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DOES LEARNING STYLE PLAY A ROLE IN COMPUTER INFORMATION SYSTEMS COURSE PERFORMANCE?

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ABSTRACT

This study represents an analysis of student performance in computer information systems (CIS) courses and Felder and Spurlin's Index of Learning Styles (ILS) on academic success in CIS courses. For this study, academic success is measured by grades achieved. The ILS measurement scale was self-analyzed by students in CIS courses from fall 2008 through spring 2013. The data showed a statistically significant correlation between various personality dichotomies of the type (Extraversion-Introversion, Sensing-Intuition, Thinking-Feeling, and Judging-Perceiving) and higher grades scores. The results of this study indicate that course performance of groups of students are different relative to their personality type. In this study, thinking type students performed better than Feeling types, and Judgers performed better than Perceivers.

Keywords: Index of Learning Styles, Computer Information Systems, ILS

INTRODUCTION

One of the most studied areas of pedagogical research is the area of student success. There are literally hundreds of studies that have proposed various factors that can influence student performance. Most studies focus on the environment that fosters student success. One of the most cited articles is from Wang, Haertel, and Walberg (1997). And most recently Truong (2016) has reviewed 51 studies and found the Felder-Silverman model to be the most used tool. Learning styles are being used to tailor e-learning to individual needs and preferences (Ghazali, Noor, and Saad, 2015).

Wang, Haertel and Walberg studied a variety of factors and found a direct influence of student-teacher interaction on student success. Some studies have examined the reasons for success from an internal student perspective. One of the most cited in this category is from Pritchard and Wilson (2009) which found that academic success in college is affected by student social and emotional factors such as stress, alcohol consumption (social), self-esteem and fatigue (emotional). Hsu and Barnes (20160 studied computer science and computer information technology students. They found CIT students have a slightly different personality compared to CS students but did not specify differences.

Our study also includes student success but from a learning style perspective. There has been some past exploration of the effect of learning styles on student success but little applied empirical investigation of learning styles has been done in the Information Systems (IS) field (Cegielski, Hazen, and Rainer, 2011). Our study examines the role of learning styles on success in CIS and MIS courses. More specifically, does learning style have an effect on computer information systems course grades.

BACKGROUND

Overview of Learning Styles

Keefe (1979) defines learning styles as "…cognitive, affective, and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment." Students have different preferences in how they process information (Felder and Spurlin, 2005). By being aware of learning style differences, instructors can teach in a way to effectively reach most students (Felder, 2010). If an instructor's teaching style is compatible with a student's learning style, the student is more likely to retain information, apply it in an effective manner, and possess a better attitude towards the topic (Wirz, 2004). Otherwise, if the learning styles of the majority of students in a class are seriously mismatched with the instructor's teaching style, the students are likely to become discouraged about the course and the curriculum and may change to a different major (Felder and Spurlin, 2005).

Models / Theories Related to Learning Styles

For years, researchers have tried to understand and categorize the different ways in which students learn information (Wilson, 1998). At least several dozen learning style models have been developed by researchers (Felder and Brent, 2005). According to Felder (2010), a learning style model specifies a "small number of dimensions that collectively provide a good basis for designing effective instruction." A few of the most widely-known models and theories related to learning styles are briefly reviewed in the following subsections.

Jung's Theory of Psychological Types / Myers-Briggs Type Indicator (MBTI)

The Myers-Briggs Type Indicator (MBTI) is based upon Jung's Theory of Psychological Types (Jung, 1971). Even though the MBTI is often used to assess personality types, MBTI profiles have strong implications on learning styles (Felder, 1996; Pittenger, 1993). The MBTI uses four scales to classify individuals:

- Introversion (I) or Extroversion (E)
- Sensing (S) or Intuition (N)
- Thinking (T) or Feeling (F)
- Judging (J) or Perceiving (P)

Individuals can be categorized into one of sixteen personality types using a combination of abbreviations listed above (i.e. ISTJ, INFP, ESFJ, etc.).

