A Design Model for using Advanced Multimedia in the Teaching of Photography in The Kingdom of Bahrain

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Abstract

Abstract

This Study investigates the effectiveness of a new Instructional Design model for using advanced multimedia in the teaching and learning of photography at university level in Kingdom of Bahrain. A preliminary study revealed that the central problems faced by students are learning key technical aspects of photography coupled with insufficient resources and high student teachers ratio.

Advanced multimedia was proposed as an effective tool for teaching and learning photography. A critical review and analysis of existing e-learning resources revealed that such technology might help in teaching and learning, especially subjects that need experience with real instruments like cameras. Through reference to the ASSURE model, Laurillard's conversational model, and insights from Steuer's Classification model, the researcher developed a new instructional design model for using advanced multimedia in photography education [AMPE]. This was field tested in University photography teaching.

For the evaluation of the AMPE model a mixed-model design was used, combining quantitative and qualitative methods. In a quantitative evaluation, effectiveness in learning was estimated from the student achievement in a test. A comparison of the opinions of the two groups of students in a specially constructed questionnaire measuring their views of the respective teaching and learning methods was also applied. Finally engagement and enjoyment in learning in the two groups of students were also assessed through questionnaire. The participants' comments, opinions, and suggestions were obtained through open-ended questions in the questionnaire.

The study found that advanced multimedia enhances effectiveness, engagement, and enjoyment in learning photography. The instructional model and associated "virtual camera" seems to be a suitable solution for the lack of real cameras in the classroom environment, and can help in the teaching of difficult technical photographic knowledge in an efficient and practical manner.

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Also special thanks for Dr Mohd J Almosawi from University of Bahrain and Dr Ziyad Hadad Dean of the Faculty of Art and Design at the Royal University – Bahrain whom assigned the task of administrating the final test e-learning resource in the University of Bahrain and Royal University students sample.

Dedication

Dedication

To my late Mother, Dad, my younger sister, my second sister and her family.

I would also like to dedicate this study to my wife, daughters and sons for their support in spirit which helped me undergo this program of study.

Lastly to my brother and sister.

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Chapter One

Introduction

1. Introduction

1.1. Choice of Topic

The researcher has undertaken this PhD study in combination with his role as a photography lecturer in the University of Bahrain.

The study includes an investigation into the areas of multimedia, e-learning and advanced multimedia in photography. The author strongly believes that the areas investigated in this study can support face-to-face teaching, which would subsequently enhance the learning and teaching of photography in Bahrain.

The multimedia technologies examined in this study are undergoing rapid growth, and require the emergence of new concepts in teaching and learning for their effective use in photography.

1.2. Research motivation

This study investigates the Development of a Design Model for Using Advanced Multimedia in the Teaching of Photography. The main motivation of the study is to solve problems faced by students in learning some aspects of photography. From the author’s experience in twenty years of teaching, and also after speaking to colleagues who work in the same field, it has become clear that the number of students who are taking photography courses is increasing. This is supported by the data shown in Figure 1.1 below.

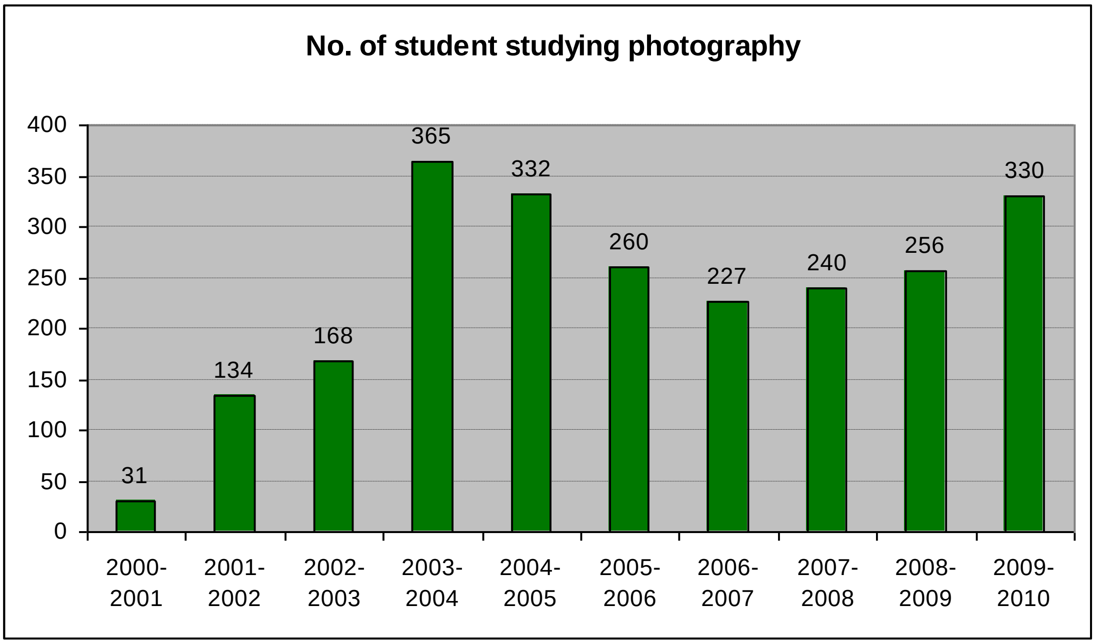


Figure 1.1 Number of students studying photography in Bahrain.
Source: University of Bahrain Timetables (2000-2010).

Photography has also been instigated in other courses as a compulsory element and, here, students are introduced to the subject for the first time. This increase in students has created problems which are difficult to solve through only traditional face-to-face teaching supplemented with hands-on demonstration, photo examples and whiteboards. The main problem, however, is that despite the rise in the number of students, there is no related increase in staff and cameras.

This has led to a dramatic increase in the staff-student ratio, particularly in the period from 2003 to 2007. This is reflected in the overall staff-student ratio for Bahraini universities from 2001 to 2010, which is shown in Figure 1.2 below.
The figures indicate that the situation has improved recently, with a lower ratio for the years 2007 – 2010, but this has been due to an increase in non- Bahraini teachers being employed, as illustrated in Figure 1.3 below. The situation is still far from ideal however, as a staff-student ratio of approximately 1: 30 is still high, particularly for practical classes.

The breakdown details of student and staff ratios of all the universities in Bahrain are discussed and presented in Chapter 2, section 2.2.1.1, of this study.

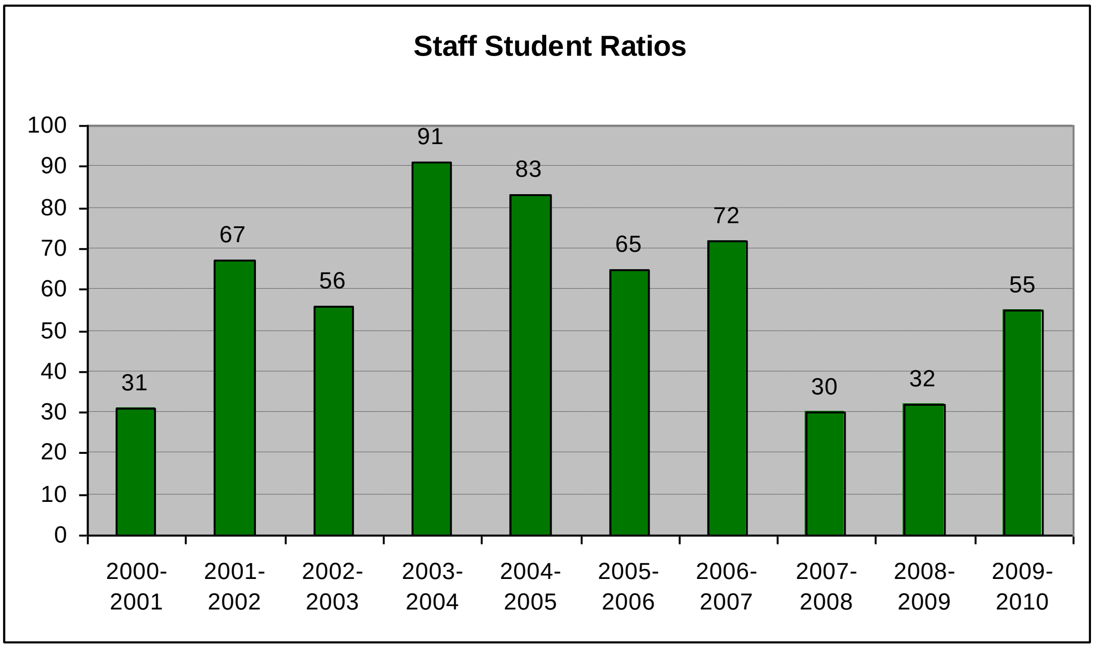


Figure 1.2 Staff-Student Ratios in Bahrain.

Source: University of Bahrain Timetables (2000-2010).

While the number of local Bahraini teachers has not changed much in relation to the increase in student numbers, this has been matched with a high dependence on non-Bahraini teachers over the years. This trend is clear from the year 2003 onwards. It started with 40% of non-Bahraini teachers in the 2003-2004 academic year, and this rose to an 80% dependence on non-Bahraini teachers in the 2008-2009 academic year. Although this increased dependence on non-Bahraini teachers has gone someway to solving the issue of staff-student ratio, it is still a problem because non-Bahraini teachers incur additional financial and logistical problems.

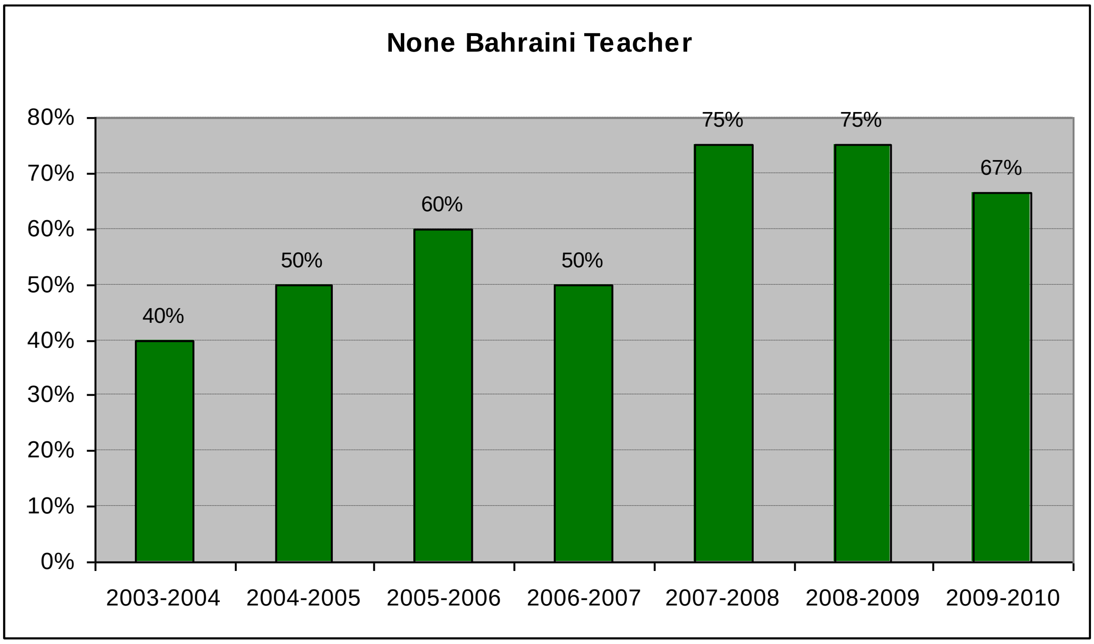


Figure 1.3 Non-Bahraini teachers.

Source: University of Bahrain Timetables (2002-2010).

It is, therefore, argued that a solution has to be formulated whereby the large class sizes, shortage of Bahraini staff and cameras can be addressed, and this can possibly be achieved by introducing advanced multimedia to teach photography, enabling students to learn some aspects of photography independently. This is required particularly in areas that are difficult to comprehend, visualize, and therefore understand, with only limited direct face-to-face teaching and camera use. For example depth of field, aperture variables and gain, freeze and motion blur are learnt by practice, and it is very difficult for a teacher to explain how to get it right without the students actually experimenting with a camera and learning by experience. It is proposed that these aspects of photography might be taught using advanced multimedia, such as virtual environments where the students can experiment with real life simulations and gain the experience of taking technically correct photographs without the need to use real cameras. These virtual cameras could reduce the problem of a shortage of cameras and staff as students can learn in their own time using the virtual examples and simulations. The key concern of this research is how these e-learning and virtual environments can be designed and implemented in teaching photography successfully.

The research will therefore explore effective ways of implementing advanced multimedia environments in photography which reduce the problems currently faced by teachers and students.

1.3. Background to the study

The study is based on the preliminary research conducted by the researcher as part of the overall study, and this was comprised of:

1. Student Questionnaire.
2. Teachers' interviews.

This preliminary research was necessary to establish the starting point for the PhD study in terms of the difficulties and problems faced by students in learning photography. The first part of this preliminary research was in the form of a questionnaire applied to students who are learning photography.

As the questionnaire was administered in the UK and in Bahrain, the study also includes an analysis which compares UK and Bahrain students and examines the problems faced in both countries. This was further coupled with the findings of a preliminary study to investigate the issues and problems faced by the photography teachers. A set of interviews with teachers who teach photography in UK and Bahrain is also discussed in Chapter 4 of this study.

