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Effects of Mindtools to Pupils' Technology Perception and Cognitive Flexibility

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Abstract: - The main purpose of this research was to investigate the relationship of technology perception and cognitive flexibility, and the intermediary influences of Mindtools. Based upon information processing theory and learning with computers view, this research attempted to explore the learners' technology perception and to transfer their cognitive flexibility by the computer mindtools. For 206 research samples from sixth grade in elementary schools, students of different technology perception showed significant differences in three different themes tests. The result appeared effects of technology perception to cognitive flexibility. The intervention of Mindtools made students have significant difference in learning achievement and learning retention. The result also demonstrated the Mindtools' intermediary effect in the relationship between technology perception and cognitive flexibility.

Key-Words: - Mindtools, Technology Perception, Cognitive Flexibility

1. Introduction

Cognitive learning focuses on whether students can adjust cognitive flexibility effectively to solve problems. Many researches show that people always forget to use their known relative knowledge when solving a new peoblem. The factors of obstructor including: (1) lack of conceptive understanding, (2) unable to use basic skills in specific content, (3) strategies limit in specific area ([1]; [9]).

The development of information technology help forward to the change of educational activities, and it provide a unique enviornment for teaching and learning([4]). Jonassen([12]) proposed a view of taking computer as Mindtools, which emphasized an innovative opinion of learning with computer, and improved high level thinking activities for meaningful learning.

Technology Perception indicates the degree of learner's aware of using technology as knowledge construction tool. Cognitive flexibility makes distinguish of knowledge category and situation factors based upon learners' schemas and then brings the cognitive adaption and organization reaction. This can carry problem solving out by making new learning proposition and strategy meaningful ([14]; [15]).

This paper focused on the effects of technology perception to cognitive flexibility, and the intermediary effects of Mindtools. According to the above mentioned facts and belief, this paper is intended to achieve the following purposes:

(1), Explore the relationship of technology perception, Mindtools and cognitive flexibility.

(2), Develop the conception framework of technology perception, Mindtools and cognitive flexibility.

(3), Analyze the fit of theoretical model.

2. Theoretical Perspectives

Here we started problem descriptions from literature review.

2.1 Information Process and Cognitive Flexibility

We can understand more about the learners' cognitive process by information process theory, which is the key of expanding the cognitive flexibility. They highlight that the occurrence of learning is effected by internal psychology process progress and pay great attention to recognize learners' learning, memorizing and cognitive transfer activities([2]; [3]).

The application of information technology helped Clark and Mayer ([7]) forward to propose the progress of network multimedia learning. It expound that work memory is the center of cognition and emphasizes some important

cognitive learning opinion, including: (1) there are two information process channels, vision and hearing; (2) the ability of human information process is limited; (3) the occurrence of learning is active in memory system; (4) new knowledge and skill should transfer to work from long memory area.

According to the above opinion, we claim that there will be three key segments that will transfer cognitive flexibility. First, similarity of new situation will affect anchored typies of sensory memory and stimulate knowledge concept connection to original long-term memory. Second, when operating the working memory process, there is some connection to original control process which would extract progress from existed knowledge and skills and to represent in problem solving activity of new learning situations to proceed concept cocfmprehension. Finally, there is control process adjusted to monitor operation and to revise processing strategies effectively.

2.2 Technological Tools as Mindtools

From the application view of technological tools, the unique should be stood out to explore the mystery of cognitive flexibility. The speciality of multimedia is combination of visual image and sound that will integrate effects of human information processing, and the linkage of long-term memory and cognitive flexibility is highly important. By the way, whether learners can construct personal knowledge schema and semantic networks by using technology will be key effect to cognitive flexibility. Finally, it will be greatly important if one can use interactive communicated specialty of technological tools to give rise to strong cognitive flexibility and transfer problem solving skills in specific content to general learning strategies and then apply in different learning situations.

We have to place importance on related cognitive learning theory when using technology tools to improve cognitive flexibility. Ausubel ([6]) brings up Subsumption theory .When the learners are confronted with unfamiliar material, a cognitive structure is available for incorporating the new concepts.