Dunn and Dunn's Learning Style Inventory

Dunn and Dunn (1979) developed the Learning Style Inventory. It is a widely-used learning styles instrument in elementary and middle schools (Keefe, 1982). Dunn and Dunn presented 18 elements of learning styles, which can be categorized into four areas:

- Instructional environment stimuli (sound, light, temperature, and seating design)
- Emotionality stimuli (motivation, persistence, responsibility, and structure)
- Sociological stimuli (peers, self, paired, team, adult, and varied)
- Physical stimuli (perceptual preferences (auditory, visual, tactile, kinesthetic), intake (eating, drinking, chewing), time of day, and mobility needs)

Dunn and Dunn (1979) believe that a student's motivation and achievement increase when teaching styles and learning styles are properly matched.

Kolb's Experiential Learning Model

Kolb (1984) classifies students based upon their preferences for how they take information and how they process information. Individuals can be categorized into four types according to Kolb's model:

- Type 1 (concrete, reflective)
- Type 2 (abstract, reflective)
- Type 3 (abstract, active)
- Type 4 (concrete, active)

Type 1 students typically learn best if their professor serves as a motivator, as they want to understand how the course material relates to their careers. Type 2 students like information to be organized logically and learn best when their professor acts as an expert on the course material. Type 3 students learn best kinesthetically, as they like to try out new things. Their professor should provide them with exercises and examples that are hands-on. Type 4 students learn best through problem-based learning, as they respond best to open-ended questions from their professor (Kolb, 1984).

Felder-Silverman Model / Index of Learning Styles (ILS)

The Index of Learning Styles (ILS) is a 44-question self-scoring instrument that assesses an individual's preferences on the four dimensions of the Felder-Silverman Model (Felder & Spurlin, 2005):

- Active / Reflective learners
- Sensing / Intuitive learners
- Visual / Verbal learners
- Sequential / Global learners

The active / reflective dimension is derived from Kolb's learning style model (1984) and relates to the introversion and extroversion components from the MBTI (Lawrence, 1994). Active learners enjoy working in groups and learn by trying things out, while reflective learners prefer working by themselves or with a person in which they are comfortable, and learn best by thinking through things first (Felder and Spurlin, 2005).

The sensing / intuitive dimension in the Felder-Silverman model comes from the MBTI. Sensing learners are concrete thinkers oriented towards procedures and facts, while intuitive learners think abstractly, are innovative, and more oriented towards theories and their underlying meanings (Felder and Spurlin, 2005). Sensors do not like courses that have no apparent connection to the "real world," while intuitors do not like courses requiring lots of memorization (Felder and Soloman, n.d.b).

The visual / verbal dimension is related to modality theory (Barbe, Swassing, and Milone, 1979), which presents the relationships between visual, auditory, and kinesthetic learning. Visual learners prefer pictures, diagrams, flow charts, time lines, and demonstrations, while verbal learners prefer written and spoken explanations (Felder and Spurlin, 2005; Felder and Soloman, n.d.b).

Sequential learners are considered to be left-brain dominant (McCarthy, 1987; Herrmann, 1991), think in a linear process and prefer incremental steps (Felder and Spurlin, 2005). Global learners are considered to be right-brain dominant (McCarthy, 1987; Herrmann, 1990), have a more holistic thinking process (Felder and Spurlin, 2005), and think in a hierarchical manner (Kirby, 1998).

Individuals can take the ILS questionnaire at http://www.engr.ncsu.edu/learningstyles/ilsweb.html for no cost (Felder and Soloman, n.d.a) in order to find out their learning style preferences (Wirz, 2004). There are eleven questions in the ILS associated with each of the four learning style dimensions (Felde
r and Spurlin, 2005). Upon completion of the online questionnaire, results are immediately displayed to the user.

The ILS test results are based on a scale of 1 to 11 for each learning style. An example scoring is shown below. Where the X represents the individuals selection.

ACT											**REF**
							X				
11	9	7	5	3	1	1	3	5	7	9	11

A score between 1and 3 indicates the individual is fairly well balanced on the two dimensions of that scale. A score between 5 and 7 indicates a moderate preference for one dimension of the scale and the individual will learn more easily in a teaching environment which favors that dimension. A score 9 or greater indicates a very strong preference for one dimension of the scale. The individual may have real difficulty learning in an environment which does not support that preference.

The ILS can be used to provide insight to students concerning their learning strengths and weaknesses. Instructors can also gain guidance by understanding their students' learning styles and designing courses that address the learning needs of all of their students (Felder and Spurlin, 2005). The Appendix provides the list of questions asked in the Index of Learning Styles.