The findings of the preliminary research were used as the basis for the overall study. The results of the student questionnaires indicated that the major problems in teaching photography are:

- Lack of availability of cameras
- High student numbers in class (between 25 and 30 students)
- Lack of access to different learning resources such as interactive web-sites, interactive CD-ROMs, conferences and trade exhibitions

The results of the interviews held with seven teachers indicated that:

- Photography lecturers have to manage large classes
- It may be difficult to pay individual attention to students
- There is a lack of resources
- Teachers in such large classes do not seem to use learning technology, such as video, internet and multimedia CD ROMs
- The teachers rely on conventional media forms, including books and notes, diagrams and photo examples, for convenience.

There are some differences and similarities between Bahrain and UK. The major similarities are the high number of students in photography classes, depth of field is regarded as the most difficult aspect of learning photography in both countries, and teachers in both countries suggest teaching photography in smaller classes. The major differences are the lack of cameras in Bahrain compared to UK, and the fact that UK teachers use the internet more for learning compared to Bahrain.

These findings confirm the problems indicated in section 1.2, above, and the need for new media technology and methods to support conventional teaching-learning methods. The author, in this context, proposes that teaching-learning, to be purposeful and effective for the benefit of the students, must be based on a blend of face-to-face class room based lectures duly supplemented by e-learning resources using advanced interactive multimedia such as virtual cameras. Future research will critically examine, and test with students, existing multimedia resources used in photography with the aim of developing design strategies for future e-learning developments in this area.

1.4. Problem Statement

Increasing staff-student ratios, and a lack of cameras and accessories coupled with a further lack of suitable learning resources, are adversely affecting the teaching and learning of key aspects of photography in Bahrain.

1.5. Aims and Objectives

1.5.1. Aim

The aim of this study is to produce an innovative design model for the effective development of an advanced multimedia learning resource to support the teaching of key aspects of photography focusing on Bahrain

1.5.2. Specific Objectives

The specific objectives of this study are:

1. To determine the effectiveness of the proposed design model to enhance learning.
2. To identify where the proposed design model could be adapted to enhance teaching in other countries and subjects.

1.6. Research Questions

In conducting this study the researcher has developed three research questions, as follows:

1. Does using an advanced multimedia based learning application give a higher level of learning compared to traditional approaches?
2. Does using an advanced multimedia based learning application give a higher level of engagement compared to traditional approaches?
3. Does using an advanced multimedia based learning application give a higher level of enjoyment compared to traditional approaches?

1.7. Research Hypotheses

There are three supported research hypotheses in this study. The hypotheses are as follows:

Hypothesis 1

Ho: Advanced multimedia based learning applications do not give a higher level of learning when compared to traditional approaches.

Ha: Advanced multimedia based learning applications give a higher level of learning when compared to traditional approaches.

Hypothesis 2

Ho: Advanced multimedia based learning applications do not give a higher level of engagement when compared to traditional approaches.

Ha: Advanced multimedia based learning applications give a higher level of engagement when compared to traditional approaches.

Hypothesis 3

Ho: Advanced multimedia based learning applications do not give a higher level of enjoyment when compared to traditional approaches.

Ha: Advanced multimedia based learning applications give a higher level of enjoyment when compared to traditional approaches.

1.8. Research Methodology

The research methodology for this study is discussed in detail in chapter three, and presented in a diagram form in Figure 3-1 and Figure 3-2. However, it can be summarised as follows:

1. Literature review into areas related to teaching and learning in photography including e-learning design methodologies and models, pedagogy in

photography, advanced multimedia and broadband technological development.

2. Interviews with relevant members of the photographic community in UK and Bahrain, with specific focus on formal educational institutions and community organizations to pinpoint the specific problems with regard to teaching photography.
3. Critical review of existing e-learning materials with a particular focus on photography and the use of interactive multimedia rich environments, as well as observation of students using e-learning materials.
4. Examination of 3D animation, virtual environments and video with a view to optimise use in broadband e-learning development.
5. Questionnaire to determine current difficulties and problems faced by students in photography courses, and identification of a suitable subject area.
6. Develop a design model for the development of advanced multimedia learning resources to effectively support learning in photography.
7. Design and construction and testing of a prototype e-learning environment to verify the suitability of the proposed design model in teaching photography

The inter-relation between the chapters is shown in the following diagram, Figure 1-4.

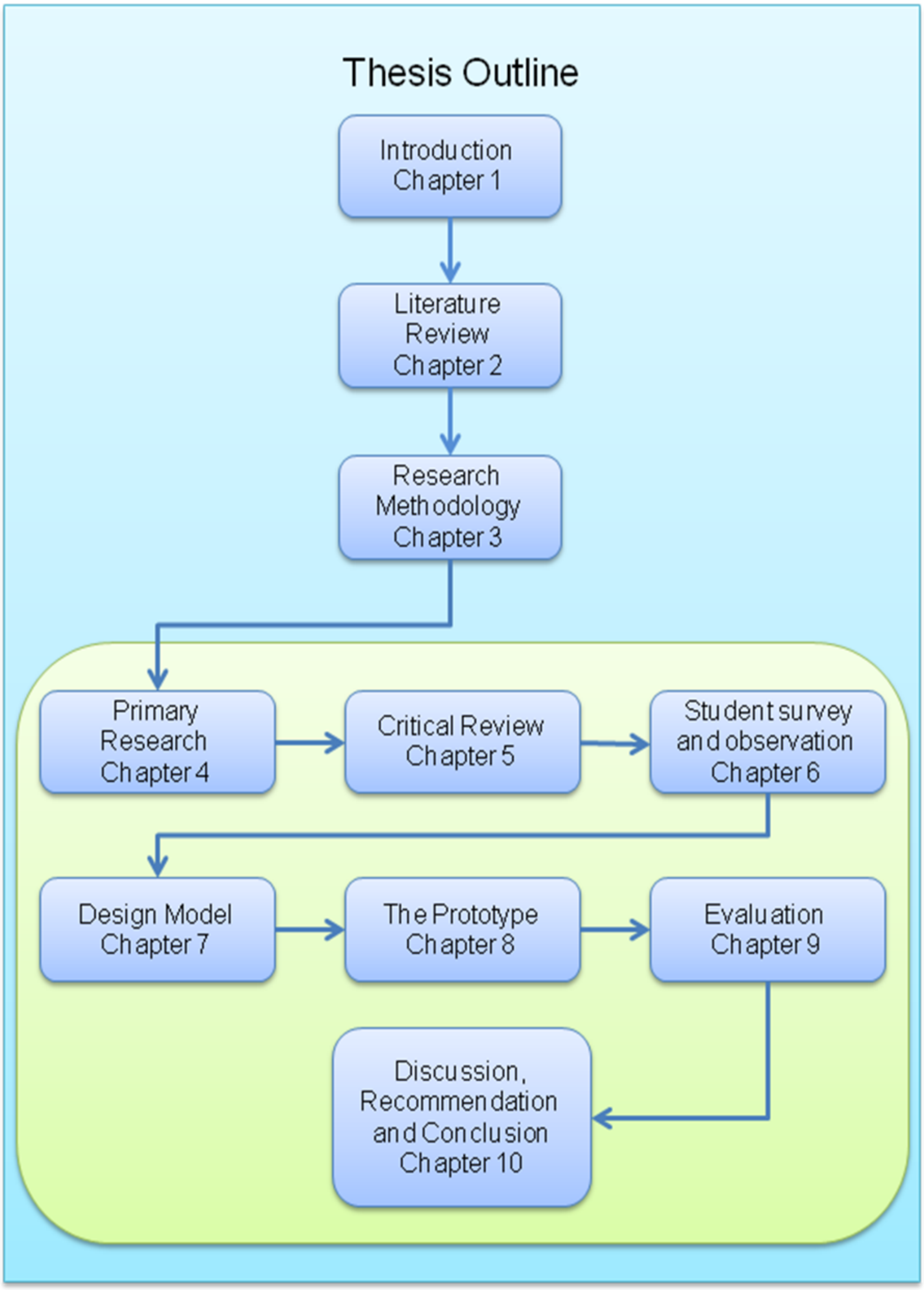


Figure 1.4 Inter-relation between chapters.

In this study, the researcher conducted data analysis using Microsoft Excel software. Tables, graphs and figures were created using Chart Wizard in

Microsoft Office Excel. Data output from the analysis will be presented by way of bar charts, trend charts, line graphs and so on.

1.9. Expected study outcome

By the end of this study, the researcher hopes to:

- Create a suitable deign model for using advanced multimedia methods to teach photography.
- Reduce the costs of teaching photography and provide greater learning support for students.
- Demonstrate the implementation of advanced multimedia teaching methods in Bahrain.

1.10. Outline of Thesis

Chapter 1 of this thesis introduces the course of research being taken by the researcher in completing this study. Aims, objectives, research questions, hypothesis, scope and limitation of the study are presented.

Chapter 2 introduces the literature review of a range of studies related to teaching and learning in photography, including e-learning design methodologies and models, pedagogy in photography, advanced multimedia and broadband technological development. These studies are reported and analysed in detail.

Chapter 3 discusses the research methodology used in this study.

Chapter 4 presents the activities and steps taken in determining the difficulties and problems faced by photography students and teachers.

Chapter 5 discusses the critical review of e-learning resources and the use of interactive multimedia rich environments as part of identifying the current state of the art.

Chapter 6 presents the student questionnaire and observation of e-learning materials in order to obtain feedback from the students on the subject matter studied.

Chapter 7 discusses the steps taken to create an appropriate design model using advanced multimedia for photography teaching and learning. The design model was then used to develop the prototype for photography teaching.

Chapter 8 presents the design and evaluation of the prototype discussed in the previous chapter, in order to determine the effectiveness of the model. It also discusses the details of the design and the ways in which the prototype was implemented and evaluated.

Chapter 9 describes the methods used to test learning, engagement and enjoyment when the prototype is used. Being the data analysis chapter, the researcher highlights the main findings of the research in relation to the tests applied to the prototype described in this chapter.

Finally, Chapter 10 provides the discussion, conclusion and recommendations. Future work that could be extended on the present study is also included in this chapter.

1.11. A profile of Bahrain

The Kingdom of Bahrain is a Muslim country; therefore most of the people dress modestly. Bahrain is also considered one of the most modern countries in the Gulf Cooperation Council (GCC) and has a mixture of people of different cultures and nationalities.

Bahrain is an Arabic word meaning "Two Seas". Archaeological evidence indicates that Bahrain was inhabited at least 50,000 years ago. Originally the seat of the Dilmun civilisation, Bahrain had connections with Mesopotamia and the Indus Valley, which became part of the Babylonian Empire in approximately 600BC. Bahrain is a group of thirty-three islands off the east coast of Saudi Arabia, the largest of which is Bahrain Island (see Figure 1-5 below). Causeways connect the four main islands, and Bahrain Island is also connected to Saudi Arabia by the sixteen-mile long King Fahd Causeway. The population is concentrated in the north around the capital, Manama. The climate is hot and humid, with minimal rain. Average maximum temperatures reach 30-40°C between May and October, and 20-30°C for the remainder of the year.

Figure 1-5 Map of Bahrain, Source: Century Travel, 2009

Bahrain was the first Gulf country to discover petroleum in 1932. Oil provided the ruling family with an independent source of income, with which they developed a modern state administration, and Bahrain became strategically and commercially more important (Century Travel, 2009).

On 14 August 1971, following Britain's decision to withdraw its armed forces from East of Suez, Bahrain announced its independence from the UK. In 1973, a National Constitution was introduced, together with a democratic National Assembly; the Amir dissolved the Assembly in 1975 after it refused to pass a proposed State Security Law.

Education in Bahrain was formally initiated in this island country with the establishment of Quranic or Kuttab schools. However, with the significant growth of its economy and due to western influence, the traditional form of education in Bahrain was transformed. In 1919, as a result of the effort made by elites from the city of Muharraq, a formal school was established. Almost about a decade later, education in Bahrain took another significant step with the opening of an all girls' school.

In recent years education in Bahrain has witnessed significant growth. Many institutions in Bahrain work hand-in-hand with some US universities to improve the education system. The University of Bahrain is the main university which imparts education not only to the local inhabitants, but students from other Asian countries also come to this university. In fact, due to the significant Pakistani and Indian population in Bahrain, there are a number of Indian and Pakistani schools (Bahrain Tourism, 2011).

Currently, there are five universities in Bahrain; namely University of Bahrain, Royal University, Bahrain Institute of Technology, Alahlia University and

Delmon University. The approximate number of students studying photography in these universities are summarised in Figure 1.1 above, and detailed in Table 2.1 in section 2.3.1.1 of this study.

1.12. Chapter Summary

In this introduction, the researcher has presented the aim and objectives of this study, the significance of the study, as well as the scope and limitations of this proposed study. The main background of the study has been introduced in this chapter, and all the pertinent issues in teaching and learning the key aspects of photography have also been discussed in this chapter.

