ISSN:1738-6764, eISSN:2093-7504

The Impact of Digital Resources Screen Layout on Learning in Intangible Cultural Heritage

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https://doi.org/10.5392/IJoC.2023.19.2.081

Manuscript Received 14 February 2023; Received 27 June 2023; Accepted 28 June 2023

Abstract: *Innovative exploration of transmission and dissemination of intangible cultural heritage plays a key role in national development, international exchange, and sustainable social development. This review presents the current state of digital preservation in China in the field of intangible cultural heritage based on contemporary approaches via study and development of interactive digital resources such as shadow puppets. Using design-based research, quasi-experimental methods, and literature review, this study provides an understanding of the current status of the development and preservation of intangible cultural heritage. Three different versions of shadow puppet interactive digital resources are presented using storyline software. Subjects learned best when viewing the global-no-catalog type of interactive resources, moderately well when viewing the left-right layout type, and the least when viewing the top-down layout.*

Keywords: Intangible Cultural Heritage; Screen Layout; Learning Effect

1. Introduction

Intangible cultural heritage refers to various traditional cultural expressions and cultural spaces handed down from generation to generation by various ethnic groups and are closely related to the lives of the masses [1]. It includes folklore activities, traditional crafts, cultural knowledge, and props and instrumental works. The current measures for the preservation of intangible cultural heritage are characterized by a single digital resource, which hampers the transmission and dissemination of the heritage and by resistance to new ways of preservation, both in terms of audience demand and the effectiveness of transmission [1-3].

To investigate the current situation of users' experience of ICH graphic design with different page layouts and the related influencing factors, and in this way to investigate which page layout graphic design is more beneficial to users' learning, this study conducted the development of relevant digital resources (three different page layouts of shadow-based digital resources) and conducted related eye-movement experiments on the resources, etc. User tests were performed before and after the experiments, and the impact of the different page layout interface designs on user learning was analysed based on the feedback.

The educational application of virtual reality technology is mainly based on a virtual reality platform or virtual reality environment to help students gain more authentic feelings and learn new knowledge. There are two main views on the impact of virtual reality technology on learning effect: one is that virtual reality technology has a significant role in promoting learning effect. For example, Zhao Jiangwei found that traffic safety interventions for intellectually backward children based on VR technology not only provide a safe and reliable immersive environment for the training of special children, but also stimulate children's interest in learning and improve the effectiveness of training [4-7]. Dai Yiling demonstrated the effectiveness of an immersive virtual reality-based elementary school science curriculum that fosters students' ability to multi-experience, multi-perspective observation of problems, and proactively identify and ask questions [8,9]. Wan Jing found that the application of VR games in the teaching of English listening in higher vocational education has a significant role in promoting students' listening learning [10]. The other is that virtual reality technology has a positive effect on certain aspects of learning. For example, Yanqiu Liu found through ANOVA that VR

teaching situations had a significant impact on primary school students' writing performance, but not on learning motivation [11,12]. Sun Huafei found that taekwondo teaching based on VR technology can alleviate problems such as site tension and safety hazards in actual teaching, and has a significant role in promoting the mastery of front kicking techniques and enhancing psychological quality, but has less impact on the improvement of physical fitness [13,14]. Despite the many advantages of VR technology, virtual experiments do not fully simulate the mistakes and anomalies that may occur in the experimental process, so they are not helpful for students' hands-on ability [15,16].

In this paper, a meta-analysis is carried out on the experimental research and quasi-experimental research research of education and teaching based on VR technology in China. The main research questions are:

- Will VR teaching improve students' learning effectiveness compared to traditional teaching?
- What aspects of VR improve student learning?
- What is the relationship between the impact of VR on learning effectiveness and variables such as phase of studying, subject type, teaching duration, teaching method, and type of VR technology?

2. Experimental Design and Process for Different Interface Layout Pages

2.1 Experimental Preparation

2.1.1 Development and design of digital resources for shadow puppetry with different page layouts

Development idea: Based on the research background and analysis of relevant literature, the overall framework of this digital resource was initially built, and the content of the digital resource was divided into five modules: the development of shadow puppets, distribution, production processes, representative works, and testing (Figure 1). In collecting the relevant materials and resources, the digital resources were arranged and produced in terms of graphics, text, sound, and video; the initial prototype of the digital resources was refined and modified to obtain the final digital resources for this experiment.

