Examining the User Experience of a Digital Camera Virtual Reality Lab with Attention Guidance

Pingping Wen, Ahmad Zamzuri Mohamad Ali, and Fei Lu

***Abstract*—In recent years, virtual reality labs have been widely used in teaching. Virtual reality labs built by virtual reality technology have been applied in different disciplines. Many studies have also shown that virtual reality experiments can replace real experiments, and some even have better learning effects than real experiments. For current digital camera experiment courses in China, it is necessary to use virtual reality labs. Attention guidance is added to the design of experimental courses. However, questions arise about learners' acceptance and experience of digital camera virtual reality labs. Another potential problem is learners' acceptance and experience of labs after attentional guidance is added. Therefore, the purpose of this research is to design and develop a digital camera virtual reality lab and study various aspects of the user experience (UX). The User Experience Questionnaire (UEQ) was used to obtain students' responses after completing digital camera virtual reality experimental courses. The subjects were 30 college students (N = 30). Participants were divided into two groups. In the first group, 15 students participate in the test of the virtual reality lab with attention guidance, and in the other group, 15 students participate in the test of the virtual reality lab without attention guidance. From the results, it is concluded that the UX level of the digital camera virtual reality lab is promising and positive. The subjects were satisfied with the virtual reality lab with attention guidance and without attention guidance, though the subjects with attention guidance were more satisfied.**

***Index Terms*—Attention guidance, digital camera, learning, user experience, virtual reality lab.**

I. Introduction

Practical experience is an important part of the educational process. It usually takes significant time and economic resources to build professional subject labs, which means that testing practical experience is beyond the competence of many institutions. By establishing a virtual reality lab with virtual reality technology, we can find a solution to this problem. In a virtual reality lab, we can simulate all the processes and actions that may occur in an actual lab and even some that cannot be addressed in an actual lab [1].

Simply speaking, a virtual reality lab is an open network virtual experiment teaching system based on frontier technologies such as the Web, VR, and so forth. It is the digitization and virtualization of various teaching laboratories [2].

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At present, the construction technology for virtual reality labs is very mature, and the benefits brought by virtual reality labs in teaching have been widely recognized [3]. The use of high-quality virtual reality labs can bring great educational benefits. Virtual reality labs are completely integrated with traditional laboratory courses in the curriculum. Different courses complement each other and enhance each other's learning [4]. It has become a trend to use virtual teaching methods in higher education institutions [5]. Virtual reality lab teaching plays a unique role in education [6]. As educators realize that they can create better learning environments for teaching with virtual reality technology, people use it in education more and more [7]. Multimedia learning based on virtual environments is helpful for achieving course goals and completing course content [8]. In the meantime, there has been more and more research on the rationality and effectiveness of the instructional design process for virtual reality labs [9].

The features of virtual reality technology include a human-computer interactive operating environment, the performance of three-dimensional space, and an immersive experience. In order to realize these features, the main experimental equipment of the virtual reality lab includes special input and demonstration equipment. This equipment is designed to affect various operations and instructions, provide feedback, and achieve truly vivid interactive effects. Through this equipment, a sufficient exchange of information between humans and computers can be achieved. According to the practical applications, some tools can be used selectively, including workstations of virtual reality series, stereo projections, stereo glasses or helmet displays, three-dimensional space tracking locators, data gloves, 3D stereo displays, three-dimensional space interactive balls, multi-channel round screen systems, modeling software, and so forth. According to the actual situation of this research, a VR laptop is selected as the main equipment for the virtual reality lab.

In virtual reality labs, an arrow can play a role in spatial positioning as a kind of attention guidance [10]. In this study, arrows were used for attention guidance. Substantial research has been done on attention guidance through visual cues in real environments [11]. For example, students' learning comprehension is improved by guiding their visual attention in multimedia environments [12]. However, there is no research on attention guidance with visual cues in virtual environments. Attention is guided in the virtual reality lab with a graphic object that does not contain any meaning but provides intuitive hints to highlight task information through visual elements or symbols (e.g., arrows, circles, or highlights) [13]. Using visual cues for attention guidance can force learners to move their eyes

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toward important visual stimuli in multimedia teaching. At the same time, attention guidance can reduce visual search time and unnecessary cognitive processing and release meaningful learning resources [14].

