

Developing a Computerized Learning and Thinking Styles Scale for Elementary School Students

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Abstract: Over the past few decades, researchers have developed various scales measuring students' learning style or thinking style; however, most of them have constructed scales for specific style, such as learning or thinking. The purpose of this study was to develop a computerized style scale by basing upon learning and thinking styles. With the reliability analysis and exploratory factor analysis, research data gathered from 622 Taiwan elementary school students revealed that the scale was an effective tool to measure the learning and thinking styles for elementary school students. This computerized learning and thinking style scale consisted of 34 items, with the following five subscales: independent, procedure, analytic, macro, and micro.

Keywords: Computerized scale, elementary education, learning and think styles, style scale

Introduction

In the last several decades, many educational psychologists have believed that an important key to facilitating students' learning is to deal with the individual differences in cognition functions [7]. In the researches of individual differences, there has been wide interest in learning style or thinking style [1] [3] [4][6][9][11][16]. In addition, several scales have been proposed for measuring the style of learning or thinking [2][8][12]; however, most of them have constructed scales for specific style, such as learning or thinking. Garica & Huges[5] suggested that learning and thinking styles are interrelated and also that the students' academic achievement is influenced by their styles, while there are few studies of measuring both learning and thinking styles scale. Furthermore, the above-mentioned scales are implemented in a pencil and paper test format so they often require additional human-resource costs and time-consuming.

In this paper, a computerized style scale by basing upon learning and thinking styles is proposed. With the rapid development of Internet technology, the computerized learning and thinking styles scale can be implemented on a web site to help educators collect a large number of students' responses on the items and then explore each student's learning and thinking styles efficiently. Understanding the learning and thinking styles of the student can assist educators to more realize the characteristics of the student and construct adaptive subject materials for the student [5].

1. Related work

In the past decades, various issues concerning learning style or thinking style have attracted the attentions of researchers and various ways of measuring learning style or thinking style are proposed. In the following subsection, relevant studies addressing learning style and think style are given.

Learning style

Whole brain model, introduced by Herrmann in 1989, as a model of describing brain processing which involves sides (hemispheres) and levels. People have styles of processing attributed to different sides of the brain—the one more analytical, logical, factual, sequential and controlled; the other more holistic, intuitive, spontaneous and free flow. In the meantime, people have at least two different ways of processing to two different levels of the brain—the one more abstract, rational and conceptual, the other more to do with processing sensory and emotional information. The important point is that each of us uses all modes of processing, that is, we have different learning styles. The model of Herrmann learning styles is graphically illustrated in Figure 1 [10].

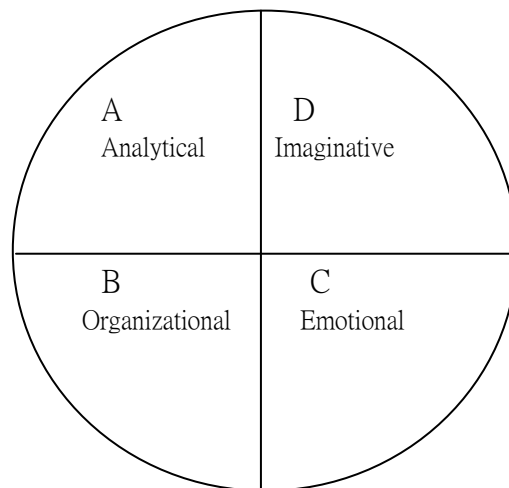


Fig.1. the model of Herrmann learning styles (Adapted from: Lumsdaine & Lumsdaine, 1995)

Thinking style

Sternberg [14] suggested that thinking style refers to what a person “prefers” to do, and how he or she like to do it when facing problems. According to a Theory of Mental Self-Government, developed by Robert Sternberg and his associates, thinking styles can be modeled as a governmental structure, that is, three functional types of thinkers: creators as legislators, who create legislation, implementers as executors ,who implement the legislation ,evaluators as judiciaries, who evaluate whether the legislation is effect or not. The Theory of Mental Self-Government also introduces four forms of thinking styles: Monarchic individuals, Hierarchic individuals, Oligarchic individuals, and Anarchic individuals. In addition, a thinking styles profile also included levels, scope, and a leaning toward an open or closed way of thinking. Levels of thinking styles consisted of global

thinking and local thinking. The scope of thinking styles spanned from task-oriented, internal thinking, to people oriented, external thinking. The leanings of thinking styles tended to lean toward a liberal or a conservative style [13] [15].

In this paper, we develop a scale based on Herrmann's learning style theory and Sternberg's thinking style theory.