Even though much research has been conducted about learning styles, little applied empirical investigation of learning styles has been done in the Information Systems (IS) field (Cegielski, Hazen, and Rainer, 2011). This study will begin to close the gap by presenting and interpreting results collected from students taking multiple IS courses at a four-year university in the mid-Atlantic region of the United States.

RESEARCH METHODOLOGY

The study centered upon the following research question: Does learning style have an effect on computer information systems course grades.

The research hypotheses to be tested are as follows:

H1: There is a significant difference between the grades and learning styles.

H2: There is a significant relationship between grade and the Active vs-Reflective index score.

H3: There is a significant relationship between the grade and the Sensing-Intuitive index score.

H4: There is a significant relationship between the grade and the Visual-Verbal index score.

H5: There is a significant relationship between the grade and the Sequential-Global index score.

RESULTS

The ILS exam was distributed to students enrolled in CIS courses at a public university located in Virginia. Five years of data were collected, from 2008 through 2013. Each semester the ILS was given to undergraduate and graduate students in CIS courses. Students from 30 classes were examined with the following course distribution: Undergraduate: Programming (14), Enterprise Architecture (7), and Computer Security Management (4), Graduate: Managerial Information Systems (5). The total number of valid scores for analysis was 810.

While the majority of students were CIS majors, there were a number of students that were taking the course as an elective or for a CIS minor. The distribution of majors and their corresponding ILS are given in Table 1. The CIS courses seem to attract more active, sensing, visual and sequential learning types. Each of the hypotheses was tested using SPSS 22.0 and an appropriate statistical process.

Table 1. Learning Styles by Major

Learning Style	CIS	CS	Mkt	Acct	Mgt	Fin	Ibus	Econ	MBA	Other	Total
Active	179	3	26	92	32	50	7	8	44	60	501
Reflective	103	4	8	52	17	35	6	5	31	48	309
Sensing	214	4	26	122	35	70	11	6	52	75	615
Intuitive	68	3	8	22	14	15	2	7	23	33	195
Visual	231	7	30	120	40	72	9	10	56	91	666
Verbal	51		4	24	9	13	4	3	19	17	144
Sequential	206	3	25	101	25	54	8	5	39	76	542
Global	76	4	9	43	24	31	5	8	36	32	268
Total	282	7	34	144	49	85	13	13	75	108	810

H1: There is a significant difference between the grades and learning styles.

For hypothesis one, a non-parametric Independent Kruskal-Wallis test was performed on the sixteen different combinations of learning styles to determine if there was any difference. A statistical difference was found at $p < .022$. Different learning styles did have an effect on performance in the CIS courses shown by the differences in grade distribution.

Further analysis was performed on each of the four styles. Table 2 and Figure 1 show the average grade distribution by the specific dichotomous learning styles. There are differences in each of the dimensions but analysis needed to be performed to determine the significance of these differences. Hypotheses two through four dealt with each of these dimensions. A multiple regression analysis with each learning dimension was prepared to determine the significance of each individual dimension. The results of this analysis are shown in Table 3.

Table 2. Grades by Learning Style

Learning Style	Average Grade
Active	81.33
Reflective	84.09
Sensing	82.82
Intuitive	81.02
Visual	82.1
Verbal	83.67
Sequential	82.08
Global	83.01

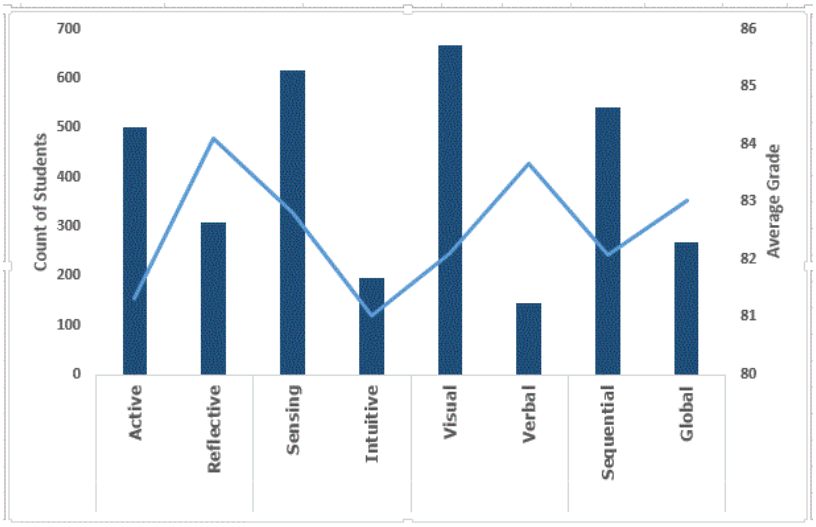

Figure 1. Count and Grades by Learning Style

Table 3. Statistical Results Based on Learning Style

Coefficients[a]

