Construct validity of learning styles questionnaire

S Srikoon
Curriculum and Instruction, School of Education, University of Phayao, 19 Moo 2, Phahonyothin Road, Mae Ka, Mueang Phayao, Phayao, Thailand

Corresponding author’s e-mail: sanit.sr@up.ac.th

Abstract. Learning styles is the importance goal for enhancing and focusing to help students develop learning outcomes. The purpose of this research was to validate of the learning styles questionnaire based on the left and the right brain theory. Sample are 201 students for validating the learning styles questionnaire. The learning styles questionnaire consists of the 40 items for self-assessment. Confirmatory factor analysis was used to confirm the construct validity. The results confirmed that the construct validity of these test an excellent fit. The results show that the fitness index of validating the learning styles questionnaire were as follow: statistic of 698.12 (degrees of freedom = 641, p= 0.058), and the χ2/df ratio having a value of 1.089 indicates a good fit. The comparative fit index (CFI) is 0.977, and Tucker-Lewis coefficient (TLI) is 0.972, Root mean square error approximation (RMSEA) is 0.021, Standardized Root Mean Residual (SRMR) is 0.061. All the indicators indicated that were a goodness of fit between the empirical data and the hypothetical measurement model.

1. Introduction
Interdisciplinary educational neurosciences is increasingly important and valued in education [11]. Learning theory is developed with educational neuroscience research [2]. The left and the right theory (LRT) is one educational neuroscience approach to explain learning styles with neuroscience research. Herman (1996) reported that LRT comprised of thinker style (TS), organizer style (OS), humanitarian style (HS), and innovator style (IS) [6]. The learning styles (LS) has been used in education to explain individual differences in the ways students approach learning. It is assumed that instruction based in learning styles theory produces better achievement [1]. LS has been used in education to explain individual differences in the ways students approach learning. It is assumed that instruction based in learning styles theory produces better achievement [1]. Moreover LS relate with creativity, learning behavior and student’s learning outcomes [4][10]. Consequently LS are recognized as importance part to enhance student learning outcome and has become the focus of student’s learning process.

2. Significant of the Study
Despite its wide-spread mention, one of the critical problems with learning styles theory is the lack of clear, explanatory framework [8], and only a few studies have defined the factor structure of LS [5]. To date, only a few studies have referred the factor structure of LS.
3. Conceptual Framework
LSQ is the self-assessment inventory for diagnosing face validity. It consists of 40 items of four factors of the left and right brain theory [6]. These four are thinkers style (TS), organizers style (OS), humanitarians style (HS) and innovators style (IS). TS focus on working of left prefrontal lobe. The TS learning style student is who like to lecture and to critic content, to study with case study, to refer research, to set reasoning, to connect prior knowledge with new knowledge, to learn in any times, to do with strength criteria, and to have gifted ability. OS focus on left hemisphere lobe. The OS learning style student is who like to learn with thinking strategies, to learn with step by step on learning processes, to learn in any case study, to learn from figure or table, to create the new approach to group discussion, to solve problem on action plan, to believe in accountability knowledge, to be exhaustively person and systematic worker. HS focus on working on right hemisphere lobe. The HS learning style student is who like to learn with exchange experience and knowledge sharing, to learn with experience or tale or prove, to communicate with body language, to participate for all, to show music, to discuss in social or daily life. IS focus on working of right prefrontal lobe. The IS learning style student is who like to learn with brain storming, to compare cases, to create high imagination, to do freedom activity, to construct creative activity, to build creative problem solving, to learn interesting topics, and to show artist. Figure 1. show the conclusion of the four LSQ. Each statement of LSQ is using a 5-point Likert scale namely 1 represents ‘Does not perform’, 2 represents ‘Does not really perform’. 3 represents ‘Neutral, not sure’, 4 represents ‘Perform somewhat’, and 5 represents ‘Absolutely perform’.

Figure 1: Conceptual framework of confirmatory factor analysis of LSQ

4. Aim of the Study
LSQ should be precisely measured to examine the nature of construct and to make valid explanations for each individual’s social activity. This study aimed to validate the LSQ. The specific purposes or this study are to test the construct validity of the LSQ with the left and the right brain theory.

5. Research Methodology

5.1. Sample of this Study
A total of 2,673 (N) samples of this survey research were draw from Grade 9 (n=472). Owing to incomplete response, a total of 201 cases.

5.2. Data Analysis
The rapid growing of advanced methodology would be provided the ability of researchers to analyze the construct validity. CFA was used to test the hypothesized of four-factor model consisted of 40 items in all samples. Covariance structures were fitted with the maximum likelihood method. The
model fitted indicator was evaluated by means of several fit indices. Universally, the model is considered acceptable when probability value (p-value) >0.05, value of ratio between chi-square statistic and degree of freedom (χ²/df) in 2:1 [5], the Comparative Fit Index (CFI) ≥ 0.90 and good when ≥0.95 [2][7] and Tucker-Lewis coefficient (TLI) ≥ 0.95 is good fit [12]. Moreover, Standardized Root Means Square Residual (SRMR) should not exceed 0.08 for a good fit [7]. Furthermore, Root Means Square Error of Approximation (RMSEA) value ≤ 0.06 are considered indicative of a good fit, ≤ 0.08 of fair fit, between 0.08 and 0.01 of mediocre fit and >0.01 of poor fit [7][9].