2. The development of the learning and thinking styles scale

The items developed in this study are mainly based on Herrmann's [10] learning style theory and Sternberg's [14] thinking style theory. These items are assembled after consulting with some experts in cognition psychology and education. Accordingly, the initial pool of items in the scale include a total 40 items. These 40 items are divided into two dimensions, "function" and "scope", and then presented using a four-point Likert scale (from "strongly agree", "agree", "disagree" to "strongly disagree") to a group of Taiwan elementary school students for item analysis. All of items are presented in Chinese. Based on the number of the students, the type of elementary school in Taiwan is divided into three types: large-scale school, medium-scale school, and small-scale school. Using stratified sampling, 622 Taiwan elementary school fifth grade students are chosen for participants in the study. There are 602 subjects in the final sample pool (large-scale school: 348 students, medium-scale school: 203 students, and small-scale school: 51 students).

For students' non-responses, unintentional skips or unidentifiable marks on some items of the initial version of the learning and thinking styles scale, this study excludes these as "missing" data. Hence, the valid number of student cases on the scale is 487.

The analysis uses the SPSS12.0 statistical software package. First, exploratory factor analysis is used on the data for item analysis. The principle component analysis with varimax rotation is used to clarify the structure of the learning and thinking styles scale.

In the function dimension, the eigenvalues of the first three factors from principle component analysis are larger than one: 5.044, 1.997, and 1.349 (Table 1). Only three factors are retained in the final version of the scale and they account for 46.61% of variance. An item is retained only when it loads greater than ± 0.45 on the relevant factor. Hence, the initial items are reduced to 18 items. Some of the retained items are shown in Table 2. A detailed description of the three subscales (factors) is presented below:

1. The independent subscale: creators and the liberal style based on Sternberg's theory and D type based on Herrman's theory are integrated into this type—relies on own procedures, seeks variety, and follows own rules.

2. The procedure subscale: implementers and the conservative style based on Sternberg's theory and B type based on Herrman's theory are integrated into this type—believes that procedures are important and follows instructions.

3. The analytic subscale: evaluators based on Sternberg's theory and A type based on Herrman's theory are integrated into this type—prefers evaluating the performance of tasks.

The internal reliability indexes, alpha coefficients, are adequate for the three subscales, 0.749, 0.782, and 0.746 and for the "function" dimension scale, 0.847.

In the scope dimension, the eigenvalues of the first two factors from principle component analysis are larger than one: 3.554 and 2.561 (Table 3). Only two factors are retained in the final version of the scale and they account for 38.22% of variance. An item is retained only when it loads greater than ± 0.45 on the relevant factor. Hence, the initial items are totally retained. A detailed description of the two subscales is presented as below:

1. The macro subscale: global thinking style based on Sternberg's theory and D type based on Herrman's theory are integrated into this type—focuses on general principles, attends to handle abstract issues.

2. The micro subscale: local thinking style based on Sternberg’s theory and B type based on Herrman’s theory are integrated into this type— needs the detail, attends to detailed information and produced detailed work.

The internal reliability indexes, alpha coefficients, are adequate for the two subscales, 0.776 and 0.737 and for the entire scale, 0.643.

Table1

In the Function dimension ,rotated factor loadings and Cronbach’s values for the three factors of the scale

item	Factor1: Independent	Factor2: Procedure	Factor3: Analytic
<i>Factor1 :Independent $\alpha=0.749$</i>			
23	0.764		
18	0.748		
31	0.722		
13	0.643		
2	0.544		
14	0.485		
29	0.456		
<i>Factor2: Procedure $\alpha=0.782$</i>			
21		0.706	
30		0.678	
33		0.642	
32		0.582	
12		0.563	
40		0.546	
<i>Factor3: Analytic $\alpha=0.746$</i>			
28			0.730
35			0.721
11			0.720
3			0.632
15			0.601
Eigen value	5.044	1.997	1.349
%Of variance	28.021	11.092	7.942
^a Overall $\alpha=0.847$, total variance explained is 46.608%			

Table2

Some of the retained items on the “Independent” subscale

Item number	Question
3	I like to solve problems by myself way.
11	At the beginning work, I like to do it by myself thoughts.
15	When doing something, I will be happier if I can make decisions myself.
28	I solve problems with myself ideas and methods.
35	I would usually prefer making decisions by myself thoughts.

Table3

In the Scope dimension ,rotated factor loadings and Cronbach’s values for the two factors of the scale

item	Factor1: Macro	Factor2: Micro
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Factor1: Macro $\alpha=0.776$

37	.798
20	.783
24	.730
8	.658
5	.575
34	.521

Factor2: Micro $\alpha=0.737$

27		.659
10		.598
16		.586
25		.557
7		.544
17		.531
6		.501
22		.486
39		.483
19		.462
Eigen value	3.554	2.561
%Of variance	223214	16.008

^aOverall $\alpha=0.643$, total variance explained is 38.22%

3. A computerized learning and thinking styles scale

The computerized learning and thinking styles scale has been implemented with PHP and MySQL on APACHE web server. In the following subsection, several major interfaces of system module are given.