Model		Unstd Coeff.		Std. Coeff.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	84.1	0.773		108.79	0
	A/R	-2.77	0.983	-0.098	-2.812	0.005
2	(Constant)	81.02	0.978		82.857	0
	S/I	1.801	1.122	0.056	1.605	0.109
3	(Constant)	83.67	1.135		73.738	0
	VI/VR	-1.56	1.252	-0.044	-1.245	0.213
4	(Constant)	83.02	0.835		99.421	0
	SE/GL	-0.94	1.02	-0.032	-0.917	0.359

a. Dependent Variable: NumericGrade

Results on the active vs reflective learner showed that there is a significant relationship between grade and the A-R index score. Hypothesis 2 was accepted. Reflective learners earned higher grades than active learners. This result was significant at $p < .005$.

Hypothesis 3, testing if there is a significant relationship between the grade and the Sensing vs-Intuitive index score was narrowly rejected at $p < .10$. The actual results were $p < .109$. The sensing type learner performed better than the intuitive learner but the results were not statistically significant. This may suggest further study and more data to determine if this possible relationship may be significant.

The data showed no other significant relationships, therefore, hypothesis 4 and 5 were rejected. There is no relationship between grades and visual vs reflective learner or sequential vs global learners.

CONCLUSIONS AND FUTURE RESEARCH

Our study has found that learning styles do have an impact on overall student success. First it was found that there are significant differences in the 16 different learning style combinations that are possible based on the Felder-Silver Model of Index of Learning Styles. A more comprehensive survey and expanded student population is needed to study in depth the nuances and significances of each of the sixteen possible combinations. This will be undertaken by the researchers. Next, it was found that active learners have better performance than reflective learners. Those who actively try things out rather than think things out have higher grades. These active learners also enjoy working in groups rather than by themselves. This is a surprising and interesting finding, contrary to the perceived stereotype of the programming loner nerd. This suggests that promoting group work and interaction is desirable in educational settings. While more active learners were enrolled in the CIS courses, the data showed that reflective learners earned higher grades than the active learners. This may be attributed to the structure of the class. Active learners learn better when they are able to study in groups. Creating students groups and promoting students studying together may improve the active learner's grade performance. Active learners prefer the subject matter have a practical use and applicable to their world. So more applied homework may be helpful for the active learner.

Further research should be done on the effect of changing the classroom environment to see if it has an effect on the active learners' grades. Also, further analysis should done to see if the active learners' performed better in certain classes. Results also showed that sensing learners who are concrete thinkers concerned with procedures and facts achieve higher performance than intuitive/abstract thinkers. This was just outside the realm of significance. Perhaps a larger sample size would confirm this potential difference. It could support the "real world" significance that is suggested in the active learning dimension correlation with higher grades earned. The final two dimensions of visual/verbal and sequential/global were not found to be significant factors in CIS performance. These findings suggest very important results. It was noted that sequential learners are considered left-brain and linear thinkers. Many studies have suggested that computer information systems require this type of thinking. But contrary to common thought we found no difference in left brain or right brain thinkers. Both performed equally well in the CIS courses. The finding of no difference between visual or verbal dimension suggests that a variety of educational methods can be equally successful in CIS instruction from diagrams to online videos. Overall, we will be expanding our studies to further explore this overall fertile area of research and welcome collaborators and contributors.

REFERENCES

Barbe, W. B., Swassing, R. H., & Milone, M. N. (1979). Teaching through modality strengths: Concepts and practices. Zaner-Bloser, Columbus, OH.

Cegielski, C. G., Hazen, B. T., & Rainer, R. K. (2011). Teach Them How They Learn: Learning Styles and Information Systems Education. *Journal of Information Systems Education*, *22*(2), 135-146.

Dunn, R. S., & Dunn, K. J. (1979). Learning styles/teaching styles: Should they... can they... be matched. *Educational Leadership*, *36*(4), 238-244.

Felder, R. M. (1996). Matters of style. *ASEE prism*, *6*(4), 18-23.