There is little application research on virtual reality labs in the field of digital media art. In this research, a virtual reality lab is suitable for most digital media art is designed and developed. However, a question appears: how do students accept and experience the laboratory? Therefore, the purpose of this research is to design and develop a virtual reality lab and analyze students' experiences. In the specific design of the virtual reality lab, we added attention guidance to explore another problem: what is the difference between the acceptance and experience of students in the virtual reality lab with attention guidance and those without attention guidance?

II. Design and Development

Instructional design involves transforming learning content and teaching principles into plans to achieve predetermined learning outcomes efficiently [15]. There are many models of teaching design, such as ADDIE, SAM, Dick and Carey, Waterfall, ASSURE, and so on. To systematically and optimally arrange the teaching process, control variables, and teaching effects, the instructional design theory model is introduced into the virtual reality lab in this study. For this reason, the classic ADDIE model is selected for course design. ADDIE is an abbreviation that refers to the five stages of this model: analysis, design, development, implementation, and evaluation.

A. Analysis

Analysis is the first step in the ADDIE model. As the primary part of the design process of the virtual reality lab, analysis is also the basis of the entire experiment design. Analysis is the prerequisite for determining the objectives of the experiment and planning the experiment course design, as well as the basis of evaluation. Analysis is also the goal-setting stage that determines the teaching objectives, target users, content, methods, hardware, and software of the experiment course.

The purpose of developing a virtual reality lab is to solve the practical difficulties and problems of digital camera experiment courses. The digital camera course is a core undergraduate course for students majoring in digital media technology, digital media art, animation, photography, radio, film, and television program production.

The target users of this experiment are fourth-semester students majoring in digital media art. After learning theoretical knowledge from the digital camera course, these students need to continue experimental learning. In experiment courses, they enhance their practical camera skills and conduct more exercise. They also master the knowledge of digital camera technology and improve their aesthetic level and artistic digital camera operation skills.

Determine the teaching objectives according to the teaching contents. First, master the layout and planning of the scene space. Second, master the scheduling of characters expertly. Third, master the application and scheduling of the shot sizes of the camera. Fourth, master lighting design.

The VR laptop was selected as the experiment device. It has a built-in processor and an integrated screen, which means it has an independent display device and computing unit without the need for a mobile phone or external host. A VR laptop has a high-precision tracking and positioning system. It can provide an accurate real-time three-dimensional space scene according to the location and direction of the user's somatosensory device, and the user's position in reality can be fed back accurately to the three-dimensional space scene in real time. This accuracy is within 1 mm of the X-axis, Y-axis, and Z-axis in 3D space.

The VR laptop is equipped with 3D tracking glasses, which can be tracked and located through the high-precision tracking and positioning system of the integrated machine. Fig. 1 shows VR laptops and 3D tracking glasses. The glasses are simple and light and require no battery or connection line. Wearing the glasses does not affect the normal communication between teachers and students in a class. The 3D tracking glasses have several reflective points that can be used with the tracker on the display for head tracking. The system can accurately judge the position of the glasses so that display content from different perspectives can be converted to achieve a realistic effect.

Virtual reality head-mounted displays are also available for virtual reality labs, but they may cause motion sickness if worn for a long time [16]. This is not a problem with 3D glasses. Therefore, glasses are more suitable for long-term teaching in the lab. It is certain that 3D glasses do not provide the same level of immersion as virtual reality head-mounted displays.

Fig. 1. VR laptop and 3D tracking glasses.

At present, scenes and characters in the virtual reality lab are made in 3DS Max. 3ds Max can easily realize data conversion with Unity3D and other software. All the graphic design needed in the virtual reality lab can be completed by Adobe Photoshop, especially the design and production of UI (user interface). The virtual reality lab was developed in Unity. The models used in Unity, including scenes, characters, object characters, and so forth, are made in 3Dmax. Lead the models in the Unity, create material balls in the Unity, assign the material to the material balls, complete the building of the scene, and then design the UI interface of the virtual lab. Finally, according to the requirements of the laboratory functions, compile the interactive codes.

B. Design

The design process is the second part of this development

phase. At this stage, the design is presented visually. The teaching objectives, teaching task list, attention guidance design, scene design, character design, experimental process, experimental operation method design, and UI design are also decided at this stage.

It is very important to define teaching objectives and teaching tasks in the design process. The first target is for students to master the layout and planning of the scene space. The second target is for students to master the scheduling of characters. The third target is for students to master the application and scheduling of the shot sizes of the camera. The fourth target is for students to master lighting design. The main learning tasks needed to achieve the teaching objectives are determined.