Chapter Two

Literature Review

2. Chapter 2 – Literature Review

2.1. Introduction

This literature review will look at a range of primary and secondary sources to gain a thorough understanding of the existing key research relating to this study in order to provide a theoretical foundation to the subsequent primary and empirical studies. The review will first consider the evidence for current problems in photography along with existing teaching methods and resources. It will then look at developments in the use of technology in the classroom focusing on advances in multimedia and advanced multimedia. It will next look at general teaching methods and theories, and their relation to new technology. Finally it will look at e-learning and web based learning as well as the instructional design models used in the creation of these types of resources.

2.2. Photography education

The literature review on the broader scope of photography indicated that photography could be further divided into the following sections, which are discussed in detail in the following sub-paragraphs.

- Teaching methods in photography.
- Changes in the educational landscape comparing Bahrain and the United Kingdom (UK).
- The impact of changes in photography and photographic processes on teaching.

2.2.1. Teaching methods in photography

Grove-White (2003), in the context of teaching photography, states that lecturers attempt to structure or facilitate learning through course design, setting appropriate learning activities and learning outcomes. Laurillard (1993), mentioned in Grove-White (2003), refers to student centricity in designing the course structure, lecture modules, practical sessions and examinations. She suggests a blend between theory and practice while teaching, for the benefit of students specializing in photography. Cruickshank and Mason (2003) have mentioned the multiple competencies needed to be a professional photographer and to produce unique photographs. They believe that uniqueness, in the context of photography, remains dependent on thorough training in staging shots, selecting locations, and usage of camera (hardware). The training proposed by Lyman (2004), covering lectures, discussions, demonstrations, rehearsals, blocking, shooting scenes, editing, writing, slide lectures, production, editing and lab work etc, provide an indication of the diversity of knowledge, skills and competencies needed to be an effective photographer. Moreover, Rizova and Kligman (2001) refer to flash photography and increasing interest in newer techniques, covering parallel-polarized light photography, cross- (or perpendicular) -polarized light photography, video microscopy, and fluorescence photography etc, which again call for the newer set of knowledge and skills that seem to confirm the ideas of Cruickshank and Mason (2003) and Lyman (2004).

Lyman (2004) believes that, irrespective of the type of courses, whether Journalism or Fine Art, conventional teaching in a classroom setting using practical demonstrations, field trips and visual aids (overhead projectors, books, journals and magazines, television, videos) continue. He, however, acknowledges that the recent digital technological developments in cameras, which have improved usability, have had a major impact on the way photography is taught. For example, the availability of digital cameras at an affordable price allows students to detect their mistakes while taking photographs (Lyman, 2004). As mentioned in the introduction however, particularly in reference to Bahrain, the key difficulties in delivering this modern, subject-rich educational experience are the high staff student ratios and lack of camera-related equipment.

2.2.2. Historical review of teaching photography

Up until the introduction of the Web which was introduced in the 1990's, there seems to have been very little information about the development of specific teaching and learning methods in photography. Photography practices during this period were preoccupied with debates on Art theory and politics and metaphysics. As Hill (2004) notes, "It was obvious that photographic practices during this period had become more self-conscious with its practitioners becoming overtly concerned with metaphysics, art theory, community politics, fine art, cultural studies, and alternative life-styles and philosophies".

Before 1888 photography had been a novelty, which only a few could afford. The first cameras were enormous and operating one was cumbersome, complicated and required expert knowledge. With the introduction of the Kodak box camera in 1888, George Eastman brought photography to the masses. The Kodak box camera incorporated 'roll film' and had the slogan "You press the button, we do the rest." This development not only made photography accessible to ordinary people but also increased the demand for photographic images and resulted in a gradual change in what constituted acceptable photography.

As the technology developed from the Kodak box camera and the mass increase in the production of photographic images continued, photographic journals and magazines emerged. Vocational and technical courses in photography were set up to meet the growing interest in learning photography. On such courses some teachers used these journals and magazines as an aid to teaching students about photography. Students were now becoming increasingly aware of the content and meaning behind photographic images as well as the technical processes involved in making these photographs. An example was 'Camera Work', an influential quarterly journal, which appeared in 1903 in the wake of the Photo-session movement. Alfred Stieglitz edited it and among the many contributors were Frank Eugene, Clarence White and Edward Jean Stiechen (Leggat, 2005).

By the 1960’s there were many colleges teaching photography. Most of the curricula for these courses were vocational and technical in nature. Teaching methods were traditionally based, taught in classrooms using lectures, magazines, journals and practical demonstrations. As time went on photography education moved from being purely technical to being more creative.

The following quote is taken from an article that was published as a result of Michael A. Smith’s travels in the United States (1976) where he met with a number of photography teachers and students. Here he discusses the main approaches to teaching photography in education:

> *There are two distinct approaches to the teaching of Photography as a Fine Art today. One approach is the traditionalist approach; the masters are revered, even placed on pedestals, and the students are all too often encouraged to emulate their style. The other approach is the non-traditionalist approach; the masters are either not respected, or they are respected only in a far off distant sort of way, and students are led to an opposite direction. This division into traditionalist and non-traditionalist approaches is intended only to indicate predominating attitudes. Most teachers, of course, combine elements of both approaches in their teaching. Teaching about materials and processes primarily involves teaching about technical matters. All too often technical matters are taught as if they are totally separate from expression and involve only the mechanical manipulation of materials. Technique, however, is much more than that. For not only does it give form to expression, it also helps to shape and modify that expression. (Smith, 1976)*

It might be useful to mention here that around this time there were only around six examination-exempt three year long full-time photography courses in England, and because they were validated by what is now the British Institute of Professional Photographers (BIPP), they had to have a vocational, industry-biased curriculum. They were based at Trent Polytechnic Nottingham, Derby College of Art, Design and Technology, London College of Printing, Polytechnic of Central London (formerly Regents Street Poly), Harrow College of Technology and Art, West Surrey College of Art, Farnham, and Manchester Polytechnic. By the late 1970s only the Manchester and Polytechnic of Central London courses had been awarded degree status (Hill, 2004). ?

Courses were validated by professional bodies, such as the BIPP, and their appropriateness and structures were policed by government inspectors, known as Her Majesty's Inspectors, who were very suspicious of self-expression, experimentation, and anything that deviated from the functional and utilitarian use of the medium. However, the curriculum pioneered by Paul Hill and others

> *(…) encouraged students to explore the ideas and issues that most directly affected them, and to subvert the clichés that inhabit the compartments that custom and practice assumes the medium must conform to. The Trent/Derby course was always over-subscribed and particularly popular with foreign students, particularly those from Scandinavia, because of its art and experimental bias.* (Hill, 2004)

Bill Gaskins was also an important character in the development of educational initiatives at that time, and he was chairman of the first Arts Council photography committee. In 1971 Gaskins was awarded a Kodak Scholarship to fund a study trip to the USA and, as a result, of what he learned and the contacts he made, a vision of an art-based, academically rigorous course at Trent Polytechnic emerged (Hill, 2004).

In these new art-based courses, the techniques, equipment and materials of photography were the servants, not the masters, although a great deal of emphasis was still placed on good craftsmanship. Students were proud when they produced a fine print, but their concern for archival quality and tonal aestheticism was never allowed to be the sole aim of the work.

”In the meantime, in 1965, Hedgecoe approached the Royal College of Art to suggest he set up a photography department. When the RCA agreed, he was plunged into an academic world in which he reveled for the rest of his career. He had a strong didactic streak and a natural ability to make the technical aspects of photography clear and comprehensible, usually with just a single explanation. He became Professor of Photography in 1975 and published a highly successful series of manuals on photographic technique, starting with The Book of Photography (1976). Most recently he released The Art of Digital Photography (2006) after a research voyage around more than two dozen countries.” (Daily Telegraph obituary June, 2010).

Taking the lead from what Beaumont Newhall had written in his History of Photography (Newhall, 1964), Hill suggested that photographic students should be acquainted with four major concerns: the straight, the formalistic, the documentary, and the equivalent. He concluded that:

> *To attain any sort of fulfillment or inner growth, teachers and students must together have a passion for photography and an obsessive desire to realise their personal truths. Should photographic education in Britain meet the challenge (...) a renaissance might then be said to be emerging.* (Hill, 2004)

2.3. Changes in the educational landscape in Bahrain and UK

On a general level, the number of students attending university has increased both in the UK and Bahrain. For example, statistics show that in England, small elite of some 50,000 students went to university fifty years ago. Now, nearly

50% of eighteen- to thirty-year-olds are studying for some kind of higher educational qualification in what has become a mass system of higher education (Stevens, 2004).

Having taught for a number of years at the University of Bahrain, the author has found that there has been a dramatic increase in students using photography as part of their studies. This increase spans across all subject disciplines including both graduate and postgraduate levels, and is mainly due to the technological developments that have happened over the past ten years. With the aforementioned increase in the number of students in both England and Bahrain, the concern about familiarity with technical aspects of photography (which is the focus of this study) arises especially in Bahrain. Results presented in chapter four of this study highlight this point. Pulli et al. (2009) point out that, with the invention of digital photography and camera attachments on mobile phones, taking photographs is now a less cumbersome affair. This is an opinion shared by two colleagues who teach photography at UOB, who commented in a personal communication that these inventions have made photography more accessible and cheaper than it has ever been in previous years for many students (Almosawi & Alghareeb, 2003).
However, increasing student numbers have a widespread impact on the ratio of staff to students as, in many countries, funding for higher education has not risen in line with this.

2.3.1. Staff-student ratios in Bahrain regarding photography studies

There is evidence in the current prospectus of University of Bahrain (UOB) to suggest that a wide range of students with differing abilities are now taking advantage of the photographic medium and using it as part of their studies to explain, document and support the findings of their essays and research.
In previous years, photography was an optional module but has now become compulsory for students studying on the university’s programmes on

educational technology, fine art and journalism mass communication. This has led to an increase in students using this medium with the associated problems of teaching a practical subject to large numbers of students. Currently, there is no adequate structure in place to cope with this increase and, more importantly, to deal with the differing levels of abilities amongst students.

Table 2-1, below, illustrates in detail universities delivering photography courses in Bahrain, the year they started, the number of students on the course, the number of Bahraini teachers and non-Bahraini teachers teaching the same course, and the ratio between students and teachers. In this table, it can be seen that there is a shortage of experienced staff to cope with this new demand in photographic studies (University of Bahrain Prospectus, 2002-2009. The staff-student ratio at UOB, which was at 1:31 in the 2000-2001 academic year, jumped sharply to 1:99 in 2004-2005 but dropped somewhat to 1:74 in 2006-2007. The case, as shown in Table 2-1, is almost the same when compared to the average staff-student ratios of all Bahraini universities.

UOB is the only national university in the Kingdom of Bahrain; it was also the first university in Bahrain to deliver applied photography courses. Royal University commenced their photography course in the 2003 – 2004 academic year. This university always maintained one non-Bahraini teacher, with fifteen students in the 2003 – 2004 academic sessions, which gradually increased to sixty-five students in the 2008-2009 sessions.

Bahrain Institute of Technology (BIT) is a government institute administered under the Ministry of Labour. All other institutes are all private universities. BIT introduced its photography course in the academic year 2005 – 2006. At that time, BIT had ten students and one non-Bahraini teacher and this gradually increased to fifty-four students in the 2008-2009 sessions. From 2006-2007, the institute had one Bahraini teacher, alongside the non-Bahraini teacher from the previous year.

Alahlia University and Delmon University introduced photography courses in the 2007 – 2008 academic year. Alahlia University started this course with twenty-three students and one non-Bahraini teacher, which later increased to sixty students and two non-Bahraini teachers in the following academic year. Delmon University started with two non-Bahraini teachers and fifty-two students in the 2007-2008 academic sessions, which only increased to fifty-four students in the following year.

Staff-student ratios at UOB were at 1:31 in the 2000-2001 academic year, and reached a peak of 1:91 in 2003-2004. After that, the ratio dropped to 1:30 in 2007-2008, and 1:33 in 2008-2009.

Table 2-1 Bahrain University's student and staff numbers from 2000-2009.

(Photography modules)

Academic Year	Number of students per academic year																	Total Average			Staff/ Student Ratios
	Bahrain University				Royal University			Bahrain Institute of Technology				Alahlia University			Delmon University						
	BT	NT	S	SSR	NT	S	SSR	BT	NT	S	SSR	NT	S	SSR	NT	S	SSR	BT	NT	S	
2000-2001	1		31	1-31														1	0	31	1-31
2001-2002	2		134	1-67														2	0	134	1-67
2002-2003	2	1	168	1-56														3	0	168	1-56
2003-2004	3	1	350	1-87	1	15	1-15											3	2	365	1-91
2004-2005	2	1	298	1-99	1	34	1-34											2	2	332	1-83
2005-2006	2	1	216	1-72	1	34	1-34		1	10	1-10							2	3	260	1-65
2006-2007	2		148	1-74	1	51	1-51	1	1	28	1-14							2	2	227	1-72
2007-2008	1	1	83	1-41	1	60	1-60	1	1	38	1-19	1	23	1-23	2	52	1-26	2	6	256	1-30
2008-2009	1		23	1-23	1	65	1-65	1	1	54	1-27	2	60	1-30	2	54	1-27	2	8	256	1-33

BT= Bahraini Teachers **NT**= Non-Bahraini Teachers **S** = Students **SSR =** Staff-Student Ratios

2.3.2. Staff-student ratios in United Kingdom

Between 1989 and 1994, total university enrolments in England across all subjects rose by over 5 percent, and expenditure per student fell by 30 percent. Between 1979 and 1997, the average staff-student ratios (across all disciplines) fell from 1:9 to 1:17. Stevens (2004) discusses the reasons for this, stating that

“The explanation was that the universities were poorly and inefficiently run”, and, in the words of the White Paper of the time, “graduate output” was all too often “not in line with the economy’s needs”.