Felder, R. M. (2010). Are learning styles invalid? (Hint: No!). *On-Course Newsletter*, 1-7.

Felder, R. M., & Brent, R. (2005). Understanding student differences. *Journal of Engineering Education, 94*(1), 57-72.

Felder, R. M., & Soloman, B. A. (n.d.a). Index of Learning Styles. Retrieved July 6, 2016 from http://www.ncsu.edu/felder-public/ILSpage.html

Felder, R. M., & Soloman, B. A. (n.d.b). Learning styles and strategies. Retrieved July 26, 2016, from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm

Felder, R. M., & Spurlin, J. (2005). Applications, reliability and validity of the index of learning styles. *International Journal of Engineering Education*, *21*(1), 103-112.

Ghazali, A. S. M., Noor, S. F. M. & Saad, S. (2015). Review of personalized learning approaches and methods in e-learning environment. *Electrical Engineering and Informatics (ICEEI), 2015 International Conference,* 10-11 Aug., 624-627.

Herrmann, N. (1991). The Creative Brain*. *The Journal of Creative Behavior*, *25*(4), 275-295.

Hsu, W. & Barnes, G. M. (2016). Are Computer Information Technology Majors Different Than Computer Science Majors In Personality, Learning Style, Or Academic Performance? *Journal of Computing Sciences in Colleges*, *31*(4), 100-107.

Jung, C. G. (1971). Psychological Types: The collected works of CG Jung (Vol. 6). Princeton University Press, Princeton, NJ, USA.

Keefe, J. W. (1982). Assessing student learning styles: An overview. In J. W. Keefe (Ed.), Student learning styles and brain behavior (pp. 43-53). National Association of Secondary School Principals, Reston, VA.

Keefe, J.W. (1979) Learning style: An overview, in J. W. Keefe (ed.), *Student learning styles: Diagnosing and prescribing programs*, NASSP.

Kirby, J. R. (1988). Style, strategy, and skill in reading. In Learning strategies and learning styles (pp. 229-274). Springer US.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development (Vol. 1). Prentice-Hall, Englewood Cliffs, NJ.

Lawrence, G. D. (1993). People types & tiger stripes. Center for Applications of Psychological Type, Inc., 2815 NW 13th Street, Suite 401, Gainesville, FL 32609.

McCarthy, B. (1987). The 4MAT System: Teaching to Learning Styles with Right. Left Mode, Excel, Inc.

Pittenger,D.J. (1993). The utility of the Myers-Briggs type indicator. *Review of Educational Research*, *63*(4), 467-488.

Pritchard, M. E., & Wilson, G. S. (2003). Using emotional and social factors to predict student success. *Journal Of College Student Development, 44*(1), 18-28.

Truong, H. M. (2016). Integrating learning styles and adaptive e-learning system: Current developments, problems and opportunities. *Computers in Human Behavior, 55*(B) 1185–1193.

Wang, M. C., Haertel, G. D., & Walberg, H. J. (1997). What Helps Students Learn? Spotlight on Student Success. Retrieved July 5, 2016 http://eric.ed.gov/?id=ED461694

Wilson, V. A. (1998). Learning How They Learn: A Review of the Literature on Learning Styles. U.S. Department of Education, Educational Resource Information Center. No. ERIC Document Reproduction Service No. ED 427017.

Wirz, D. (2004). Students' Learning Styles vs. Professors' Teaching Styles. *Inquiry, 9*(1). Retrieved July 8, 2016 from http://eric.ed.gov/?id=EJ876847