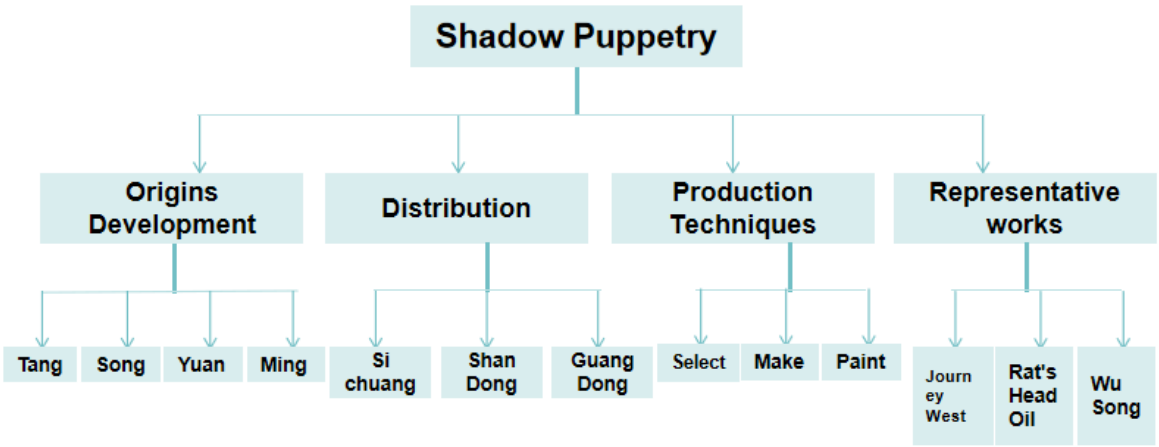

Figure 1. Framework diagram of the digital resource structure

2.1.2 Analysis phase : Data collection and integration.

The main focus is on collecting relevant content and information about shadow puppetry, including the origins and development of shadow puppetry, current conservation measures and status regarding shadow puppetry, distribution, genres formed in various regions, and relevant characteristics of different shadow puppets; and an extensive analysis of the target audience for this resource. Once the basic information on shadow was understood, a search through books and websites was conducted to collect relevant resources in multimedia form, as well as to collate various types of information [17].

2.1.3 Design phase : Material preparation.

After the analysis phase has made a good basic stock of content, the design phase focuses on building the structure and framework of the entire interactive visible. The content and structure of the complete digital

resource are divided, and how to present and display each type of resource in each part rationally is the design phase's primary task. In this phase, the collated resources are classified, with each category belonging to a different section.

The digital resources are divided into five sections: development, distribution, production, representative works, and testing of the shadow. The development section contains six main development time points, with a combination of pictures (or videos) and text introduced under each time period; the main distribution of about 17 regions and 34 shadow genres, with each part supplemented by pictures plus text; the eight processes in the production process section are presented using images plus text; the representative works section selects three familiar and exciting works, each using a clip section Finally, the test section is designed with four types of questions: single choice, multiple choice, fill-in-the-blank, and matching, and you can see your total score after doing all the questions.

2.1.4 Development phase : based on Articulate Storyline software development.

The entire framework sorted through the design phase provided a complete direction and process for the development phase. Taking into account the currently existing lack of interactivity, integrity, and attractiveness in the communication of shadow puppetry art and combining the characteristics of digital conservation measures, a combination of multiple techniques learned in the profession was adopted to produce this visibility. This resource was mainly developed using the software Articulate Storyline.

During the development phase of the digital resource: firstly, the overall color scheme was considered, and the relevant image resources were processed through PS techniques to unify the overall color; secondly, each page icon and interaction key was created, combining PS and AI; furthermore, PR was used to edit the videos required in the digital resource. Finally, we consider how to break away from the traditional monolithic digital resources and choose to combine a variety of media and present them in each interface while constantly adding interest and interactivity to the entire digital resource so that it can be used in a wide range of practical ways.