Markham (1997) commented on his concern about staff-student ratios at UK universities, stating that “Financial constraints have meant that growth in staff numbers has not kept pace with this explosion in student numbers. The problem of deteriorating staff student ratios is of course not confined to the Commonwealth, elsewhere too there is the feeling that ‘never have so many been taught so much by so few’ ” (Markham, 1997, p. 2).

When looking at slightly more recent ratios (here expressed as student-staff ratios), those of the UK were higher than for the countries that make up the Organization for Economic Co-operation and Development (OECD), and for other countries that are the UK’s economic competitors, over a period of nine years from 1999 to 2007, as shown in Table 2-2. The ratio was at or near the figure of 18.0:1, although it reached its lowest, of 16.4:1, in 2006, and the reason for that was that it was the year that top-up fees were introduced in England and Northern Ireland. That was the same year when first-year full-time undergraduate student numbers temporarily decreased.

Table 2-2 OECD ratio of students to teaching staff in higher education institutions*

	1999	2000	2001	2002	2003	2004	2005	2006	2007
France	16.9: 1	18.3: 1	18.1: 1	17.9: 1	17.6: 1	17.8:1	17.3:1	17.0:1	16.6:1
Germany	12.3:1	12.1:1	12.3:1	12.6:1	12.7:1	12.7:1	12.2:1	12.4:1	12.1:1
Japan	11.5:.1	11.4:1	11.3:1	11.2:1	11.0:1	11.0:1	11.0:1	10.8:1	10.6:1
UK	18.5:1	17.6:1	17.6:1	18.3:1	18.2:1	17.8:1	18.2:1	16.4:1	17.6:1
USA	14.0:1	13.5:1	13.7:1	15.1:1	15.2:1	15.8:1	15.7:1	15.1:1	15.1:1
*(OECD) country mean	15.3:1	14.7:1	16.5:1	15.4:1	15.9:1	15.5:1	15.8:1	15.3:1	15.3:1
* Organization for Economic Co-operation and Development (OECD)									

Source: UCU (2010)

This observation of general student increase in full-time education suggests that there may also have been an increase in the number of students studying photography at universities. Any subsequent increase in student numbers or decrease in staff numbers in universities will affect the quality of teaching in photography based subjects especially now that there are already high numbers of students in photography classes.

The effects of the changes mentioned above were felt quite strongly in the late 1990s, and they were:

- An increase in the number of students overall, and student numbers in groups for teaching or tutorial support.
- Lack of staff, which led to increased workloads on teachers, as each one had to teach many groups, and each group consisted of a large number of students.
- Shortage of cameras, which does not give students enough chance to practice.
- Increasing number of students caused changes in curricular content.

More details are provided in the feedback received from teachers in Bahrain and the UK, which is discussed in Chapter 4, in section 4.14.3 and Table 4-14.

2.3.3. The impact of changes in photographic processes on teaching

A wide variety of photography courses are now offered and these can be part-time or full-time, at different levels ranging from basic beginners photography offered at adult education or community centres, to master and doctorate levels at universities. With the range of photography courses now available, teaching methods can be quite different depending on the course. For example, Journalism courses will tend to focus more on the production of a good quality image as well as its social context, meaning and impact on society. Art-based photography, on the other hand, tends to be more experimental in its approach to social issues as well as the technical aspects of photography (Lyman, 2004).

However, many courses whether journalistic or fine art-based are still taught in a classroom setting using practical demonstrations, field trips and visual aids (overhead projectors, books, journals and magazines, television, videos). In the 20th century, Technological developments in the camera itself have made photography even more accessible than in the era of the Kodak camera. There are now a number of automatic and digital cameras which allow students to see their photographs instantly after taking their photographs or as a live preview before taking a photograph. Cameras can also be found on mobile phones and a vast number of young people now own a mobile phone with a camera on it. Digital cameras are less expensive now than when they first came out on the market. Unlike the era between 1800’s and 1900’s, everybody now has access to a camera of some sort.

Nevertheless, the ubiquitous nature of photography has led to a decrease in students’ understanding of basic technical concepts in photography. The range of automatic settings on a camera mean the turn of a dial is usually sufficient to adjust the camera - from taking portraits to close-ups, or from landscapes to sport. Cameras have included autofocus for a long time but with digital technology incorporated, some cameras now include facial recognition technology so the camera adjusts to take the ideal group photograph or portrait.

This technology has great creative potential and if a person does not have any interest in knowing how a camera works, it will provide a good photograph in most circumstances, regardless of any knowledge of apertures or shutter speeds. Students of photography, however, rely more and more on technology and the automatic rather than manual approach, and this transition away from using traditional black and white film to digital means that there students need to have some knowledge of the technological aspects before embarking on a Higher Education programme in photography.

This has led to a serious knowledge gap that educators need to overcome before students can fully realize the potential of photography as a creative and communicative medium. This knowledge gap is exacerbated by the increase in student-staff ratio discussed earlier, as the technical theory was usually assumed to have been covered in previous photographic courses or acquired practically when using color negative, or black and white development and printing. Now, it has to be taught to large groups whereas traditionally the craft skills, including those that are technical, were acquired either in 1:1 teaching or in small groups of, for example, twelve students to one member of staff.

2.3.4. Conclusions

Overall teaching methods have changed from technical to addressing more theoretical and critical approaches, but the type of teaching methods used still depends very much on the type of photography covered in a course. Generally speaking, the teaching methods used are still very traditional; in the case of Fine Art-based photography, the approaches are strongly experimental and tutorial-based approaches, while for other courses there tend to be more lecture sessions and practical work. The use of visual aids should enhance the learning process by improving students' involvement in learning but their use depends on the willingness of photographic educators to use different approaches to learning, teaching and assessment.

The following points summaries the present situation regarding the teaching of photography:

1. Photography is best taught in small groups to help develop student's visualization and creative skills alongside their technical understanding and ability to use a camera.

2. Student-staff ratios have increased nationally and internationally and are unlikely to decrease.
3. Students are coming into Higher Education with some visual skills but very poor technical understanding of photography.
4. Digital cameras have the potential to increase a student's ability to visualize and understand the photographic process.

This leads on to looking at whether a technological approach can support improvements in learning, teaching and assessment for photography education.

2.4. Technological approaches to supporting learning in photography.

There are several studies (Kirkpatrick & Cuban, 1998; McKenzie, 1999; Mokhiber & Weissman, 2000; Roblyer, 2003) which claim that the use of technology does produce scholastic gains in the classroom; however, the lack of quality studies on how technology impacts education is apparent. Seymour Papert (1992), former MIT professor, colleague of Piaget, creator of LOGO, and technology Guru, believes that the use of technology in the classroom has the potential to level the ability to disseminate information throughout the classroom – regardless of the economic background – as everyone will have the same information available to them. However, the technology itself – the speed of the processors, the number of students able to activate the site simultaneously, and the amount of add-ons (SMARTBoardstm, LCD projectors, T-lines, servers) will continue to depend upon funding. Those with more funds are allowed to purchase more technology to allow more students access to the information: "Without enough of the right equipment or the right training, technology' leverage is lost" (Gordon, 2002, p. 5). Photography teachers are not different from any other teachers in that there are those who are able to take advantage of technological advances, and those who are very unlikely to be persuaded to develop their skills into this area of practice.

For the purpose of the literature review conducted in this study, the researcher has further divided the discussion of relevant technology into the following sub-paragraphs. The details of technology are discussed and presented as follows:

- Technology in the classroom
    - What we mean by technology
    - Information technology
    - Technology integration in teaching
- Technology outside the classroom
    - E-learning
    - Virtual Learning Environment
    - Blended learning
- Types of technological content
    - Hypermedia
    - Web based content
    - Adaptive hypermedia
    - Multimedia
    - Features of an Advanced Multimedia learning environment
    - Teaching using Advanced Multimedia

2.4.1. Technology in the Classroom

Technology in the classroom has become currently a major trend in teaching and learning especially at the college level; such a situation therefore needs to be clearly discussed. The following sections deal with this aspect.

2.4.1.1. What do we mean by technology

Before beginning to utilize technology in the classroom, there must be an understanding that the terms "technology" and computers" are not synonymous. Uses of technology can range from speaking into a microphone while sharing a story in the author's chair, listening to a friend read a story on a tape player, or watching a video to documenting the learning process with a digital camera or surfing the Internet for background information. There are multiple uses and definitions of technology. Kozma (1994) warns, "because technology changes over time, so too does the definition” (p. 11). We need, then, to be careful when we hold to a specific definition, as technology will continue to evolve and our understanding may become obsolete. Kosma suggested, instead, to first recognize what the technology is capable of, then understand when and how to employ its capabilities (ibid).

Drake (2001) described technology best practice to be “identified, successful, education practices which utilize technology to support literacy and create an objective measure for achieving improved performance goals” (p. 12). As Piaget (1978), Dewey (1896), and Vygotsky (1978) believed with traditional education, Gordon (2002) adhered to the notion that technology should match a student’s age and ability levels in order to be developmentally appropriate.

Morrow et al. (2002) warn that computer technology should supplement and not supplant the teacher. Computers should not be the cornerstone of a learning environment but an addition to what already exists. Alessi and Trollip (2001) believe that we should be looking for “situations where the computer is likely to be beneficial. These situations include those in which the cost of instruction by other methods is high” (p. 6). Offering one-on-one tutoring to a student who needs additional practice with phoneme and grapheme relationships is costly; allowing a child to complete lessons on a computer to reinforce skills previously learned as a group or individually is affordable.

After affirming their own pedagogical perspectives, the teacher’s first step should be to help students regard technology as meaningful and relevant. Just as it is imperative for students to view their teachers as avid readers and writers, students need to observe educators using technology in their daily lives in order to recognize its importance. Conveying the relevance of technology is correlated with how adults rely on it to complete tasks. Therefore, in order for educators to convey the ideology that technology is meaningful, they must utilize and view technology as a useful tool in their own lives.

When teachers rely on technology to deliver messages (via e-mail), gain background information (through Internet searches), edit papers (through word processing), document classroom activities (through digital cameras), or manage grades (through spreadsheets), they believe technology is an important tool for completing work and will transfer that ideology to their students (Morrow, 2002). This is applicable to using technology in teaching photography as the teacher can use photography as a technological communication tool with students, in addition to the technology's capability to provide advanced and interactive simulation to explain and discuss abstract ideas such as depth of field.

Currently, the use of technology in the classroom is as varied as teachers' pedagogical perspectives. Those more comfortable with technology will use it to access electronic resources, document learning through creating multimedia projects and presentations, and share information with those in distant environments. Modern uses of technology include tutorials and practice software, talking books, text-to-speech software, hypermedia, web-based communication, and assessment administration using online tests or classroom-based audience participation devices like Turning point or Smart Boards.

However, technology use is not a substitute for teaching and learning challenges which assures academic success. It is a medium of current trend in line with the development taking place in the technological world (Marshall, 2002) enabling students to gain a competitive edge in the work environment on graduating.

A technological instructional method through the use of words, pictures, video, animations, simulations and others provide meaningful learning (Mayer, 2003), which leads to higher levels of student engagement (Mitchell, 2003). According to Mayer (2003), a multimedia instructional message is "a presentation consisting of word s and pictures that is designed to foster meaningful learning.

Thus, there are two parts to the definition: (a) the presentation contains words and pictures, and (b) the presentation is designed to foster meaningful learning" (p. 128).

Therefore, in order for students to develop to their greatest potential, we must support their learning with the tools that best encourage learning.

2.4.1.2. Information Technology

Information technology plays a crucial role in the changing dialogue about imagery. The proliferation of digital technology has contributed to drastic changes in communication and networking, and has also been a tremendous influence on the creation and processing of images. In turn, these developments in the processing of imagery have affected the utilization of visual images in academia. The ease with which digital technology allows for creation and manipulation has given rise to its adoption in education because students tend to remember the content more efficiently when some visual images are attached. The impact of technology has made itself known in other areas as well. The prevalence of video monitors, projection screens and increasingly smaller, and more portable, computers is creating a fundamental shift in where, when and how we view and access images. The capacity that networking technologies allow for sharing ideas and exposing viewers to new and innovative ideas across the world has even shifted perceptions of place and distance (Sweeny, 2004).

However, mere inclusion of visual images in the educational curriculum does not assure higher achievement in students. Those who are and are not associated with the field of education often postulate that technology is capable of solving the woes of the educational system. Roblyer (2003) eloquently sums up the situation by stating: “simply having students use computers does not raise achievement” (p. 11). It is how technology is used to support education that makes the difference. Alessi and Trollip (2001) agree with Howard Gardner’s (1999) theory of multiple intelligence and suggest that, as with traditional instruction, the teaching of technology should adhere to the notion that “not all people learn alike or at same rate. Similarly, some instructional methods are better for some learners than for others” (Alessi 2001, p. 30).