APPENDIX: INDEX OF LEARNING STYLES QUESTIONNAIRE

1. I understand something better after I
   (a) try it out.
   (b) think it through.
2. I would rather be considered
   (a) realistic.
   (b) innovative.
3. When I think about what I did yesterday, I am most likely to get
   (a) a picture.
   (b) words.
4. I tend to
   (a) understand details of a subject but may be fuzzy about its overall structure.
   (b) understand the overall structure but may be fuzzy about details.
5. When I am learning something new, it helps me to
   (a) talk about it.
   (b) think about it.
6. If I were a teacher, I would rather teach a course
   (a) that deals with facts and real life situations.
   (b) that deals with ideas and theories.
7. I prefer to get new information in
   (a) pictures, diagrams, graphs, or maps.
   (b) written directions or verbal information.
8. Once I understand
   (a) all the parts, I understand the whole thing.
   (b) the whole thing, I see how the parts fit.
9. In a study group working on difficult material, I am more likely to
   (a) jump in and contribute ideas.
   (b) sit back and listen.
10. I find it easier
    (a) to learn facts.
    (b) to learn concepts.
11. In a book with lots of pictures and charts, I am likely to
    (a) look over the pictures and charts carefully.
    (b) focus on the written text.
12. When I solve math problems
    (a) I usually work my way to the solutions one step at a time.
    (b) I often just see the solutions but then have to struggle to figure out the steps to get to them.
13. In classes I have taken
    (a) I have usually gotten to know many of the students.
    (b) I have rarely gotten to know many of the students.
14. In reading nonfiction, I prefer
    (a) something that teaches me new facts or tells me how to do something.
    (b) something that gives me new ideas to think about.
15. I like teachers
    (a) who put a lot of diagrams on the board.
    (b) who spend a lot of time explaining.
16. When I'm analyzing a story or a novel
    (a) I think of the incidents and try to put them together to figure out the themes.
    (b) I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.
17. When I start a homework problem, I am more likely to
    (a) start working on the solution immediately.

(b) try to fully understand the problem first.

18. I prefer the idea of
    (a) certainty.
    (b) theory.
19. I remember best
    (a) what I see.
    (b) what I hear.
20. It is more important to me that an instructor
    (a) lay out the material in clear sequential steps.
    (b) give me an overall picture and relate the material to other subjects.
21. I prefer to study
    (a) in a study group.
    (b) alone.
22. I am more likely to be considered
    (a) careful about the details of my work.
    (b) creative about how to do my work.
23. When I get directions to a new place, I prefer
    (a) a map.
    (b) written instructions.
24. I learn
    (a) at a fairly regular pace. If I study hard, I'll "get it."
    (b) in fits and starts. I'll be totally confused and then suddenly it all "clicks."
25. I would rather first
    (a) try things out.
    (b) think about how I'm going to do it.
26. When I am reading for enjoyment, I like writers to
    (a) clearly say what they mean.
    (b) say things in creative, interesting ways.
27. When I see a diagram or sketch in class, I am most likely to remember
    (a) the picture.
    (b) what the instructor said about it.
28. When considering a body of information, I am more likely to
    (a) focus on details and miss the big picture.
    (b) try to understand the big picture before getting into the details.
29. I more easily remember
    (a) something I have done.
    (b) something I have thought a lot about.
30. When I have to perform a task, I prefer to
    (a) master one way of doing it.
    (b) come up with new ways of doing it.
31. When someone is showing me data, I prefer
    (a) charts or graphs.
    (b) text summarizing the results.
32. When writing a paper, I am more likely to
    (a) work on (think about or write) the beginning of the paper and progress forward.
    (b) work on (think about or write) different parts of the paper and then order them.
33. When I have to work on a group project, I first want to
    (a) have "group brainstorming" where everyone contributes ideas.
    (b) brainstorm individually and then come together as a group to compare ideas.
34. I consider it higher praise to call someone
    (a) sensible.
    (b) imaginative.
35. When I meet people at a party, I am more likely to remember
    (a) what they looked like.

(b) what they said about themselves.

36. When I am learning a new subject, I prefer to
    (a) stay focused on that subject, learning as much about it as I can.
    (b) try to make connections between that subject and related subjects.
37. I am more likely to be considered
    (a) outgoing.
    (b) reserved.
38. I prefer courses that emphasize
    (a) concrete material (facts, data).
    (b) abstract material (concepts, theories).
39. For entertainment, I would rather
    (a) watch television.
    (b) read a book.
40. Some teachers start their lectures with an outline of what they will cover. Such outlines are
    (a) somewhat helpful to me.
    (b) very helpful to me.
41. The idea of doing homework in groups, with one grade for the entire group,
    (a) appeals to me.
    (b) does not appeal to me.
42. When I am doing long calculations,
    (a) I tend to repeat all my steps and check my work carefully.
    (b) I find checking my work tiresome and have to force myself to do it.
43. I tend to picture places I have been
    (a) easily and fairly accurately.
    (b) with difficulty and without much detail.
44. When solving problems in a group, I would be more likely to
    (a) think of the steps in the solution process.
    (b) think of possible consequences or applications of the solution in a wide range of areas.