Previous studies show that the forms of attention guidance include arrows, highlighting, color changes, and so forth. Arrows can play a very effective role as guiding symbols [17].

An arrow is a symbol representing a guiding role in human cognition. Arrows are also effective for attention guidance in virtual reality labs. The arrow is designed to hang directly above the current selected object so that it is easier to distinguish it from the props in the scene and it can serve as a reminder and guide. Specifically, the arrow does not contain any meaning and will not become an additional cognitive burden for students. In the virtual reality lab, as the number of items students place in the scene increases, it is easy for students to lose track of the items they are manipulating. Adding arrows can solve this problem.

Because it is a 3D scene in the virtual reality lab, 3D arrows are used as attention guides. The sense of immersion is one of the important features of virtual reality. It is generally believed that a high level of immersion creates a strong sense of presence that enhances the experience [18]. Therefore, in the process of laboratory design, a sense of immersion is key. Adding 2D symbols into the virtual reality scene will destroy the immersion of the experiment. That is to say, if a 2D arrow is placed above a character or camera, the immersive feeling of the experiment will be destroyed, and the added 2D arrow will be very abrupt. Further, the 2D arrow cannot be seen in the Z-axis of three-dimensional space. These are all reasons for selecting a 3D arrow.

Color is an important cue in attention research, and many attention experiments use color to attract attention [19], [20]. The colors selected for symbols of attention guidance tend to be striking. Because the function of symbols of attention guidance is to remind and guide, striking colors can attract more attention and focus students' eyes on the target more quickly. Based on the background color of the scene in the virtual reality lab, yellow is more striking.

When students enter the digital camera virtual reality lab, the interface is a virtual environment. First of all, students choose a scene. Scenes are divided into indoor scenes and outdoor scenes. All operations will be completed in the virtual scene chosen by students. Scenery selection includes character selection, camera selection, and lighting selection. First, for character selection, a man and a woman are required. Students choose from the provided character models and drag the selected character models to the virtual scene. It is required to shoot the scene of two people talking. The position relationship between the two characters and the position design of the characters in the scene are included in the lecturer's assessment of the students. Second, for the choice of camera, three cameras are required to shoot the medium shot, close shot, and close-up of the characters. Here, the camera position is fixed and the shooting content is determined according to the camera position. Third, there are two choices for lighting. According to the choice of natural light, set the lighting. The lighting position choice and the choice of whether to combine lighting and natural light are subject to assessment. Finally, students generate and submit the experiment results and save them. Students can withdraw from the experiment at any stage. The experiment procedure chart is shown in Fig. 2.

Fig. 2. Virtual reality lab process.

The purpose should be shown in the UI clearly so that even inexperienced users immediately understand what they should do [21]. The text, graphics, and animation used in this virtual reality lab are mainly based on the principles of human-computer interaction design. Because the UI is on the level above the scene, the UI style is minimal, and the displayed layout and graphic features are as simple as possible to highlight the experimental operation.

C. Development

The purpose of the development phase is to generate and validate the virtual reality lab. In this stage, the steps of the experiment, the requirements of the experimental results and conclusions, and the detailed content of the experiment are introduced.

Determine the experimental procedures for the students according to the designed experimental procedures. The students should follow the experimental procedures to complete the content.

Students are required to submit screenshots of the scene design and lens design effects set by the lecturer, and in the design report, how to use the actor scheduling and space scheduling according to the plot development narrative, and complete the performance of the design scene, so as to

create an effective scene. Students are encouraged to record innovations, problems encountered in the design process, and solutions to the problems.

The experimental procedure adopts a local computer installation, and students save data to the local hard disk. The digital camera virtual reality experiment course has four experimental objectives: scene space layout and planning, character role scheduling, camera scene application method, and scheduling and lighting design (Fig. 3, 4, and 5).

