	.294

Table 2. Paired Samples Correlations N = 51

Pairs	Correlation	Sig
Pre & Post HMI	.518	.000

Table 3. Group Statistics for Pre-HMI scores

		N	Mean	Std. Deviation	Std. Error Mean
Pre-HMI scores	Not Completed	36	-.8889	13.09913	2.18319
	Completed	51	-3.6275	12.00827	1.68149