2.1.5 Application phase : commissioning and experimentation.

The application phase begins with a self-application to test the usability of the resources. The first stage of the self-application was a continuous modification and improvement of the digital resources, in which the text, pictures, and videos were modified; the lack of content was enriched, the dynamism of the text was added, and the cumbersome form of the pictures was reduced, making the whole structure of the digital resources clearer and more reasonable. In the second stage, a few subjects were selected to test the usability of the help before the actual experiments were carried out, and the feedback was used for continuous modification and debugging. The third stage of the application was the formal application of the quasi-experiments, in which eye-movement experiments and brainwave testing were carried out, and the data obtained from the experiments were analyzed to make them indeed facilitate learners' learning for further research later on.

2.2 Experimental Design

2.2.1 Experimental Purpose

Through the study and viewing of digital multimedia resources with different interface layouts, the subjects were able to identify the most user-friendly layout for the production of digital resources and use this as a practical basis and experimental support for the development and production of storyline digital resources.

2.2.2 Experimental Hypothesis

It was hypothesized that there would be significant differences in the learning outcomes (comparison of pre-date post-knowledge test scores) of learners when 45 subjects were grouped to view digital multimedia resources with three different interface layouts while keeping other irrelevant variables such as the environment in which the experimental subjects in groups a, b and c were located consistently.

2.2.3 Experimental Subjects

More than 45 undergraduate students from a teacher training university, majoring in Chinese language and literature, new media communication, foreign language and literature, and physical education, were randomly

recruited as alternative subjects for this experiment. With the subjects' knowledge and consent to the investigation, they were randomly divided into three groups (a, b, and c) without screening to watch three different layouts of digital resources for the experiment.

2.2.4 Experimental Equipment

This experiment used the SMI-ETG spectacle-type oculomotor to record the subjects' eye movement data throughout the experiment. iViewETG software was used to record the subjects' eye movement data from viewing digital resources, followed by BeGaze software to process and export the eye movement heat zone map and eye movement trajectory map. The subjects maintained a positive sitting posture throughout the experiment, keeping their heads still and using a 3-point oculomotor calibration [3]. Visual attention has been shown to correlate with gaze [4]. In this study, the eye movement hot zones and eye movement trajectories of the subjects in digital multimedia resources with different page layouts were selected to examine the learners' visual attention allocation and gaze.

The brainwave instrument uses BrainLink Pro, a product of Macro Intelligence Technology Ltd. Its basic EEG parameters are dry electrode contact sensors, acquisition frequency 3-100Hz, sampling rate 512Hz, bandwidth 100Hz, ADC 24bit, maximum input impedance 20Mohm, and signal transmission method serial (UART). The brain wave meter reflects the concentration and relaxation of the learner.

2.2.5 Experimental Materials

- Interactive digital resources : Storyline

  The experiment was conducted by giving subjects access to an interactive digital resource of shadow puppets.
- Measuring tools

Prior Knowledge Test. A 10-question questionnaire consisting of 10 multiple-choice questions out of 10 was used to measure the subjects' basic knowledge about shadow puppetry. There was no significant difference in the scores of the three groups of subjects on the pre-test questionnaire ($F=0.397$, $p=0.756$). Post-experimental knowledge test. This was used to measure the subjects' knowledge after learning the content of the interactive digital resource. Ten questions were asked, including ten multiple-choice questions 10.

2.2.6 Experimental Procedure

The experiment in this study was univariate. Subjects were randomly divided into three groups to view digital multimedia resources in three layout types: a (left-right distribution), b (top-bottom distribution), and c (global - no table of contents). To control for the influence of other irrelevant variables, all three groups were kept consistent except for the inconsistent layout of the content of the digital resource pages. In the experiments of this study, the pre-test questionnaire and post-test questionnaire were organically combined to reveal the effects of different digital resource interface layouts on learning-related knowledge from multiple dimensions and perspectives (Figure 2).