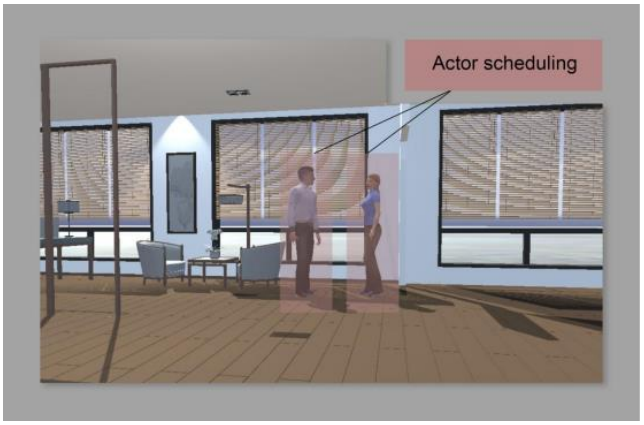

Fig. 3. Actor scheduling.

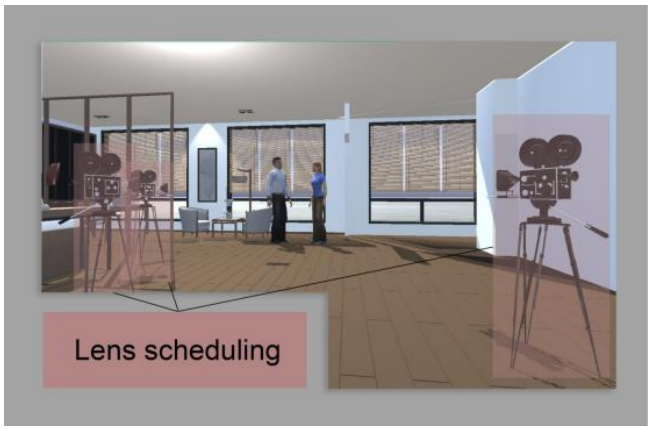

Fig. 4. Lens scheduling.

Fig. 5. Lighting distribution.

The lecturer gives the students two scripts. Students can choose one of these two scripts for the experiment. Students select Script 1 for an indoor scene and Script 2 for an outdoor scene. Students can create a spatial layout for the existing scenes according to the requirements of the script.

In the digital camera virtual reality lab with added attention guidance, a 3D yellow arrow serves as the attention guidance symbol. If the current student operates a role, yellow arrows appear above the role, as shown in Fig. 6. The arrow can switch to the selected role.

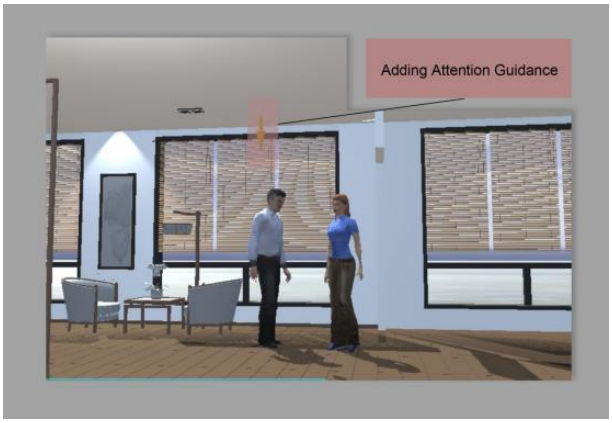

Fig. 6. Adding attention guidance.

If the current student is operating the camera, yellow arrows appear above the camera, as shown in Fig. 7, and the arrow can switch according to the selected role.

Fig. 7. Adding attention guidance.

If the current subject operates the camera lamp, a yellow arrow will appear above the camera lamp, as shown in Fig. 8.

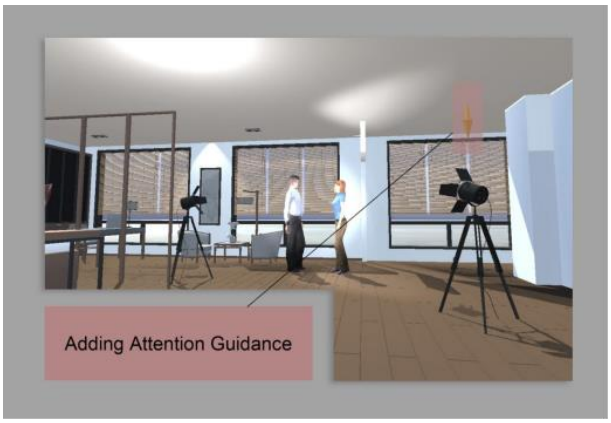

Fig. 8. Adding attention guidance.