Situated cognition theory argued that knowledge existed in the enviornment we live and the activities we engaged in. And learners should get into the context of specific situation to acquire knowledge. Cognition and Technology Group at Vanderbilt ([8]) proposed Anchored Instruction based upon situated cognition theory to help learners to develop confidence, skills and knowledge in order to solve problems. Jonassen ([12]) addressed the revolutionary application opinion of using computer as Mindtools or mental tool. By using Mindtools to stimulate students' critical thinking, creativity will cultivate their high-level thinking and skills of solving problems, and then promote them to construct knowledge concepts. The learning process is shown in Fig 1. ([11])

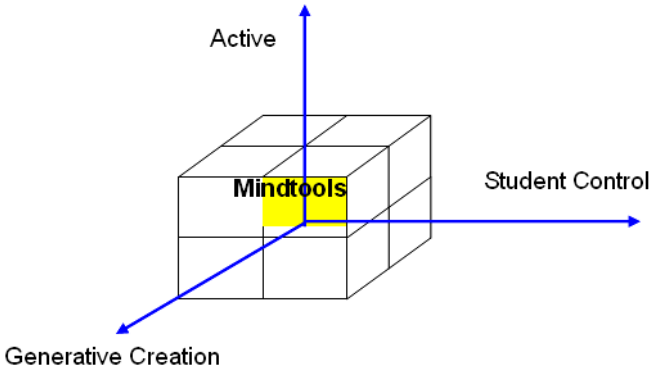

Fig.1 Learning processes of Mindtools

2.3 Constructing Model between Technology Perception and Cognitive Flexibility

Based upon the analysis of previous literature, we set out to test the modrating effect of Mindtools including technology perception and cognitive inflexibilty. The research framework is shown in Fig. 2. We integrate three contentions of information process opinion in cognitive theory, and merge in Jonassen([12]) 'Computers as Mindtools' concepts of cognitive learning, and then constructs the model of 'technology perception', 'Mindtools' and 'cognitive flexibility.'. Learners would be stimulated greatly into technology perception by using technology tools and then get forward to use Mindtools to spread out more cognitive flexibility.

The use of technological tools should focus on technology capability and progress of knowledge construction and cognition([5]). Technology assisted learning would promote the learning attitude([10];[13]). The improvement of technology perception would not only promote the learning attitude, but also use Mindtools more as high-level thinking tool in cognitive learning.

When learners have high-level critical thinking, they will transfer self learning temperament to affect cognitive flexibility. Cognitive flexibility will effectively proceed to production, creation and problem solving in learning progress.

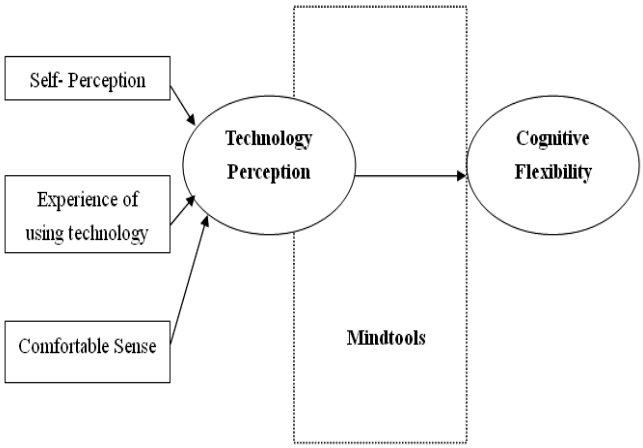

Fig.2 Research framework

3. Methods

Research methodology, research instrument and data analysis will be described in this section.

3.1 Subjects

Six 6th-grade elementary school classes were divided into 2 groups who empoyed different learning situations. One was traditional teaching and the other was using Mindtools. Each of the two groups had 103 students.

3.2 Instrument

The research questionnaire included four parts: Technology Perception, Cognitive Flexibility Test, Delayed Test, and Learning materials.

3.2.1 Technology Perception Questionnaire

The questionnaire of technology perception was carried out by the experimental group of students. There are three parts in the questionnaire including Self-Perception, Experience of Using Technology, Comfortable Sense. In order to establish its objective reliability and validity, a review of literature was undertaken to identify construct definitions and existing measures. Interview for sixth-grade students and Expert reviews reported acceptable internal consistency and validity for each subscale.

3.2.2 Cognitive Flexibility Test

The researchers conducted the cognitive flexibility test after a learning period. The purpose of this test is to assess tranfer of learning strategies of the students. There are thirty questions divided into three sections.

3.2.3 Postpone Test

This was conducted three weeks after the learning period completed. The purpose of the test is for the researcher to analyze the knowledge retention of two groups of students.

3.2.4 Learning materials

We designed three subjects of computerized mindtools in this research.They includes abundant multimedia contains implemented by Excel and Micromedia Flash. Animation, sound effects, color images, and spreadsheets are integrated into the system.