The craft of teaching, positive teacher-student interaction and productive problem-solving based learning environments that foster creative skill development and lateral thinking may be decisive factors for successful student futures. The roles of effective teaching supported by learning technology have never been as important as they are now. They are major factors in the development of young people that can make a strong contribution to a technology-based society.

The advent of global communications networks means that learning environments can now utilize local and global communities, peer interaction and the knowledge of others and allow different, new and exciting approaches to teaching, learning and assessment. As Trinidad expresses it:

> ‘’Educators can shift their pedagogical approach towards a balance between the appropriate uses of direct instruction with a collaborative, inquiry-driven, knowledge-construction approach allowing students to achieve far beyond expectations’’. (Trinidad, 2003, p. 98.

The world of work demands the skills of negotiation, decision-making, and problem solving with the understanding and application of knowledge, and such skills can be developed through authentic assessment tasks where the students continually receive feedback to enhance their understanding and build new knowledge and skills.

2.4.1.3. Technology integration in teaching

Technology-rich learning environments can engage the learner giving them a sense of empowerment, in which they work in a “community of learners” (Trinidad, 2003, p. 105) that is guided by teachers or instructors, instead of depending on these educators, who might not have such a broad knowledge of a particular subject. This means that students can participate in the process of pedagogical change that involves practical application of new materials, new methods and new beliefs. At the same time, given the opportunity to apply new methods (learner-centred and learner-directed learning principles) to new materials (e-learning), teachers are able to shift the focus from teaching to learning (Khine & Fisher, 2003).

Bransford et al. (1999) state that “the new technologies provide opportunities for creating learning environments that extend the possibilities of old-but still useful technologies - books, blackboards, and linear, one-way communications media, such as radio and television shows - as well as offering new possibilities”. In this way, multiple information resources are used from books through to the Internet. As Albon and Trinidad note, “Interactive technologies allow the educator to build a learning community that transcends the four walls of classrooms but is not restricted by traditional class timeframes”. (Albon and Trinidad, 2001)

Jonassen (2000) said that technologies can support meaning making and knowledge construction by students if they are used to reflect on what has been learned as well as on what students know. Bitter and Pierson (2002) hold the view that technology is an agent of change, and appropriate use of technologies can make learning for students more interesting and enriching and prepare them for the demands of the workplace. Therefore, it is important that educators seriously consider matching the appropriate use of technology with content to maximize the student’s potential in learning. Sharp (2002) envisaged teachers “teaching” less, and it is up to educators to inspire, motivate, and excite students about the use of technology for learning.

In photography, technology is an essential element in facilitating the process of teaching and learning. Specifically, technology is considered an enhanced method, where interactive multimedia helps in simplifying the complicated aspects in photography education, such as aperture, shutter speed and depth of field, among others. Therefore, technology through the use of interactive multimedia becomes a strong catalyst to promote the teaching and learning of photography. As such, it is useful to integrate technology for teaching photography as an enhanced method to supplement the advanced and interactive multimedia capabilities to explain and discuss abstract ideas such as depth of field in the area of photography teaching.

2.4.2. Technology outside the classroom

As the student-staff ratios increase and students' contact hours with staff are decreased, so consideration of what additional support can be provided outside the classroom becomes a key role of the photography teacher. Here, technology may take many different forms from e-journals, web pages on a particular subject, or online videos or tutorials, and these may be either generally available or specifically attached to courses and students through university administration systems and Virtual Learning Environments (VLE). This support outside the classroom comes under the general heading of electronic learning, shortened to e-learning.

2.4.2.1. E-learning

Learning is highly affected by the degree of student's interactivity with the media and content. It can happen at three levels (high, medium and low) depending on the degree of interactivity, and the medium form used. The learner will achieve more through the level of interactivity with advanced multimedia technology (Laurillard, 2002). Some studies indicate that this medium of delivery has a positive impact on performance, for example, Smith and Hardaker (2000). Other studies however, find that more online teaching has a negative impact on performance (Johnson, 2005).

Emerson and Taylor (cited in Johnson, 2005) found that the use of an 'experimental' approach produced better academic results than using what they characterised as 'traditional' methods. They did not, however, examine whether the better 'experimental' results were due to the teaching methods being more effective (in terms of more closely reflecting student learning styles), or alternatively, because this approach encouraged greater student engagement (effort). Other research in this area suggests that students' academic performance may be affected by both engagement effects and learning-style effects.

Carini et al (2006) found that, although in general the relationship between engagement and performance is complex, engagement is positively correlated with student grades. Their conclusion is supported by a number of empirical studies. For example, Rodgers and Ghosh (2001) identified that 'effort' (or engagement) levels were highly significant in determining student examination performance, whereas another study made in an e-learning context (Davies and Graff, 2005) found that online engagement had no statistically significant impact on examination performance.

A successful e-Learning website is thought to be enjoyable and engaging, positive and supportive, active, collaborative and contextual (Iverson, 2004). This study further explored the nature of e-Learning for enjoyment through a grounded study with five experts drawn from the field of museum website design in Taiwan. Interviews with these experts allowed insights into key factors affecting website design from those with considerable experience in the field.

Since engagement and enjoyment are major variables of concern in this study, they need to be clearly defined.

Engagement:

Engagement implies that a student is participating in the activity. However, engagement does not necessarily equal full participation. Yes, students are doing something but, 'Is this activity actually meaningful? If students have difficulty with the material they may be engaged but only at a surface level, reading through the material. In task based learning where students are using a simulation or engaged in a simulated learning opportunity they need to actually be involved in the learning process.

Engagement in this study is operationally defined as follows: increasing the student’s desire to participate insightfully in their class work by making the overall learning process more interesting, attractive, and self-motivated. It aims to enable the student to use what s/he learns in new areas of learning and application; stimulating his/her attention towards the instructional material, and desire to benefit from and be aware of it; and encourage him/her to use their own motivation/active learning (Ruhe, 2006).

Enjoyment:

Enjoyment in this study is operationally defined as follows: A student's feeling of real delight in a certain learning context; his/her desire to: re-apply in other contexts and topics, and transfer to other students; and his/her feeling of happiness towards the presentation/practice method of the topic. (Ruhe, 2006)

Further studies in this area have examined the issue of what determines the amount of time that a student spends on e-learning. Arbaugh (2000) argues that this will depend on the student’s attitude to the perceived usefulness, and also the ease of use, of this delivery medium. It is suggested that students who spend more time on internet-based courses tend to be the ones who take more ownership of the learning process and, as a consequence, receive the greatest learning benefit. From this it can be implied that we might expect to find a significant, and positive, relationship between the level of e-learning engagement and academic performance.

The other key performance-influencing issue relates to differences in student learning styles. These may result in differences in the *effectiveness* of e-learning delivery methods for individual sub-groups within the student body.

Within the learning-styles that different learners have, different cognitive styles have been extensively examined (Messick, 1976; Klob, 2000). Cranfield (1998) finds specific learning-style differences between students enrolled on different courses within institutions. In addition, Garland and Martin (2005) and also Blum (2005), find evidence of significant gender-related differences in learning styles. Findings such as these have led some commentators to conclude that it may be advantageous to take into consideration different learning styles when developing e-learning courses (Cooze and Barbour, 2007).

It is interesting to note, however, that a key learning-style related factor may in fact be the student's familiarity with the technology used. For example, Draffan and Rainger (2006) examines the challenges to students' use of blended learning and includes 'learning styles' as just one of a number of learner characteristics that impacts on learner interaction with learning materials. A number of studies have shown that computing experience is a strong predictor of attitudes towards, and also use of, computers and the internet (Dyck & Smither, 1994; Atkinson & Kydd, 1997). In effect, the student's learning style may adapt as familiarity with the e-learning medium increases.

The following lists the benefits of e-learning suggested by Jones (2007) and others:

- Technology has revolutionized learning anywhere, anytime and for anyone. The growth of the World Wide Web, high-capacity corporate networks, and high-speed desktop computers will make learning available to people 24 hours a day around the globe.
- Web-based products allow instructors to update lessons and materials across the entire network instantly. This keeps content fresh and consistent and gives students immediate access to the most current data.
- Students have more control over their learning process.
- Improved collaboration and interactivity among students, teaching and communication techniques which create an interactive online environment including case studies, story-telling, demonstrations,

simulations, streamed videos, personalized coaching and mentoring, discussion groups and tutorials.

- Higher retention of content through personalized learning.

From what was discussed above, the author has learnt what is e-learning and its benefits; now it will be seen how the virtual environment is being used in e-learning to improve face-to-face (F2F) teaching. The author has examined the technologies which are being used for virtual e-learning and what advantages this has over F2F teaching, as well as how these technologies can be used with F2F teaching to improve learning among students.

2.4.2.2. Virtual Learning Environment

Virtual Learning Environments (VLE), such as WebCT, Blackboard, Virtual-U, and Learning Space can be used to manage and deliver online learning content. A VLE is software which provides an integrated online learning environment, where content delivery, communications facilities, assessment, student tracking, and links to other systems are brought together. This type of software can be used, for example, in distance learning, where it can be the medium through which a whole course can be delivered to students off-site. It can also be used as a support, or addition, to F2F teaching in a classroom environment. (Pentelényi, 2006).

One case of such software which complements traditional, F2F classroom instruction is Web-based instruction (WBI) (Dabbagh, 2002). The main purpose of VLEs is to engage students in the learning process by providing flexibility in where and when this process takes place. A key component of a ‘virtual classroom’ is communication among students, and between students and their teachers, for which use can be made of tools such as e-mail, discussion groups and notice boards. Other important functions of VLEs are the delivery of learning resources, and the assessment and tracking of students (Suleman, 2003).

Dabbagh (2002) lists the points which make VLEs attractive for supplementing traditional methods of delivering F2F learning, in that a VLE:

- provides a central resource of information that the learner can access at their choosing ("always-on learning") and work through at their own rate;
- can be image-rich, truly interactive and can offer instant feedback and individualised learning;
- facilitates the tutor maintaining currency of information;
- can include an alternative means of communication outside "office hours";
- can be a vehicle for encouraging collaborative learning;
- Obviates the need for tutors to provide paper-based materials for students. (Dabbagh, 2002)

Other advantages of VLEs, also identified by Dabbagh (2002), include the fact that they allow each activity and resulting ‘product’ to be recorded and conserved, so that educators can refer to them at other moments, and with other students. Students’ contributions are also made more viable as they can utilise communication tools asynchronously, and this accessibility allows them to choose the best time for them to access materials, interact with teachers or colleagues, and offer their contributions. Online discussion forums can also motivate active learning, as can what are called ‘just-in-time’ learning resources. ‘Modelling and scaffolding’ activities can also be promoted by using examples of students’ work and the collaboration of experts in a particular field. Projects can also be accessed in a virtual environment, facilitating peer review and collaboration, again at times and in places that suit the students outside the traditional classroom space. All the different media that can be utilised, and the flexible time and space factors, are all aimed at promoting learning (Dabbagh, 2002).

VLE instruction, however, has several following disadvantages, the first being pointed out by Dearing (1997) in terms of the ratio between the time it takes to produce one hour of learning with high quality WBL material, and the 200 hours it takes for experts to create this material. Cost is also a restricting factor as it is necessary to supply an infrastructure to deliver and support "always-on" learning (Andrew, 2003). The same author also mentions that students can come to rely on WBL and favour this method of instruction over traditional paper-based materials, for example textbooks and printed journals. Using online materials also means that printing costs are often passed on to the student. One general criticism of the information available on the internet is that it is not ‘policed’ and, in learning environments, this means that information can be reliable or unreliable. However, students are often not able to discriminate between these sources, which can have a negative result on their studies. For the educators themselves, they have to keep up-to-date with what is happening on the website, and this is a time-consuming task, apart from their other duties (Andrew, 2003).

2.4.2.3. Blended Learning

As mentioned above, e-learning is often considered an optimum learning environment when combined with a traditional face-to-face environment, and this is known as Blended Learning. This is reflected in the definition of the term suggested by Cisco Systems (2004), which mentions that aspects of e-learning such as web-based instruction, streaming video, audio, synchronous and asynchronous communication can be combined with traditional learning methods and materials. Valathian’s (2002) definition sees Blended Learning as “a solution, which includes face-to-face and self-paced learning”.

As there are advantages in both traditional and e-learning environments, when these are blended the benefits can be increased. One of the main benefits concerns students from different cultures, in that blended learning allows them to choose how their learning content is delivered, thus improving their interaction with the learning environment. Together with the blending of traditional classroom learning and e-learning, which brings together the theories and practice from instructor-centred and student-centred learning, there is also a second type of blending, which is that of synchronous and asynchronous e-learning technologies. This is very beneficial when we consider the number of international off-campus students studying courses at the tertiary level, and the associated geographical and access issues. Therefore, to create an environment which is accommodating to cross-cultural learners is essential in enhancing their possibilities of learning achievement.

