Influence of Animation Presentation Mode and Spatial Ability on Multimedia Learning under the Background of Modern Information Society

Yidong Liu

School of Digital Media,

Chongqing College of Electronic Engineering, Chongqing 401331, China

47418946@qq.com

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Abstract: In order to study the effects of animation presentation mode and spatial ability on multimedia learning, the effects of animation presentation mode and spatial ability on multimedia learning are explored from the perspectives of learning retention effect, learning transfer effect and learner cognitive load. The research results show that spatial ability is strongly positively correlated with learning retention and learning transfer, and negatively correlated with task difficulty. It can be seen that the learning effect of high spatial ability learners is better than that of low spatial ability learners, and the external cognitive load of high spatial ability learners is lower than that of low spatial ability learners. In the animation multimedia learning situation, the spatial ability has a strong influence on the learning effect and the cognitive load generated in the learning process.

1. Introduction

With the development of science and technology, many new technologies have been applied to education and life. The development of image technology has prompted people to begin to know the potential use of multimedia as a tool to improve human understanding. This potential is called the prospect of multimedia learning [1]. The presentation effect of animation is not only related to the organization of animation itself, but also related to many other factors, especially the individual characteristics of learners [2]. The core issue of learner-centered design orientation is "how to use multimedia technology to promote human learning". However, in practical teaching, there is often a phenomenon of using technology for technology. Multimedia teaching design does not follow certain principles of psychological pedagogy, and neglects the learners' psychological characteristics and individual differences. Any kind of media technology is not omnipotent. Especially in the complex field of learning, the use of multimedia is a system in which technology, material properties, learners' personal characteristics and teaching strategies interact. Multimedia learning research has also experienced comparing the influence of various characteristics on learning from single-media teaching to multi-media teaching. And now more and more factors such as learners' individual characteristics, and learning content itself characteristics are taken as important research variables to comprehensively analyze learners' various learning behavior, activity process and internal psychological mechanism in various information representation environments [3].

2. State of the art

At present, there are more and more research on multimedia teaching of animation. Animation has attracted people's attention because of its vivid image and intuitive presentation. However, the research on multimedia of animation is still in its infancy, especially the empirical research on multimedia learning of animation in China, which is still relatively little [4]. Many doubts about the effectiveness of animation multimedia teaching still need to be solved. Previous studies mostly used adults and college students, lack of research results for primary and secondary school students. There has been no difference or even the opposite result between animation and static picture

representation, that is, learning effect of picture is better. Then, for middle school students, animation or static picture representation, which is more conducive to students' multimedia learning effect? Therefore, it is necessary to make a more in-depth comparison and study of static pictures and animation presentation modes, and further expand the research object, so as to make the design principles and application range and the audience of measures of dynamic visual multimedia (animation multimedia) information presentation more widely used [5]. The ultimate goal of designing teaching materials is to adapt individuals with different characteristics to promote their learning effect. However, in most multimedia experimental studies, learners' individual characteristics are considered as control variables, and some research conclusions are still contradictory. As a result, the research on multimedia learning based on individual characteristics of learners is still worth in-depth analysis and verification [6].

3. Methodology

3.1. Experimental design

The experiment is designed with 2 (animated multimedia presentation mode) and 2 (spatial ability level) experiment. The animated multimedia presentation mode is controlled group and uncontrollable group, and the spatial ability level is high spatial ability group and low spatial ability group. The experimental results of dependent variables include two categories: subjective evaluation score and academic achievement (learning retention performance and learning transfer score).

The first step is the selection and production of experimental materials. This experiment chooses the working principle of automobile engine (internal combustion engine) as the learning content. First, collect information from the Internet to find out how the automobile engine works and determine the text content of the engine's working principle. The working principle of automobile engine includes four steps: intake stroke; compression stroke; combustion stroke; and exhaust stroke.

The second step is to print out the text of the working principle of the automobile engine, and ask the mechanical teachers to evaluate and correct the text to ensure the accuracy and scientificity of the learning materials.

The third step is to produce two types of animations based on a certain text learning material (animation with controlled progress and animation with continuous play following the principles of multimedia learning design), especially the principle of time proximity (the learning effect of animation and sound simultaneously present is better than that of subsequent rendering) and the principle of space proximity (the learning effect of pictures and texts approaching each other is better than that when they are away from each other). The animation commentary refers to the content of the learning material, and the speed of commentary is consistent with the animation picture. The commentary of animation is completed by the students who majored in broadcast and host.