6. Research Finding
CFA was used to evaluate the goodness of fit. CFA were conducted using MPlus program. Model fit was assessed using χ², χ²/df, CFI, TLI, SRMR and RMSEA. Results showed that all indicators indicated that there was a goodness of fit between the empirical data and the hypothetical measurement model for model. In other word, statistic of 698.12 (degrees of freedom = 641), the p-value in CFA models are not significant (.0.058), χ²/df values are fall in 2:1 (1.089), all CFI ≥ 0.95 indicate the good fit (0.977). Similarity all the TLIs ≥ 0.95 are good fit (0.972). Moreover all the RMSEAs are ≤ 0.06 are considered indicative of a good fit (0.021). Finally all the SRMRs≤ 0.08 are accepted for a good fit (0.060) too. Detailed in Appendix.

7. Discussion
LS is considered as the start point of learning processes because students who learned available with LS are more likely to engage learning outcomes or knowledge into long term memory at high level [11][14]. Moreover students who are supported with learning environment to comply with student’s LS can possessed information processes at high level, too [2]. Therefore LS is the important factor of student’s learning. In addition, investigating the construct validity provide the further understanding of how any tool can measure and evaluate any variable [13]. This study was conducted purposively to examine the validity of the LSQ with the sample grade 9. Result reports that the LSQ are the well fit for all indicators as LSQ can measure the LS and can give the valid information for learning management in classroom. Moreover the LSQ can used pretest measurement for diagnosis student’s LS in classroom.

Acknowledgement
This work was supported by the Unit of Excellence in Research Methodology of Innovations and Learning Sciences based-on Educational Neurosciences, University of Phayao Research Fund, Thailand.
8. Appendix

![Diagram showing the relationships between items and factors TS, OS, HS, and IS with loadings and significance levels.]

\[\chi^2=698.12, \text{ df}=641, p=0.058, \chi^2/\text{df} = 1.089, \text{ CFI}=0.977, \text{ TLI}=0.972, \text{ RMSEA}=0.021, \text{ SRMR}=0.061\]

**Figure 2.** Results of Confirmatory factor analysis of LSQ
References
[1] Palghat, J C Horvath and J M Lodge 2017 The hard problem of educational neuroscience Trends in Neuroscience and Education 6 204-210
[2] Anderson 2009 Neurocognitive theory and constructionism in science education: a review of neurobiological, cognitive and cultural perspective. Brunei Int. J. of Sci. & Math. Edu 1 1-32
[3] Herman 1996 The Whole brain business book (New York: McGraw-Hill)
[4] An and M Carr 2017 Learning styles theory fails to explain learning and achievement: Recommendations for alternative approaches Personality and Individual Differences 116 410-416
[5] An and M Carr 2017 Learning styles theory fails to explain learning and achievement: Recommendations for alternative approaches Personality and Individual Differences 116 410-416
[6] Eishami, E A Saad and Y Nami 2014 The Relationship Between Learning Style and Creativity Procedia-Social and Behavioral Science 114 52-55
[7] Magdalena 2015 The relation of learning styles, learning behavior and learning outcomes at the romanian students Procedia-Social and Behavioral Science 180 1667-1672
[8] Jamil, F N Baharuddin and T S R Maknu 2015 Factors Mining in Engaging Students Learning Styles Using Exploratory Factor Analysis Procedia Economics and Finance 31 722-729
[9] Hair 2006 Multivariate data analysis. (N.J.: Prentice-Hall International)
[10] Bentler 1992 On the fit of models to covariances and methodology to the Bulletin Psychological Bulletin 112 400-404.
[11] Hu and M Bentler 1999 Cutoff criteria for fit indexes in covariance structure analysis: Alternatives Structural Equation Modeling 6 1-55.
[12] Sharma, S Sharma, A Sharma and W R Dillon 2005 A simulation study to investigate the use of cutoff values for assessing model fit in covariance structure models Journal of Business Research 58 935-943.
[13] MacCallum, M.W. Browne and H M Sugawara 1996 Power analysis and determination of sample size for covariance structure modeling Psychological Methods 1 130-149.
[14] Srikoon, T Bunterm, T Nethanomsak, T K Ngang 2017 A comparative study of the effects of the neurocognitive-bases model an the conventional model on learners’ attention, working memory and mood Malaysain Journal of Learning & Instruction 14 83-110
[15] Anderson 2009 Neurocognitive theory and constructivism in science education: a review of neurobiological, cognitive and cultural perspective Brunei Int. J. of Sci & Math. Edu 1 1-32
[16] Srikoon, T Bunterm, T Nethanomsak, T K Ngang 2016 Construc Validity and Measurement Invariance of the Research Skill Inventory Mediterranean Journal of Social Sciences 7 366-377