Blended learning can be accomplished through the use of 'blended' virtual and physical resources. Examples include combinations of technology-based materials, face-to-face sessions and print materials. Researchers Heinze and Procter (2004) have developed the following definition for Blended Learning in higher education:

> *Blended Learning is learning that is facilitated by the effective combination of different modes of delivery, models of teaching and styles of learning, and founded on transparent communication amongst all parties involved with a course. (Procter 2003, quoted in Heinze, 2004)*

Given that, overall, blended learning refers to the integration (or the so-called blending) of e-learning tools and techniques with traditional methods, the two important factors are the time spent on online activities and the amount of technology utilized. In this respect, there are currently three trends: continuation of the classic face-to-face (F2F) lecture; at the other end of the continuum is pure online e-learning; and, in between, variations of blended learning (see Figure 2-1, below).

Because of the way learning materials, such as those created for this study, are developed for use in the classroom, they can be presented as an F2F demonstration, used as learning materials in a class with computers allowing students to go at their own speed (blended), or put online for purely online delivery and access. The key is how the advanced multimedia is used and supported, and using a blended approach gives the students the best of both worlds; that is, well-designed technology-enhanced learning materials together with F2F support with someone on hand to answer questions, whether about the learning materials or computer use.

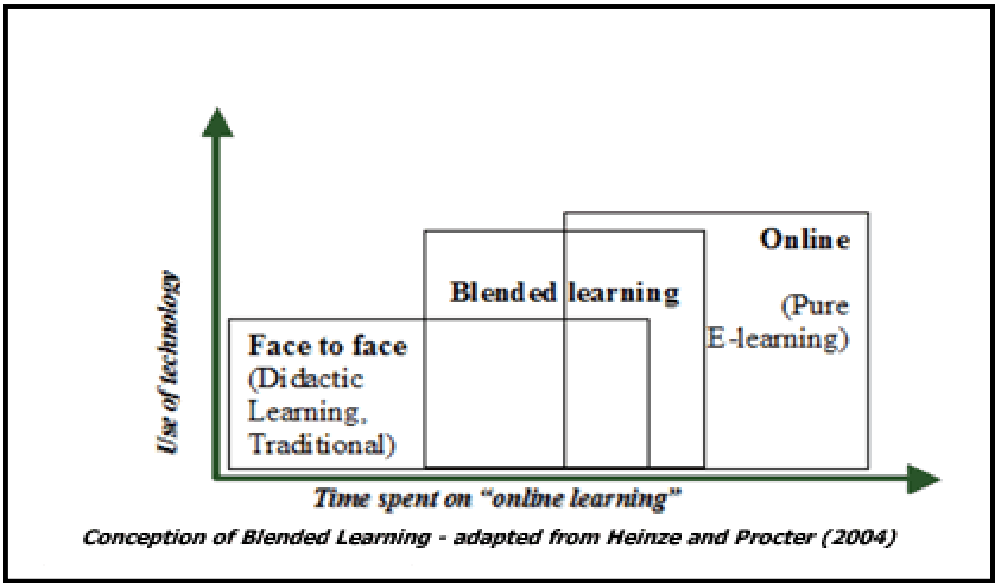


Figure 2.1 The Conception of Blended Learning

Source: Adapted from Heinze, (2004).

2.4.3. Types of technological content

The two previous sections have looked at technology in and outside the classroom. However, these are simply modes of delivery or ways of presenting content whether F2F, such as lectures or tutorials, or through online content management systems like VLEs or other Managed Learning Environments (MLEs). As photography teachers we are purely another mode of delivery, if a more sophisticated one. How and what materials are created and used is often more important than the mode of delivery - classroom, web-based, internet or CD-ROM.

Just as students find coping with a poor teacher a difficult experience, so too can poorly designed and badly thought-out learning materials affect their learning experience and level of engagement. If we, as instructors, come to rely on these materials to replace or enhance the student experience, we will have to be more aware of what is possible and which types of media and content are best suited to support learning.

One of the problems with looking at the use of media in teaching, and ways of organising that content, is the terms that have been used and how, over time, even such a short time as the digital era, the use of many words and terms have strayed from their original application and meaning. Often the origin of a word is closely linked to a concept, application or even the originating programme. However, this link can become tenuous, or even non-existent, as the programme became out-dated and the term then developed into a more generic, rather than specific, meaning or took on a different meaning entirely. This confusion of language has not helped researchers or educators who use the different media and their applications.

Technology is based around specific media and their integration:

- Visual media:
    - Text
    - Still images: photographs, diagrams, illustrations
    - Moving images: videos, cartoons, animations
- Audio
    - Sound: sound effects, atmospheric
    - Speech: talks, lectures, telephony
    - Text-to-speech: computer interpretation of text to speech

This next section, therefore, seeks to explore what some of the terms mean and how they were, and are, being used in an educational context, as well as how aspects of these areas can be brought together to clarify what we mean by technological content for learning and teaching. There will be examples later of some of the above terminological problems.

2.4.3.1. Hypermedia

One option for incorporating technology to support learning through reading is the use of hypermedia. Hypermedia is simply electronic text with links to related information. However, authors like Alessi and Trollip (2001, p. 140) have gone further and said that hypermedia "represents the integration, extension, and improvement of books and other media (including photographs, video, and audio recording) in the electronic domain".

Hypermedia offers opportunities to provide background information to students and, while they read a book or study a topic on the computer, they are able to click on words or pictures and be automatically linked to explanatory information. This does provide a wonderful opportunity to easily offer necessary background information, but some students get lost in the links and enjoy clicking around pages to see where it takes them without finishing requested tasks (Carroll, 2001).

The opportunities for extended learning are enormous. However, this is not to say that traditional book learning should be replaced with Text-to-Speech (TTS), or hypermedia as Drake (2001) wrote:

> Technologies of literacy are rapidly changing and children need to be prepared for more than book literacies in order to succeed in the 21st century workplace. New technologies will not replace books, but teachers today must be prepared for the new literacies that go beyond book technologies. (Drake, 2001, p. 17)

2.4.3.2. Web-Based Communication

Web-based communication is another example of the effective use of technology. The terms Web and Internet are often used synonymously, when in actuality they are very different. Through networks, the Internet enables computers to communicate with each other, while the Web is an application that uses the Internet as its network. This is similar to the way an automobile rides on a motorway. In this example, the motorway would be the Internet, and the

Web would be a car. The motorway and car do not affect one another directly in that the car has no effect on the freeway, unless there is damage caused by an accident. However, the motorway's design (condition of road, safety of entry and exit points, speed limit, or ability to accommodate multiple users) can have positive or negative effects on the car.

When discussing web-based communication, reference is being made to electronic pages that can be accessed through an Internet connection. This also includes email, chat room, and audio- and video-conferencing. It can be used to send, retrieve, or post information quickly and efficiently. The implications for teaching are enormous and only limited by the teachers' and students' imagination, and by technology proficiency, in an environment that is open to exploration as a way to create new knowledge. The range of communication supported is either synchronous or asynchronous including; text on web pages (see below) or bulletin boards; speech, live or streaming video.

The use of web-based learning is increasing around the world (Wentling & Johnson, 1999). Of course, with this innovation questions arise about the effectiveness and quality of practice with these web-based tools (McCollum, 1998, as cited by Wentling and Johnson, 1999).

There are currently a number of websites which are all designed to assist students in their understanding of different stages and processes involved in photography. Most of the websites currently available are text-based and the images are static, making it non-interactive and uninviting to newcomers to photography (see section 5.6.3). Furthermore, much of the information on these websites assumes that the user has some previous knowledge of photography, which is not always the case.

It is true, however, that the tremendous growth and availability of the contents on the World Wide Web (WWW) means that users can get lost in hyperspace and become disoriented by hyperlinks overload (Nielsen, 1990).

2.4.3.3. Adaptive hypermedia system

Researchers have tried to overcome the problem of the above-mentioned 'hyperlink overload' by producing an adaptive hypermedia system (AHS). An adaptive hypermedia system should be distinguished from adaptable hypermedia systems, in that an adaptable system allows users to change or adapt the systems' parameters before or during the action of the system. On the other hand, an adaptive system is one which adapts autonomously. It monitors and registers users' actions to be adapted to the current state of the users in the system.

An AHS limits the users' navigations or browsing space to documents that contain data which are relevant, interesting or useful for them. Although many definitions exist for adaptive hypermedia, Brusilovsky's (1994) definition seems most appropriate. It states that an AHS builds a model containing each individual user's goals preferences, and knowledge to be used through the interaction with the user, in order to adapt to the needs of that user.

An AHS combines hypermedia with Artificial Intelligence (AI) through the adaptation of the information, and its presentation. The field has witnessed an expansion of applications that make use of the AHS, with most of them being in the educational field. However, other fields such as Information Retrieval (IR), virtual museums touring and online help have a wide range of applications (De Bra, Houben, Wu, 1999).

With the explosive popularity of the WWW, adaptive hypermedia educational systems have dominated the adaptive learning system research to improve students' learning, and decrease navigation time. It combines Intelligent

Tutoring Systems (ITSs) with the hypermedia by using student model techniques and other knowledge to guide students dynamically and intelligently. They were merged into so-called Adaptive Hypermedia Education (AHE) systems to provide a new quality with more sense. These are computer-based learning systems that capture students' information to provide visible information adaptation, where teaching materials are presented in hypermedia format such as audio, graphics, or any other non-textual format (Brusilovsky, 1994).

Brusilovsky (1994) distinguished Adaptive Hypermedia technology into two major techniques. The first is adaptive presentation, which is the most popular type of hypermedia. It supports the adaptation of the hypermedia content to the student knowledge, goals and other essential characteristics. An example of this type of system in Photography would be the Internet for Photography (http://www.vts.intute.ac.uk/tutorial/photography /) created by Intute as part of its Virtual Training Suite. The second technique, adaptive navigation, supports students through directed link navigation to improve sequencing of contents helping students find the optimal path through the hyperspace of learning material.

One way of providing more detail about where the link will take them before they click can be as simple as a tooltip or visualization of the page they are going to, as shown in Figure 2.2 below, or a rollover which provides suggestions, questions or information.

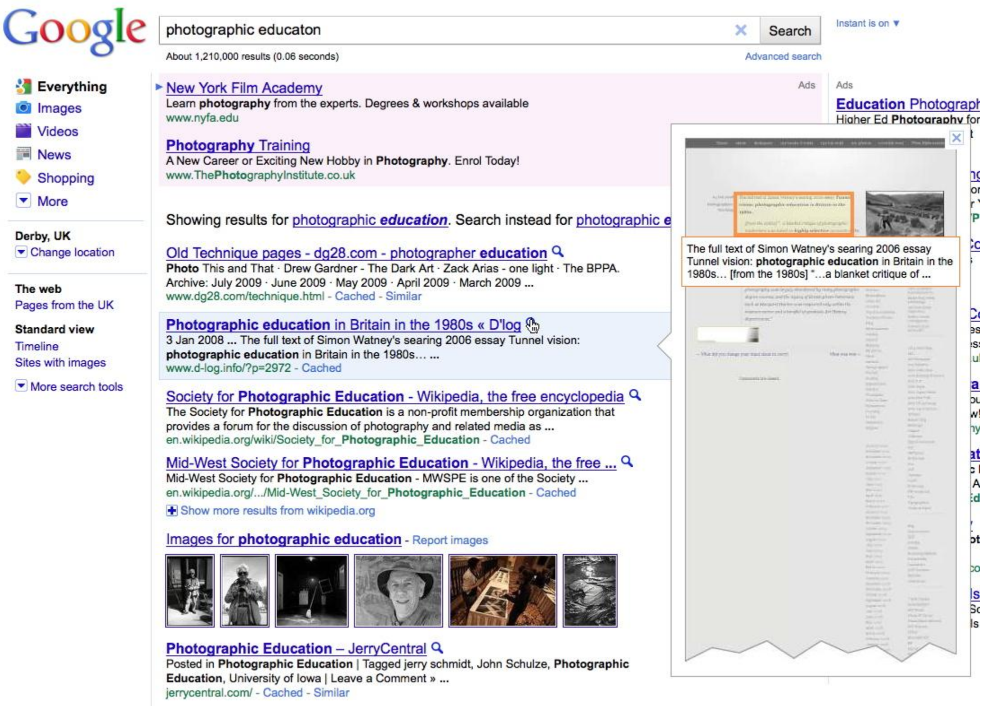


Figure 2.2 **Pre-visualization of page a link will go to in Google.**

A flexible technology for adaptive navigation support is adaptive annotation of visible links (Brusilovsky, 1992). A number of systems have been developed, and one example suggested by De Bra (1999) is adaptive navigation methods:

Direct guidance - A "next" or "continue" (link) button is shown.

Sorting of links - A list of links is sorted and presented from most relevant to least relevant.

Link annotation - Link anchors are presented differently depending on the relevance of the destination, for example use of coloured dots and arrows as annotations (green means interesting and red means inappropriate).

Link hiding - Links leading to inappropriate or non-relevant information are hidden.

Link disabling - Inappropriate links are disabled.

Link removal - Inappropriate links (and anchors) are simply removed
(adapted from De Bra, 2000).

Although systems using truly adaptive navigation are heavily based on higher level programming, the basic principles behind this can be applied to even modest multimedia developments by building in support which could simply be a glossary, informative links or help and hints at points where students are known to have problems understanding concepts. Students who do not need these can move on regardless, whilst those who do need support will find it available when they need it most.