3.3 Research Design

A questionnare of technology perception was tested by 206 six-grade students in elementary school. Then, those students were divided into 2 groups for experimental instruction, which process was for four weeks and two classes per weeks. Two groups have the same instruction contents but different learning situations. One was traditional teaching and the other was using Mindtools. The curriculum concept was based upon function that including three subjects: function conjecture, estimate volume and calculate speed. The experiment will measure whether students can use cognitive flexibility to adjust tactics in order to improve learning outcomes in different subjects' learnng.

3.4 Hypotheses

Hypothesis 1: students' perception of technology has no positive influence to cognitive flexibility significantly

Hypothesis 2: Students using Mindtools have worse cognition flexibility significantly than using traditional teaching in different learning subjects.

Hypothesis 3: There is no significant difference bewteen control and experimental groups to let Mindtools make cognitive flexibility more stable and constant.

3.5 Analytical Procedures

Statistical methods used for analysis included the ANCOVA and regression analysis.

(1).ANCOVA：The grade of whole semester is covariant. Cognitive flexibility test and mathmatics knowledge retention are dependent variables. Those data were analyzed using ANCOVA methods.

(2).Regression analysis：Regression analysis was used to examine the direct and moderator relationships between student technology perception and cognitive flexibility. An alpha level of 0.05 was used for all tests of significance.

4. Results

Perception of Technology was measured by 20 items in three subsections: Self-Perception, Experience of Using Technology, and Comfortable Sense. Each item, measured on Likert 5-point scale, was from 1 (totally disagree) to 5 (totally agree) for each subscale.

(1). Instrument reliability

For the current samples, the reliability analysis using Cronbach's coefficient alpha was quite acceptable for overall Perception of Technology (α=.78), Self-Perception (α=.75), Experience of Using Technology (α=.82), and Comfortable Sense (α=.80).

(2). Regression analysis

Regression analysis is used to examine the relationships between students' Perception of Technology and Cognitive Flexibility (from the post-test score). The data is shown P=.038 and indicates that students' perception of technology has a significant influence to cognitive flexibility positively.

(3). ANCOVA analysis of Mindtools to cognitive flexibility

The result of exploring the variation homogeneity of samples was shown in Table1. There is no significant difference between six samples (F=1.569, p=0.170>0.05) that hypothesis wasn't violated. There is significant difference in cognitive flexibility test using learning types (traditional and Mindtools) as a criterion (F(1,204)= 2.327, p<.05). Students using Mindtools had better cognition flexibility than using traditional teaching in different learning subjects significantly.

Table 1. ANCOVA analysis summary of Mindtools to cognitive flexibility test

Source	Sum of Squares (SS)	DF	Mean Square	F
Mindtools	1298.706	1	259.741	2.327*
Residual	22325.388	204	111.627	
Total	46880.357	206		p=0.044

* p ＜＝ .05

(4). ANCOVA analysis of Mindtools to learning retention

The result of exploring the variation of samples was shown that there is no significant difference (F = 0.559, p = 0.731 > 0.05) and hypothesis wasn't violated. The examination scores of knowledge retention under different types of learning (using traditional teaching and Mindtools) are shown in Table 2. The result shows there was significant difference (F(1,204) = 2.603, p < 0.05) bewteen control and experimental groups, and this provides support for hypothesis that Mindtools makes cognitive flexibility more stable and constant.

Table 2. ANCOVA analysis summary of Mindtools to learning retention

Source	Sum of Squares (SS)	DF	Mean Square	F
Mindtools	991.511	1	198.302	2.603*
Residual	15234.094	204	76.170	
Total	37139.149	206		p=0.026

* p ＜＝ .05

5. Conclusion

The result appeared effects of technology perception to cognitive flexibility. Conclusions were showed as follows：

(1).Technology as Mindtools increases student's cognitive flexibility significantly

Mindtools not only can be the way or the source of knowledge and learning, but can utilize the computer to promote the high-order thinking activities. This is a valid important key to indicate how the technology is used effectively in learning ([11]). Results showed that the use of Mindtools can make learner's achievement and knowledge retention apparently be all superior to students who did not use that on the test in the

fields of different problems of the same concept. This can prove that cognitive flexibility was increased significantly.

(2).Technologies perception has positive influences cognitive flexibility significantly

Cognitive flexibility can distinguish knowledge typies and situation factors on the basis of existed schema. Through the anchored sensory memory to new learning situations and linking of the original system of long-term memory, it brings the adjustment of control and reflection progress and organizational reaction. This can carry cognition learning out by making new learning proposition meaningful and technical ability automated. Results show that technology perception positively and significantly influences the cognitive flexibility by the regression analysis.

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