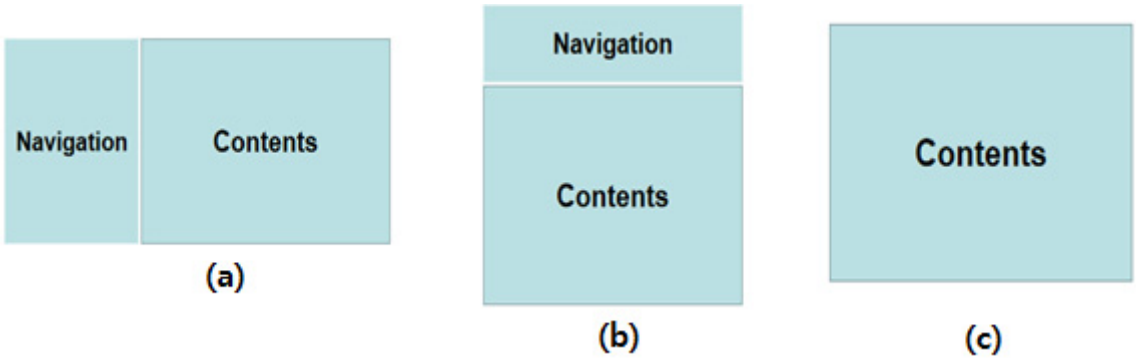

Figure 2. Structure of the experimental design page

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3. Analysis of Experimental Data

3.1 Learning Effect Analysis

The learning effects of this experiment included both the pre-test questionnaire and post-test questionnaire scores of the subjects. This pre-test post-test performance learning effect analysis was conducted using SPSS.

3.1.1 Learning Effect Descriptive Statistics Results

The results of the descriptive statistics are shown in Table 1, which shows the sample sizes of the pre-tests and post-tests of groups a, b and c, as well as the mean and standard deviation of the pre-tests and post-test scores of the three groups of subjects. According to the results of the analysis, the pre-test scores of the three groups were basically the same and the difference was not significant. In the post-test, group b (top and bottom distribution) had the lower learning effect and group c (global - no catalogue) had the best learning effect.

Table 1. Results of descriptive statistics on learning effects

		Number of cases	Average	Standard Deviation	Standard Error	Confidence Interval 95%	
						Upper limit	Lower limi
pre-tests	1	15	5.87	1.598	.413	4.98	6.75
	2	15	5.93	1.624	.419	5.03	6.83
	3	15	6.07	1.792	.463	5.07	7.06
	Total	45	5.96	1.637	.244	5.46	6.45
post-test	1	15	6.13	1.407	.363	5.35	6.91
	2	15	5.07	1.163	.300	4.42	5.71
	3	15	6.40	1.549	.400	5.54	7.26
	Total	45	5.87	1.471	.219	5.42	6.31

3.1.2 Chi-square test for learning effectiveness data

The results of the chi-square test of the data are shown in Table 2. To test the effect of different interface layouts on learning outcomes, the analysis was conducted with the interface layout (groups a, b, and c) as the independent variable and the post-test scores of the three groups as the dependent variable, in line with the relevant requirements.

Table 2. Results of chi-squared tests of learning outcomes

		Levine Statistics	Degrees of freedom1	Degrees of freedom 2	Significance
Pre-test results	Based on average values	.373	2	42	.691
	Based on median	.169	2	42	.845
	Median-based with adjusted degrees of freedom	.169	2	37.773	.846
	Based on mean value after clipping	.314	2	42	.732

Post-test results	Based on average values	.320	2	42	.728
	Based on median	.223	2	42	.801
	Median-based with adjusted degrees of freedom	.223	2	35.131	.801
	Based on mean value after clipping	.316	2	42	.730

3.1.3 Results of the analysis of differences in learning outcomes

The results of the analysis of variance are shown in Table 3. It is assumed that there is no difference in the learning effect of students who viewed the three different layouts. The significance of the three groups' pre-test scores >0.05, then the subjects' knowledge of the art of shadow puppetry is maintained to be basically the same; in the post-test scores, the significance is 0.041 (<0.05) when comparing the subjects in group a and group b, i.e. the significance is greater; the significance is 0.012 (<0.05) when comparing the subjects in group b and group c, i.e. the significance is The significance between group a and group c is 0.6 (>0.05), which means that the significance is not significant. Therefore, the three interface layouts of group a (left-right layout), group b (top-bottom layout) and group c (global-no table of contents) have some influence on the learning effectiveness of the learners.