2.4.3.4. Multimedia

Multimedia, at its most basic, means ‘many media’. The incorporation of many media together to create a cohesive whole could be in the form of a digital slideshow, screen cast, a television programme, interactive learning materials or role playing games.

The history of multimedia has been a long one, as has its use in teaching and learning. From the multimedia used in teaching in the 1980s, with audio tapes linked to slide projectors, to Open University broadcasts where lecturers used basic animations on boards as they talked, and interaction was at the level of push buttons and keypads for moving to different slide numbers on a Kodak carousel slide projector with its limitation of eighty slides per carousel. These technologies by the very definition are using ‘multimedia’ but, in terms of today’s technological perspective, they are as antiquated as the lantern slide projectors of the 19th Century were in the 1980s.

The devices referred to above were, even in their crude way, interactive long before the arrival of the Personal Computer, but not very user-friendly. This led to the common use of the phrase ‘Advanced multimedia’ to differentiate between what was possible in combining many media together previously, to how we can now combine many media together into richer learning experiences.

The evidence to support multimedia is seen as equivocal as the use of the term multimedia has changed along with the potential of computers to facilitate the development and presentation of multimedia materials. For example, Mitchell (2003), following the paper by Ellis (2001) listed the obstacles to the wider use of multimedia:

1. There is still relatively little evidence to support the value of multimedia for enhancing learning (Ellis, 2001).

2. The cost of most multimedia production is still relatively high (Ellis, 2001) and

3. There are a number of perceived problems of integrating technology into a regular content-driven course (Mitchell, 2003).

The difficulty with this list is that the term 'multimedia' is poorly defined. Since its inception, multimedia has proved to be effective but that effectiveness is related to the type of multimedia examined. Cost is relative to the type of multimedia, from simple learning resources that cover one point in a single PowerPoint slide to what amount to commercial games with a development price tag to match. The final point assumes that a 'regular content-driven' course is what is required. The aim of multimedia and its use has been very much to get away from the traditional 'teacher talks, student listens' approach to education.

This difference in what we mean by multimedia is reflected in the literature, with early papers looking at the effectiveness of using photographs or video in teaching and learning. Current papers, however, are looking at the effect of often extremely complex tools, which are almost computer programmes in themselves, rather than simple narrative led audio-visual programmes.

The advantages to integrating lessons with well-designed multimedia applications are abundant, as reported in Alick (1999). Alick's study shows that well-developed multimedia instruction:

- ***Increases motivation*** *through immediate feedback, multisensory involvement and greater enjoyment of learning.*

- ***Increases involvement*** *as more senses and activity are required of the student, more learning and progress occurs.*
- ***Ensures instructional consistency*** *because instruction progresses as mastery is achieved.*
- ***Reduces learning time*** *by as much as 50 per cent.*
- ***Increases retention*** *of content over time*
- ***Enables students to have more privacy*** *allowing them the experience of trial and error, failing tests, and asking embarrassing questions without disclosure.*
- ***Allows multiple access*** *so students can use programs when they need and want them and at a variety of places*. (Alick, 1999)

Further to that, other researchers have found that well-designed multimedia helps learners build more accurate and effective mental models than they do from text alone. Shank (2005) listed some of the benefits of multimedia in learning that could be helpful in enhancing students' learning, and these include:

1. Alternative perspectives
2. Active participation
3. Accelerated learning
4. Retention and application of knowledge
5. Problem-solving and decision-making skills
6. System understanding
7. Higher-order thinking
8. Autonomy and focus
9. Control over pacing and sequencing of information
10. Access to support information. (Shank, 2005)

As the support for, and use of, multimedia technologies becomes more widespread in higher education in the teaching medium, studies have been carried out to find out what impact such technologies have on student learning.

One such study by Welsh and Null (1991) points out that advanced multimedia technologies which tend to focus on the inclusion of better visual aspects with regard to material presented in class are beneficial to students.

Researchers (Frey, 1994; Kulik & Kulik, 1987; Mayer, 1997; McNeil & Nelson, 1991; Petty & Rosen,1990; Sekuler, 1996; Welsh & Null, 1991; Worthington et al., 1996) have considered both the 'likeability' aspect of classes using multimedia as compared with classes that have a traditional lecture-oriented approach, and the effect of this on students' academic achievements. They have been found to reflect slight but statistically significant improvements in students' learning, and it is these findings which have given rise to the widespread adoption of these technologies.

The work of Smith (2002) suggests that, for decades, educational psychologists have been studying different methods of teaching, to understand the key triggers of learning experiences that occur for the benefit of the student (Alvino,1995). This research demonstrates the positive influence that multimedia technology which is used for teaching and learning does have both on students and teachers. Roberts (2000) states that, if teachers have access to the correct multimedia technologies and materials for their subject, this enables them to assist students to "comprehend difficult-to-understand concepts and engage in learning, provide their students with access to information and resources, and better meet their students' individual needs" (Roberts, 2000, p. 4).

Despite the fact that several studies (for example Lee et al., 1996) seemed to claim that multimedia instruction benefits students, others found no significant differences between classes using a multimedia approach and traditional classes, but this could be a result of different teaching and learning styles, as well as the particular multimedia used.

One of the powerful technologies which can be incorporated into multimedia applications is interactivity. Rather than have the user passively view content, interactivity can give the opportunity to interact, to do something with the content in a stimulating way. According to Cunliffe, Elliott (2003), interactivity is not the same as navigation. Navigation is simply moving through the content, whereas interactivity is manipulating the content.

Multimedia is often interactive in that it involves the user doing something - they are not just viewing the application passively. Games are probably the most extreme example of interactive multimedia, but interactivity can be used for a variety of reasons, not just entertainment. Interactivity involves more than just clicking on the 'next page' button or selecting an option from a menu; the user has to actually do something with the content of the application. This aspect of multimedia is not yet fully developed, and Cunliffe (2003) states that the majority of multimedia applications are not truly interactive. As an earlier study by Savage and Vogel (1996) said:

> Interactive media can produce fundamental changes in teaching and affect faculty and students alike; for just as the development of the tools of multimedia was implicit in the evolution of the computer, so is their continuing deployment is implicit in a kind of natural evolution of multimedia applications in education. (Savage & Vogel, 1996)

Multimedia can provide a range of interactivity, including:

- Simulations where the user can change the parameters of the simulation to see what the effect of the changes are.
- Games where the user controls characters or events.
- Quizzes, tests and puzzles where the user can enter text, or drag and drop elements.

- Allowing the user to customize and personalize the application by adding new content or new link, or by restructuring existing content. (Cunliffe, 2003)

Some limited attempts have been made to explore the educational potential of advanced multimedia in Photography including simple interactivity, and these are described and discussed below.

The Virtual Studio

Brown and Cruickshank (2003) utilized a 3D computer generated model called The Virtual Studio to explain the effects of directional lighting, and this research highlights the benefit that this technique can offer (see Figure 2.3). It allows the choice of different poses of a human reference figure in combination with a type of light source and direction to give a visual display of the shadow outcome. It is simple to use and the student is able to recognize the effects quickly, which aids in recollection during fieldwork.

Despite the good features of this model, there are also limitations. For example, normally when lighting a real-life situation at least two lights are used. In this model, only the effect with one light at a time is seen, and this gives a slightly false environment. A greater level of interactivity would be moving from clicking on the arrow to change the position of the light, to physically moving a light on screen, from left to right for example, and looking at the effect this had on the lighting.

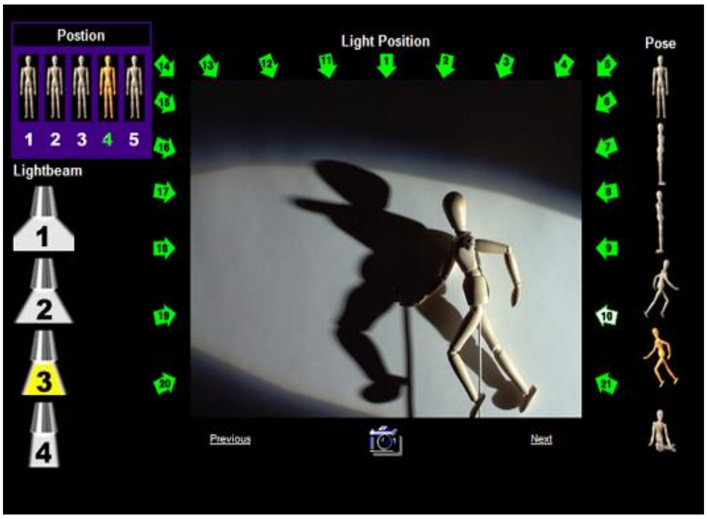


Figure 2.3 The virtual studio
Source: Brown and Cruickshank (2003)

These models were set up at De Montfort University to deal with the high numbers of students who wanted to spend more time in the photographic studio experimenting with lights and were not able to, due to lack of resources.

Rule of thirds in photography

The "Rule of Thirds in Photography" is another example of an interactive learning tool which is being developed in The Higher Colleges of Technology in the United Arab Emirates, to enable students to learn and have a better understanding of how to use Rule of Thirds to support composition as they take photographs. Lister (2002) claims in the advertising for this programme that:

> The "Rule of Thirds in Photography" is a Macromedia Flash-based program, to aid learners in becoming visually literate through the introduction of design principles and compositional techniques emphasizing the Rule of Thirds. The product, while addressing the special needs of English as a Second Language learner, uses multimedia activities and simulations in the realm of photograph composition. With over 120 images, more than 70 'introduced' terms with glossary roll-overs, and many options to go 'deeper' or try 'more', the product provides an engaging 60 minute computer- mediated photography lesson. (Lister, 2002)

The Rule of Thirds states that you should not put a subject in the middle of photo but, rather, have it along an imaginary line that divides the photograph in thirds either horizontally or vertically. As this product is still being developed, its strengths and weaknesses are not yet known but, on completion of the thirty to forty-five minute computer-based training programme, the software suggests that the student will be able to:

1. Choose the main focal point of a photograph or identify photographs that do not have a focal point.
2. Explain the terms focal point and composition.
3. Explain what the Rule of Thirds means and why a good photographer might use it.
4. Show how the Rule of Thirds can be used when composing photographs.
5. Identify photographs which use the Rule of Thirds from those that do not.

2.4.3.5. Streaming media

Streaming audio became available on the web in 1995, but with the development of the Synchronized Multimedia Integration Language (SMIL) (W3C, 2003), the technology reached a new level of maturity. SMIL is based on the XML standard, and allows audio, video, images, and text to be integrated in real time as it is downloaded over the Internet (Diaz, 2002). Streaming media is defined as network-based data, which can be presented to the user before the whole data file has finished transferring (Childers et al., 1999). Streaming media, which includes Real Media, Windows Media, QuickTime and Shockwave among others, is now the norm in web-based delivery of audio and video. However, the present reality of this web delivery is that bandwidth is still severely limited for the majority of the global student population (Diaz, 2002).

How well a piece of media or multimedia streams or downloads to your computer and onto your computer screen or into your web browser depends on a number of factors: the way that a video or other media is stored on a server (Streaming Media Server) and delivered to the end-user's computer; how the original media was created, including its size, as the higher the quality the more likely the media is to be larger in size and so take longer to download; the type of compression, and the way the interactive multimedia was created. Even something as simple as using Cascading Style Sheets (CSS), rather than tables or frames, can speed up the download speed of a web page and its contents.

2.4.4. Conclusions

When considering the conclusions that can be drawn for the implications of the use of technological approaches in teaching and learning, looking at the multiplicity of technology and technological approaches confuses rather than narrows down the range of possibilities, but certain key themes begin to emerge.

The use of technology is effective in nurturing the process of learning, and is considered as a supportive supplementary tool for the teacher towards better learning outcomes, being specifically useful in teaching difficult aspects of subject areas. Technology is a remedy and solution for some of the problems students have, such as motivation, as technology can make learning more interesting and engaging.

It is also a great opportunity to maximize a student-centred approach and expose students to unlimited, verified and authentic knowledge and resources, rather than depending on what could be limited knowledge on the part of the instructors.

However, to reach the optimum stage of best utilization of technology in teaching requires particular conditions, including level of interest, which are matched by provision of the correct equipment, interactivity and training in the use of technology.

Therefore, the following aspects have to be taken into consideration:

1. There are complex interactions between the learning technology, teaching style in how it is used, and students' learning styles and their ability to use technology.
2. The effectiveness of multimedia or any other technological solution needs to be assessed on its own merits as a learning resource, both inside and outside the classroom.
3. Students' engagement in the learning process affects their enjoyment, and learning and multimedia can be an effective way of stimulating interest in subjects that can be boring, or technically challenging.

2.5. Features of an Advanced Multimedia learning environment

As has been seen in section 2.3 above, the use of the term 'Multimedia' covers a wide range of materials which go beyond the conventional 'many media' combining several different types of media. The term 'Advanced Multimedia' is then used in the teaching-learning environment to cover the multi-sensorial nature of rich interactive media, which provides high levels of interactivity and vividness.