3.2. Subject selection and grouping

The subjects were sophomores and juniors of educational technology. Firstly, 85 students were randomly selected and asked to fill in a questionnaire about the knowledge level of automotive engine working principle. Their knowledge level on the content of automotive engine working principle was tested. The students whose test questionnaire score was less than 10 (low knowledge level) were selected as the experimental subjects. Finally, 80 students were selected as research subjects. According to the experimental data, invalid data were removed, and 64 subjects were selected for data collection, including 21 boys and 43 girls. The age of the subjects was 20-24, with an average age of 21.92 years. All subjects were proficient in computer operation and volunteered to participate in the experiment. All subjects did not preview the relevant learning materials before the experiment, nor did they participate in similar experiments. After the test of spatial ability, the final grouping of subjects is shown in Table 1.

Table 1 Distribution of subjects

	High spatial ability level (person)	Low spatial ability level (person)	Total (person)
Continuous presentation group	16 (5 males and 11 females)	16 (6 males and 10 females)	32
Controlled group	16 (5 males and 11 females)	16 (5 males and 11 females)	32
Total	32	32	64

4. Results and discussion

4.1. Normality test of sample data

4.1.1. Normality test of learning retention performance

According to the experimental data, it is believed that learning retention performance may follow normal distribution. In order to test its hypothesis, considering whether learning retention performance keeps track of normal distribution, the K-S test is used to diagnose it. The results are shown in Table 2.

Table 2 One-sample Kolmogorov-Smirnov test

		Learning retention performance
N		64
Normal Parametes	Mean	2.48
	Std. Deviation	0.926
Most Extreme	Absolute	0.022
Differences	Positive	0.022
	Negative	-0.0025
Kolmogorov-Smirnov Z		0.72
Asymp. Sig. (2-tailed)		0.63

The original hypothesis is given: the learning retention performance follows the normal distribution of mean value of 2.48 and the standard deviation of 0.926. Key results of K-S test are: the maximum positive frequency difference between the actual distribution and the test distribution is 0.022, and the maximum negative frequency difference is -0.0025, so the maximum absolute frequency difference used to calculate statistics is 0.022. The subsequent K-S statistics Z value equals 0.72, and the corresponding probability value is 0.63, which is greater than the significant level of 0.05. Therefore, accept the null hypothesis that learning retention performance follows normal distribution.

4.1.2. Normality test of task difficulty evaluation value

Firstly, according to the analysis of experimental data, it is thought that the evaluation value of task difficulty may obey normal distribution. In order to test its hypothesis, considering whether the task difficulty evaluation value obeys normal distribution, the K-S test is used to diagnose it. The results are shown in Table 3.

Table 3 One-Sample Kolmogorov-Smirnov Test

		Task difficulty
N		64
Normal Parametes	Mean	5.73
	Std. Deviation	1.819
Most Extreme	Absolute	0.17
Differences	Positive	0.14
	Negative	-0.17
Kolmogorov-Smirnov Z		1.37
Asymp. Sig. (2-tailed)		0.048

The original hypothesis is given: the task difficulty evaluation value is subject to a normal distribution with a mean value of 5.73 and a standard deviation of 1.819. Key results of K-S test are: the maximum positive frequency difference between the actual distribution and the test distribution is 0.14, and the maximum negative frequency difference is -0.17. Therefore, the maximum absolute frequency difference used to calculate statistics is 0.17. The subsequent K-S statistics Z value is equal to 1.37, and the corresponding probability value is 0.048, which is less than the significance level of 0.05, but close to 0.05. Therefore, it is necessary to further analyze the evaluation value of task difficulty.