During the experiment, the split lens schematic diagram and the scene scheduling schematic diagram will be output synchronously, including the split mirrors 1, 2, and 3 captured by the three cameras, respectively. The scene scheduling schematic diagram portrays a top view of the entire shooting scene, including characters, cameras, lighting fixtures, and so forth. Students can click the "Generate Design" button to generate the design results and save them to the computer for the lecturer to evaluate.

D. Implementation and Evaluation

The two methods of formative evaluation and summative evaluation are adopted throughout the design and development process. Formative evaluation is conducted during the design and development of the virtual reality lab, mainly by providing feedback on problems existing throughout the experiment. This includes the evaluation of experts and students. Two technical experts, two teaching experts, two educational psychology experts, and several students participate in the evaluation process. In most cases, the evaluation takes the form of an unstructured interview. Continuous improvements are made to the virtual reality lab based on expert and student feedback. After the improvements, a summative evaluation is conducted by 30 students in the form of a user experience questionnaire. Overall, the virtual reality lab is very good both in terms of availability and user experience.

III. Methodology

This study analyzes the aspects of UX in learning with virtual reality labs. It compares virtual reality labs with and without added attention guidance. To accomplish this, virtual reality labs with and without attentional guidance were designed and developed.

A. Research Sample

In this study, the participants are 30 students (20–24 years old; 22 males and 8 females) in the fourth semester of Chinese digital media art. The students are sophomores in the School of Fine Arts and Art Design, Qiqihar University, China. These students have just finished the theoretical section of the digital camera course and need to continue with the experimental course. Participants had no previous experience with the virtual reality lab.

B. Research Instrument

The UEQ is a set of tools for quantitative analysis of user experience developed by SAP (System Applications and Products). It is a fast and reliable questionnaire for measuring UX in interactive products [22]. It is also a set of tools for quickly evaluating the user experience of interactive products [23].

Users express their feelings, impressions, and attitudes about using products and services in the questionnaire. Furthermore, a quantitative form of several aspects of the user experience is generated automatically in an Excel file. Through factor analysis, six scales and 26 items are generated, including traditional easy accessibility indicators—efficiency, perspicuity, and dependability—and three indicators of convenient experience—attractiveness, stimulation, and novelty. There are 26 different semantic differences in the UEQ, and it is important that participants fill out the questionnaire in their native language. In this study, a Chinese questionnaire was selected because the experiment was aimed at students majoring in digital media art in China.

Some studies have shown that the UEQ has strong validity and reliability [24], [25]. Cronbach's Alpha coefficient is usually used to evaluate reliability. The results of some previous studies support the UEQ as a reliable tool for measuring UX, with a high Cronbach's alpha value [23], [26], [27].

The participants were 30 students from digital media arts majors currently in their fifth semester. The test was conducted after the students completed the digital camera virtual reality experiment course, which lasted 30 minutes, and completed the questionnaire for five minutes. Prior to the test, the lecturer explained the main objectives of the digital camera experiment course and how to use the virtual reality lab. Students started the experiment, and the UEQ was distributed to students immediately after finishing the experiment.

The testers were divided into two groups. Group 1 completed a digital camera experiment course with added attention guidance, and Group 2 completed digital camera experimental courses with no added attention guidance.

Completed questionnaires were collected and examined immediately to identify defective or incomplete questionnaires. Subsequently, the data of the questionnaire were analyzed. This study was primarily conducted using descriptive quantitative analysis.

IV. Analysis

The reliability of describing the consistency of the scale items is measured by obtaining Cronbach's alpha for the data analysis tool of the UEQ. A small sample (less than 50) is used in this study, and the alpha value should be explained very carefully. In this case, lower alpha values indicate that the scales that reflect the user's intent in UEQ are inconsistent or that there are some problems in the correlations between items. These may result from sampling errors and may not be an indicator of problems in the scale. They may also be due to a misunderstanding of certain items or may show that the scales may not be related to the context of the questionnaire's application [28]. Table I shows the Cronbach's alpha values of the UEQ for Group 1 and Group 2 . It is generally believed that a Cronbach's alpha coefficient above 0.7 is acceptable. The mean values of Cronbach's alpha for Groups 1 and 2 are 0.742 and 0.722, respectively, which means that the scale is sufficiently reliable.