Table 3. Results of the analysis of variance test for learning outcomes

Dependent variable		**(I) No.**	**(J) No.**	**Mean Difference (I-J)**	**Standard Error**	**Significance**	**Confidence Interval 95% Lower limi**
Pre-test results	LSD	1	2	-.067	.611	.914	-1.30
			3	-.200	.611	.745	-1.43
		2	1	.067	.611	.914	-1.17
			3	-.133	.611	.828	-1.37
		3	1	.200	.611	.745	-1.03
			2	.133	.611	.828	-1.10
Post-test results	LSD	1	2	1.067*	.505	.041	.05
			3	-.267	.505	.600	-1.29
		2	1	-1.067*	.505	.041	-2.09
			3	-1.333*	.505	.012	-2.35
		3	1	.267	.505	.600	-.75
			2	1.333*	.505	.012	.31

3.2 Eye Movement Data Analysis

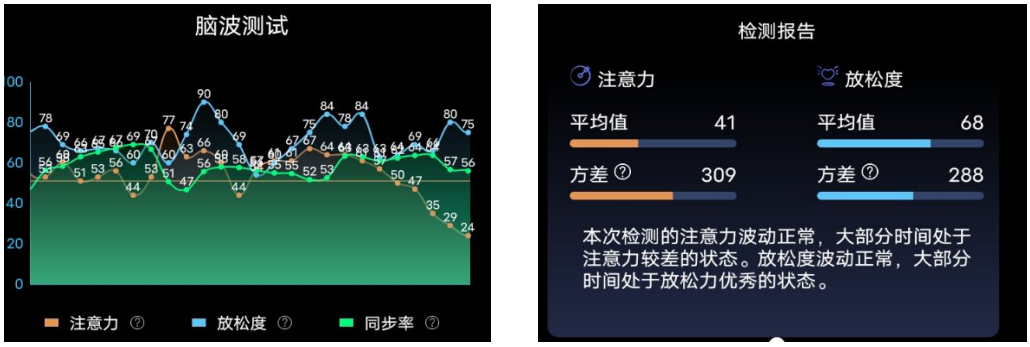
In this study, an eye-tracking device was selected to record the subjects' gaze and visual attention allocation when observing interactive resources with three different interface layouts. Eight representative pages of the interactive resources were selected to analyze the relevant eye movement data while keeping the interest zones consistent (Figure 3). The eye movements of a (left-right layout) and b (top-bottom layout) were analyzed for each of the three layouts of the respective layout pages, a total of 24 pages, including the eye movement gaze hot zone map and the gaze order map.

(a) (b)

Figure 3. Subjects' oculomotor hot zone map Oculomotor trajectory map: (**a**) left-right layout; (**b**) top-bottom layout.

3.3 Brainwave Data Analysis

The This experiment tested brainwave data taken for relaxation and attention, the brainwave experimental data is shown in Figure 4, the brainwave data was imported into SPSS for some analysis.



(a) (b)

Figure 4. Subjects' real-time brainwave maps

3.3.1 Basic Descriptive Statistics of Brainwave Data

As shown in Table 4, the mean values of attention and relaxation of the three groups of this experiment, a, b and c, were counted, etc. From the analysis of the data, it is clear that the relaxation of the three groups of subjects remained basically the same. In attention, the lowest mean value of attention was found in group b and the highest in group c, which reached 55.89 (taking the last two decimal places).