Frequency analysis of task difficulty evaluation values is carried out to observe the distribution diagram (Figure 1) and statistics results (Table 4). Observing the histogram, it can be seen that the distribution of the task difficulty deviates from the normal distribution to the right. However, visual inspection is often unable to determine whether skewed distribution is significantly different from symmetrical normal distribution, so a significant test is needed. From the statistic description, it can be seen that the Skewness is negative, which indicates that the distribution of task difficulty is negative skewness. Because the Skewness is -0.26, the standard error is 0.299 and the absolute value of Skewness is less than 1.96 times of the standard error, the Skewness distribution is not obviously different from the normal distribution. In other words, the distribution of task difficulty is basically symmetrical. The Kurtosis value (which reflects whether the peak state of the distribution map is steep or moderate) is 0.083, greater than 0, indicating that the distribution of task difficulty is very steep and belongs to the thin-high type. Because the absolute value of Kurtosis is less than 1.96 times of the standard error (0.59), the distribution of task difficulty is not obviously different from the normal distribution.
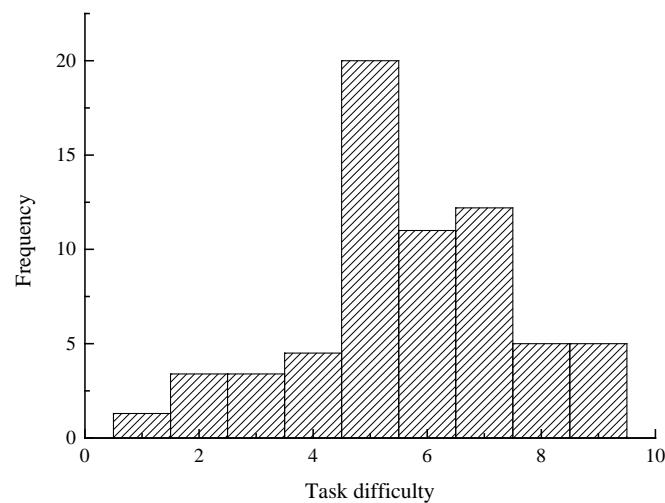

Figure 1 Distribution of task difficulty

Table 4 Statistics

N	Valid	64
Missing		1
Mean		5.7344
Std. Deviation		1.8191
Skewness		-0.26
Std. Error of Skewness		0.299
Kurtosis		0.083
Std. Error of Kurtosis		0.59

4.2. Correlation test between spatial ability and learning effect

From Table 5, it can be seen that the simple correlation coefficient between the spatial ability

and the subjects' learning retention performance is 0.70, indicating that there is a positive correlation between the two. The probability P value of correlation coefficient test is 0.001, approximate to 0. Therefore, when the obvious level is 0.05 or 0.01, the original hypothesis should be rejected and the relationship between spatial ability and retention performance should not be zero correlation.

From Table 6, it is known that the simple correlation coefficient between spatial ability and learning transfer performance is 0.79, close to, 0.8, indicating that there is a strong positive correlation between them. The probability of correlation coefficient test is approximately 0. Therefore, when the obvious level is 0.05 or 0.01, the original hypothesis should be rejected and the relationship between spatial ability and transfer performance should not be zero correlation.

In conclusion, spatial ability has a strong correlation with learning effect.

Table 5 Correlation between learning retention performance and spatial ability

		Learning retention performance	Spatial ability
Learning retention performance	Pearson Correlation	1	0.70
	Sig. (2-tailed)		0.001
	N	64	64
Spatial ability	Pearson Correlation	0.70	1
	Sig. (2-tailed)	0.001	
	N	64	64

Table 6 Correlation between learning retention and transfer score and spatial ability

		Spatial ability	Learning retention and transfer score
Spatial ability	Pearson Correlation	1	0.79
	Sig. (2-tailed)		0.000
	N	64	64
Learning retention and transfer score	Pearson Correlation	0.79	1
	Sig. (2-tailed)	0.000	
	N	64	64

5. Conclusion

Through the above research and analysis, it is known that spatial ability has a strong positive correlation with learning retention performance and learning transfer performance, and a strong negative correlation with task difficulty. Therefore, theoretically speaking, the learning effect of high spatial ability learners is better than that of low spatial ability learners, and the external cognitive load of high spatial ability learners is lower than that of low spatial ability learners. In the animation multimedia learning situation, the spatial ability has a strong influence on the learning effect and the cognitive load generated in the learning process. Spatial ability, as a kind of individual characteristics, should also be concerned and considered in other forms of learning environment. Therefore, teaching practitioners should fully consider learners' individual characteristics (not only spatial ability, but also cognitive style, interest motivation, age differences, etc.) when designing teaching. The reason is that only the teaching form which suits learners' individual characteristics is the most effective teaching method and can achieve the best teaching effect.

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