TABLE I: Cronbach's Alpha of UEQ Scale for Groups 1 and 2

	Scale	Cronbach's Alpha (Group 1)	Cronbach's Alpha (Group 2)
1	Attractiveness	0.79	0.70
2	Perspicuity	0.72	0.73
3	Efficiency	0.71	0.71
4	Dependability	0.80	0.73
5	Stimulation	0.73	0.76
6	Novelty	0.70	0.70

For the tests of Group 1, the mean scale scores of UEQ are compared with the internal database of UEQ using the

accompanying Excel file. Results are shown in Table II and Fig. 9. The UEQ dimensions of efficiency, dependability, stimulation, novelty, perspicuity, and attractiveness are all rated excellent. Compared with the internal database of UEQ, the results of these scales can be considered excellent, as the scores are within 90% of the scores in the database. The scores for perspicuity are slightly lower but still rated good, in the range of the 75th to 90th percentile. The high scores indicate that students generally accept the concept of the prototype and consider it fascinating and interesting.

TABLE II: UEQ SCALE SCORES AND INTERPRETATIONS IN THE DATABASE OF GROUP 1

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	1.86	Excellent	In the range of the top 10% of results
Perspicuity	2.00	Good	10% of results were better, 75% of results were worse
Efficiency	2.27	Excellent	In the range of the top 10% of results
Dependability	2.18	Excellent	In the range of the top 10% of results
Stimulation	2.08	Excellent	In the range of the top 10% of results
Novelty	2.45	Excellent	In the range of the top 10% of results

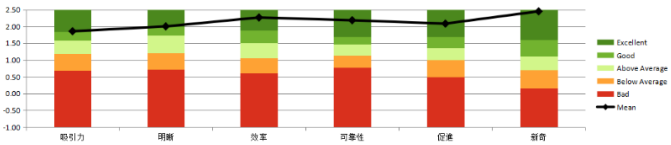

Fig. 9. Evaluation of Group 1.

For the tests of Group 2, the mean scale scores of the UEQ are compared with the internal database of the UEQ using the accompanying Excel file. The results are shown in Table III and Fig. 10. The UEQ dimensions of efficiency, dependability, stimulation, and novelty are all rated excellent. The scores are within 90% of those in the database. These high scores indicate that students generally accept the concept of the prototype. The scores of attractiveness and perspicuity are slightly lower but still rated good, in the range of the 75th to 90th percentile. This indicates that it is also easy for students to understand the teaching content of the virtual reality lab.

TABLE III: UEQ SCALE SCORES AND INTERPRETATION IN THE DATABASE OF GROUP 2

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	1.83	Good	10% of results were better, 75% of results were worse
Perspicuity	1.95	Good	10% of results were better, 75% of results were worse
Efficiency	2.33	Excellent	In the range of the top 10% of results
Dependability	1.80	Excellent	In the range of the top 10% of results
Stimulation	1.83	Excellent	In the range of the top 10% of results
Novelty	2.48	Excellent	In the range of the top 10% of results

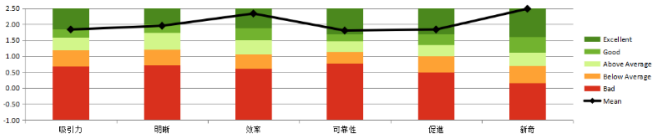

Fig. 10. Evaluation of Group 2.

The responses to the UEQ from Groups 1 and 2 participants were compared according to user experience, as shown in Table IV.

TABLE IV: UEQ SCALES, MEAN, VARIANCE, AND BENCHMARK INTERVALS OF GROUPS 1 AND 2

Scales	Group 1 Participants' responses		Benchmark intervals	Group 2 Participants' responses		Benchmark intervals
	Mean	Variance		Mean	Variance	
Attractiveness	1.86	0.29	Excellent	1.83	0.21	Good
Perspicuity	2.00	0.33	Good	1.95	0.20	Good
Efficiency	2.27	0.22	Excellent	2.33	0.21	Excellent
Dependability	2.18	0.34	Excellent	1.80	0.39	Excellent
Stimulation	2.08	0.23	Excellent	1.83	0.43	Excellent
Novelty	2.45	0.18	Excellent	2.48	0.24	Excellent

The results of Group 1 are much better than those of Group 2 in terms of attractiveness: Group 1 is rated excellent and Group 2 is rated good. The groups have similar good ratings for perspicuity. In the other four aspects, the results of Group 1 and 2 are both excellent. T-tests are also applied to the mean responses of Groups 1 and 2, indicating that there is no significant statistical difference ($p > 0.05$) between the two groups. Based on these results, participants are satisfied with both the virtual reality lab with attention guidance and the one without attention guidance, although they are more satisfied with the former.