Table 4. Results of basic descriptive statistics of brainwave data

		Number of cases	Average	Standard Deviation	Standard Error	Confidence Interval 95% Lower limi
Attention mean	1	15	49.04	6.30	1.62	45.54
	2	15	46.95	9.63	2.48	41.61
	3	15	55.88	9.49	2.45	50.63
	Total	45	50.62	9.26	1.38	47.84
Relaxation mean	1	15	46.32	20.84	5.38	34.77
	2	15	47.88	18.19	4.69	37.80
	3	15	48.01	11.78	3.04	41.49
	Total	45	47.40	16.98	2.53	42.30

3.3.2 Chi-square Test of Brainwave Data

As shown in Table 5, the test values for attention and relaxation means have a companion probability of >0.05 and meet the requirements.

Table 5. Results of basic descriptive statistics of brainwave data

		Levine Statistics	Degrees of freedom1	Degrees of freedom 2	Significance
Attention mean	Based on average values	2.810	2	42	.072
	Based on median	1.773	2	42	.182
	Median-based with adjusted degrees of freedom	1.773	2	34.785	.185
	Based on mean value after clipping	2.715	2	42	.078
Relaxation mean	Based on average values	1.053	2	42	.358
	Based on median	.616	2	42	.545
	Median-based with adjusted degrees of freedom	.616	2	33.776	.546
	Based on mean value after clipping	.886	2	42	.420

3.3.3 Results of Variance Analysis of Brainwave Data

As shown in Table 6, the mean significance of attention in groups a and b is 0.51 (>0.05), which is not significant; the significance of group a compared with group c is 0.035 (<0.05), which is a high degree of significance, i.e., there is a significant difference in attention in the left-right layout and the global-no-directory interface layout; the significance of group b compared with group c is 0.007 (<0.05), high level of significance, i.e., there was a significant difference in attention in the top and bottom layout and global-without directory.

The difference in attention between the top and bottom layout and the global-no-eye layout was high. Comparing the three groups of relaxation, the significance remained between 0.7 and 1.0 and was greater than 0.05, meaning that there was no significant difference in the level of relaxation of the subjects under the three different layouts.

Table6. Results of basic descriptive statistics of brainwave data

Dependent variable		(I) No.	(J) No.	Mean Difference (I-J)	Standard Error	Significance
Attention mean	LSD	1	2	2.089	3.146	.510
			3	-6.847*	3.146	.035
		2	1	-2.089	3.146	.510
			3	-8.936*	3.146	.007
		3	1	6.847*	3.146	.035
			2	8.936*	3.146	.007
Relaxation mean	LSD	1	2	-1.560	6.340	.807
			3	-1.692	6.340	.791
		2	1	1.560	6.340	.807
			3	-.1321	6.340	.983
		3	1	1.692	6.340	.791
			2	.132	6.340	.983

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4. Conclusions

This experiment was conducted by eye-tracking and brainwave instrumentation to record the experimental data of the subjects while viewing interactive resources with three different page layouts, and the data were analyzed in conjunction with relevant software at a later stage to draw the following conclusions.

Layout type, and the worst learning performance for the top-bottom layout type. There was little difference in learning performance between the global-no-catalog type and the left-right layout type and a significant difference in learning performance between the top-down layout type and the other two layouts. The combined eye movement and brainwave data showed that the left-right layout was the most beneficial and effective of the three layouts.

The best learning outcomes were found in the left-right layout. The data show that, firstly, in the brainwave data analysis, subjects had the highest attention span when viewing the global-no-directory type of interactive resource; the left-right layout type had the middle attention span; and the top-down layout type had the worst attention span. Second, in the eye-movement data analysis, the subjects were able to focus their attention on the main content more easily when viewing the global-no-catalog type of interactive resource, which lasted the longest; the left-right layout type had the highest attentional hotspots allocated to the left-hand catalog and the right-hand subject content, which lasted for a medium amount of time and lasted less than the global-no-catalog version, but the difference in learning achievement was not significant; the top-bottom layout The top-bottom layout has a more diffuse hot zone of attention than the left-right layout, and the top table of contents in the top-bottom layout distracts some of the subjects' attention but does not have the effect of guiding and facilitating learning.

In conclusion, among the three layouts, the subjects spent a moderate amount of attention and a moderate amount of time viewing the left-right layout type but achieved better results, and the learners learned more efficiently and effectively in this layout.

Conflicts of Interest: The authors declare no conflict of interest.

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