3.1 The interface of login management

After confirming the identification, the student can login the system of measuring the learning and thinking style, as shown in Figure2.



Fig.2. login management interface

3.2 The interface of user management

The functions of user management include bulletin, learning and thinking styles scale, profile of measuring scale, documentation, and logout, as shown in Figure3

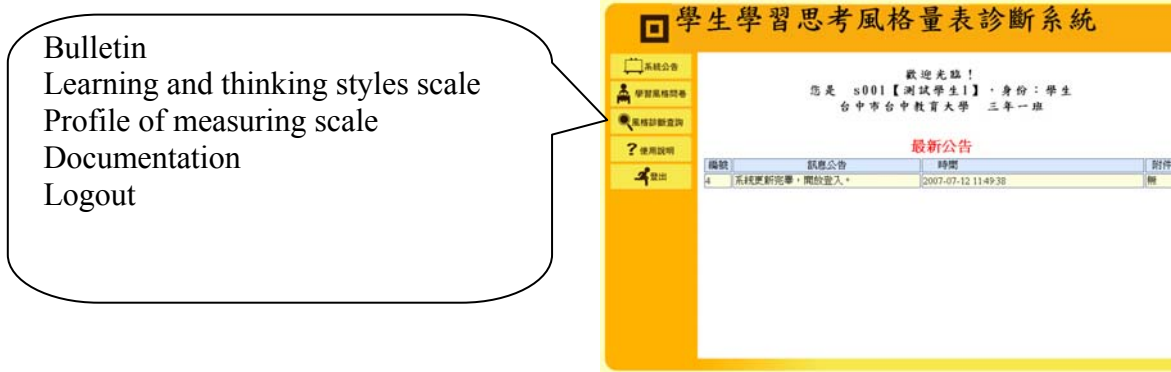


Fig.3. user management interface

3.3 The interface of measuring learning and thinking style

Ten items per screen is presented in measuring learning and think style. The scale consists of 34 items, as shown in Figure4.



Fig.4. the interface of measuring learning and thinking style

3.5 The interface of the results of measuring learning and thinking style

When the students finish the learning and thinking style scale, the system then determines the learning and thinking styles of the student. By accessing the results of measuring learning and think style, the student can get the detail description of the various style types, as shown in Figure5

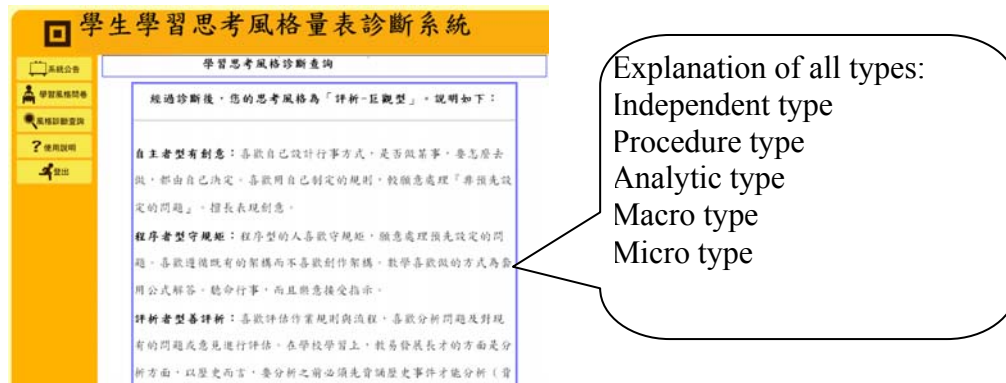


Fig.5. the interface of the results of measuring learning and thinking style

4. Conclusions

The issues concerning learning or thinking style have been widely discussed in the past decades. In this paper, we propose a computerized students learning and thinking styles scale, which takes Sternberg's thinking style theory and Herrman's learning theory into consideration. By the network technology, being easily administered and time efficient, can help educators assess students' responses on the scale and then diagnose students' learning and thinking styles in a short time. The computerized learning and thinking styles scale provides educators with a well validated and easy-to-use instrument for measuring the characteristics about students' learning and thinking styles. When the educator understands the learning and thinking styles of students, they can adjust their teaching style and develop subject materials to meet the styles of students.

In this paper, we apply exploratory factor analysis to verify the structure of a new learning and thinking style, we hope that future research will do confirmatory factor analysis. In addition, perhaps future research could examine the relationship between learning achievement and subject materials meeting the styles of students.

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