V. DISCUSSION

Virtual reality labs can solve problems that can't be solved in real experiments. Applying a virtual reality lab to digital camera courses is an innovative and practical part of research and teaching. However, it is worth studying how the design of virtual reality labs can be more accepted by learners, attract more learners, and enhance students' interest in learning. The mechanism of attention guidance for learning is a very complex problem, and there are different opinions in different multimedia teaching studies.

Developers need to design a virtual reality lab according to the teaching content of the specific experimental course. At the same time, another lab can be designed the same way but with added attention guidance to facilitate further comparative research. Obviously, on the whole, students' experiences with and acceptance of virtual reality labs are positive. The UX test of 30 students in the virtual reality lab went well. The content of the virtual reality lab attracts student interest and helps them enjoy learning.

With the data analysis tools of UEQ, Cronbach's Alpha is calculated and applied to measure the reliability and describe the consistency of the scale items. The Cronbach's alpha values of the UEQ of the two virtual reality labs are both above 0.7, which means that the scale was reliable.

The results of the data analysis show that the virtual reality lab attracted the interest of students, the students liked this form of experiment, and this experiment increased the fun of in-class learning. This finding is demonstrated by the positive average scores for attractiveness, stimulation,

and novelty. This finding is also consistent with the research on the application of virtual reality labs in teaching, which can enhance students' enjoyment of learning [29], [30]. Among them, attraction reflects the students' experience on the whole, indicating that the students identify with the attraction and interest of the virtual reality lab. Stimulation indicates whether students are excited and motivated to use the lab and whether they find it interesting. Novelty shows whether students think the lab design is creative and whether their interest is captured. It is found that a virtual reality lab with attention guidance can arouse students' interest more than one without attention guidance. However, these studies only evaluate courses from the perspective of students and lack teachers' evaluations of whether students' academic performance has improved. Further research is needed on whether students' grades and understanding of what they have learned are improved with this enhancement in interest.

In addition, the three aspects of perspicuity, efficiency, dependability are also studied. Perspicuity shows whether students can easily become familiar with the virtual reality laboratory and learn to use it. Significantly, sub-terms of perspicuity score positively. This suggests that the structured development of ADDIE instructional design models can ensure the quality and availability of virtual reality labs. Efficiency indicates whether the student can complete the experimental task within the specified time. In particular, students think that learning in virtual reality labs is efficient and practical. The third aspect is reliability, which explains whether students can control the interactions and whether virtual reality labs are safe and predictable. Students can control the interactions in experiments, which are also easily understood. However, it is difficult to control the degree of these interaction modes. At a high level of interaction, it is easy to produce excessive distraction and increase cognitive load [31]. Therefore, the rationality of the interaction design of virtual reality laboratories needs to be determined by further measurement of cognitive load [32].

In addition, the choice of equipment for virtual reality labs has been increasingly dominated by head-mounted displays, which give a stronger sense of immersion. Therefore, future research could also discuss the application of virtual reality head-mounted displays in virtual reality labs from the perspective of motion sickness.

Finally, through a comparative analysis between the virtual reality labs with attention guidance and those without it, we find that in the aspects of attractiveness, labs with attention guidance are better than those without it. Both labs are good in the aspects of perspicuity. In the remaining four aspects of efficiency, dependability, stimulation, and novelty, the results of virtual reality labs are both excellent. These results further demonstrate that a virtual reality lab with attention guidance provides a better user experience.

VI. Conclusion

Above all, the participants' feedback in this study shows that virtual reality labs have availability and significant positive effects on students' interest and motivation. However, it does not show whether a virtual reality lab with attention guidance can effectively reduce students' cognitive load or improve students' learning efficiency and academic performance. Students have a high acceptance of virtual reality labs with attention guidance, but this is only based on student feedback. Finally, the questions of whether the lecturer's teaching aims are fulfilled and whether the students' academic performance and learning efficiency are improved from the lectures' perspective need further research and tests. Further, for experiment courses of differing difficulty levels, the influence of adding attention guidance on students' academic performance and learning efficiency also needs additional research.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Pingping Wen and Ahmad Zamzuri Mohamad Ali conducted the research; Pingping Wen and Fei Lu analyzed the data; Pingping Wen wrote the paper; all authors had approved the final version.

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