2.5.1. Definition of Advanced Multimedia

In a teaching-learning environment, 'Advanced Multimedia' can be defined as a combination of rich interactive media, which provides high levels of interactivity and vividness. It uses advanced media hardware and software tools including Virtual Reality and Simulation (Albayat, 2007). Multimedia supplements traditional teaching and can benefit students by providing a highly visual experience.

Multimedia-based educators have long known that not all students learn in the same manner; individual students exhibit strengths and weaknesses in different areas. Some students seem to learn more effectively when reading new material, while others learn better when the material is discussed in the classroom. Some students seem to thrive in an environment where they can freely explore information on their own, while others do better in an environment where the information is presented in a sequential manner.

Gardner's work in multiple intelligences (cited in Berge, 2005), where he identified and discussed seven unique intelligences: linguistic, logical-mathematical, intrapersonal, spatial, musical, bodily-kinaesthetic, and interpersonal, is one way of looking at these styles. More traditional learning styles identify students as concrete versus abstract, sequential versus random, and auditory versus verbal learners or Visual, Auditory, Read and Kinaesthetic (VARK, 2010).

Regardless of the theory cited, the purpose and application is the same: to differentiate instruction and offer multiple learning opportunities to learners when designing lessons. In the design and development of online learning there are several unique challenges, as well as opportunities, presented to developers. The most obvious challenge is that online learning is not appropriate for all learners. Students who prefer a more hands on or kinaesthetic learning environment may well feel frustrated with the primarily text-based nature of many online classes. In addition, auditory learners who prefer hearing and discussing the material presented will be equally frustrated with the text-based context.

At the same time, developers who have successfully integrated the resources for collaboration and virtualization offered by the Internet may be able to design a curriculum that is more engaging to learners who prefer a more hands on and non-sequential style of learning. Additionally, a well-designed online class should allow a learner to move through the curriculum at a speed and pace they are comfortable with versus the traditional classroom in which all learners are expected to learn at the same pace, the pace being that of the lecturer not of the student.

Advanced multimedia encompasses a range of ideas. However, it should be noted that many of these areas overlap but the key is the difference in experience of the user, from watching and simple navigation with low levels of engagement to higher levels of engagement with the multimedia experience in advanced multimedia. The following aspects are key to the success of advanced multimedia:

- Rich multimedia
- Virtual Reality
- Simulation
- Vividness
- Interactivity

Vividness and interactivity are the main components of presence in the communication system.

2.5.1.1. Rich multimedia

Rich multimedia refers to technology-rich multimedia with highly advanced media in terms of hardware and software requirements, and tools for more user interaction. It paves the way for more user involvement and engagement, and the richness of the media is based on the following four criteria from Daft et al. (1987):

1. Capacity for immediate feedback - The medium facilitates quick convergence on a common interpretation.

2. Capacity to transmit multiple cues - An array of cues, including physical presence, voice inflections, body gestures, words, numbers, and graphic symbols, facilitate conveyance of interpretation and meaning, rather than simply information or data.

3. Language variety - Numbers and formulas provide greater precision, but natural language conveys a broader set of concepts and ideas.

4. Capacity of the medium to have a personal focus - This refers either to the conveyance of emotions and feelings, or to the ability of the medium to be tailored to the specific needs and perspectives of the receiver.

The above comments were made in a study from 1987, when the early work on multimedia and Human Computer Interaction took place. Now we also need to include ‘touch and feel’ to the second point above, as we interact more closely with multimedia through touch screens and handheld controllers. The physical positioning of our bodies is also an interactive tool as this can be detected through infrared, accelerometers or other artefacts including gloves and heads up displays, and eye movements.

2.5.1.2. Virtual Reality

Virtual Reality is an experience rather than a collection of technical hardware (Biocca & Delaney, 1995). Virtual reality (VR) can be defined as a real or simulated environment in which a perceiver experiences telepresence through increased media vividness and interactivity by increased sensory involvement and immersion in virtual environment. To most people VR means a collection of technological hardware including a computer, a head mounted display, headphones, and motion-sensing gloves. Therefore, what people understand by virtual reality is something technical rather than a particular type of experience.

The most common definitions of VR are discussed below.

Coates (1992) defined VR as “an electronic simulation of environments experienced via head-mounted eye goggles and wired clothing enabling the end user to interact in realistic three-dimensional situations”. The terms virtual worlds, virtual cockpits, and virtual workstations were used to describe specific projects at that stage in the development of VR. The term ‘virtual reality’ was coined in 1989 by Jaron Lanier, CEO of VPL Research to bring together all of the virtual projects using different tools. Therefore, the term has come to refer typically to three-dimensional realities implemented with stereo-viewing goggles and reality gloves (Krueger, 1991).

Whether accessed through stereophonic video goggles or fibre-optic data gloves, VR is an alternate world filled with computer-generated images that respond to human movements (Greenbaum, 1992). It involves the use of advanced technologies, including computers and various multimedia peripherals, to produce what Pehlivanis et al. (2004) define as “a simulated environment that viewers perceive as comparable to real world objects and events”. Taking that comparison further, VR can successfully be used to support such complex understanding by stimulating and exploring all human senses whereas traditional notions of learning tend to focus on purely intellectual skills (Fallman et al., 1999).

It is Pehlivanis et al.’s (2004) definition of virtual reality as “A simulated environment that viewers perceive as comparable to real world objects and events” which is the most valuable as it best fits both current trends and future developments as an overall definition. This definition of VR is independent of the technology and, thus, allows for a wide variety of environments that can be perceived as virtual. These range from 3D videos and televisions or 3D virtual objects that can be rotated to interactive devices, such as the Nintendo Wii where the movement of a controller controls movements or Sony PlayStation 3 which recognises hand and body movements, and fully immersive technologies where users actually perceive that they are in the game or computer environment by wearing a suit and gloves with goggles and headsets, providing the computer’s virtual reality directly rather than at a distance.

2.5.1.3. Simulation

Simulation is a term used in many fields as its general definition is “an imitation of a real device, state of affairs or process” (Bedir et al., 2010). Simulation attempts to represent certain features of the behaviour of a physical or abstract system using a simulator, or otherwise experimenting with a fictitious situation in order to show what could happen in reality given certain conditions. As such, simulation gives learners the ability to ‘’learn by doing’’ in a safe environment, thus driving mastery (Merelli & Luck, 2004). Students work interactively with a simulation's model to input information and then observe how the variables in the simulation change, based on this output. Most often, simulations are fully or partially implemented with a software program that allows the user to learn something about a given object of interest by "playing" with parameters of a model, According to Mergendoller et al. (2004): Randel, Morris, Wetzel, and Whitehill (1992) examined 68 studies on the effectiveness of simulations and found that students engaged in simulations and games show greater content retention over time compared to students engaged in conventional classroom instruction.

Vividness means the representational richness of a mediated environment as defined by its formal features; that is, the way in which an environment presents information to the senses (Lombard & Ditton, 1997; Steuer, 1992). It is stimulus-driven, and depends on the technical characteristics of a medium. Vividness as defined by Steuer (1992) involves the representational richness of a medium and is increased by using rich imagery, audio feedback and/or haptic feedback within the user interface design. Vividness promotes engagement by providing multisensory stimulation during interaction. The scale of vividness presented by Steuer (1992), which is illustrated in Figure 2.4 below, shows the transition from low to high vividness. At the low end of the scale are books, where the imagination of the reader is relied on to recreate the scene. Medium vividness is represented by a photograph, slides or diorama providing a more vivid, and high vividness is delivered through such devices as 3D IMax films, where the very movement of the camera is felt by the viewer or where interactivity is also introduced, or the virtual reality of a flight simulator and its viewing screen.

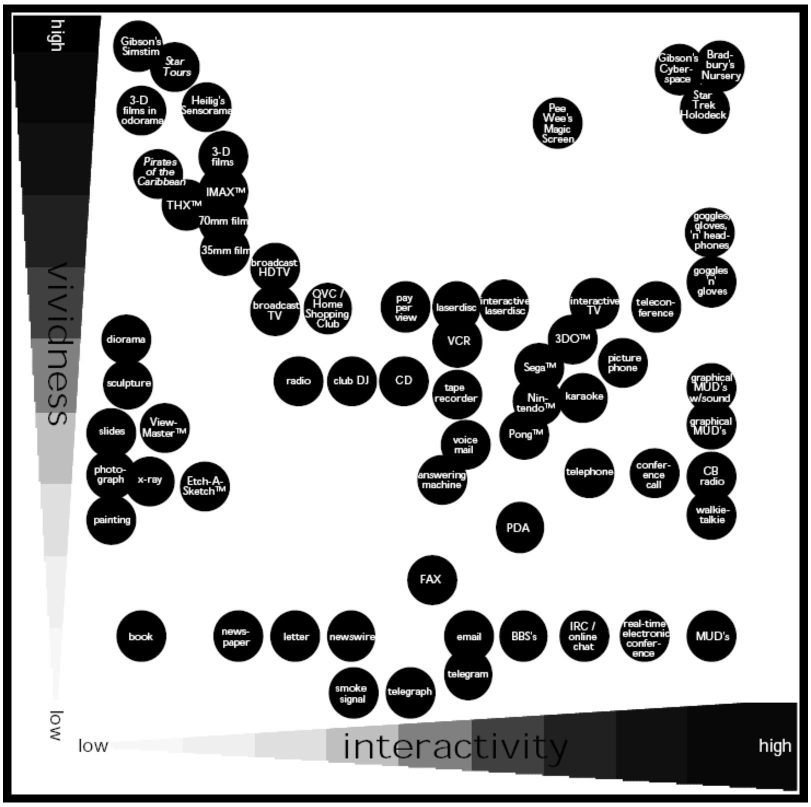


Figure 2.4 **Various Media Technologies - Vividness and Interactivity**
Source: Steuer (1992).

2.5.1.4. Interactivity

Interactivity involves the user doing something; instead of simply viewing content, they are involved in manipulating the content (Cunliffe, 2003). Interactivity as defined by Steuer (cited in Manninen,2002) involves the extent to which an individual can influence system parameters and combines both the possibilities of the system and the human action that is needed to activate those possibilities. With increased interactivity, users are free to switch between goals and strategies. Interactivity can also be defined as ‘the extent to which users can participate in modifying the form and content of a mediated environment in real time’ (Steuer, 1992, p. 14). Like vividness, interactivity is a stimulus-driven variable, and is determined by the technological structure of the medium (Hopkins et al., 2004).

One further aspect of interactivity is that it is similar to the degree of responsiveness, and examined as a communication process in which each message is related to the previous messages exchanged, and to the relationship between those messages and the preceding ones (Rafaeli, 1988).

Figure 2.5 below depicts different media technologies classified by interactivity and vividness, with the advanced multimedia technologies highlighted in the upper right corner.

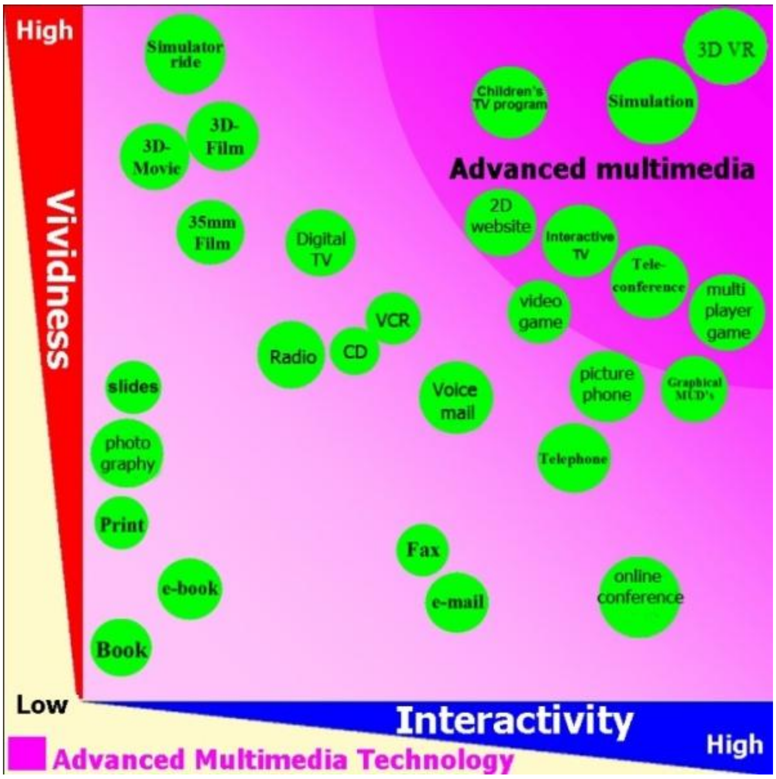


Figure 2.5 Level of Vividness and Interactivity
Source: Albayat, 2011 (Adapted from Steuer, 1992).

In developing the figure above, the researcher has incorporated various media technologies classified by vividness and interactivity to Steuer's classification of

1992. More than two decades later, the researcher has amended the classification by adding some media such as simulations and films to simulation word and 3D VR films, and has converted named examples of films or events to categories of technologies.

Degree of interactivity

Interactive features, such as dynamic feedback based on user control input (visual input, auditory input), are provided and add value. Content provides the manipulation of data sets and simulations (Anderson, 2002). The level of interactivity is illustrated in **Error! Reference source not found.** below. It is evident that with the increase of the degree of interactivity, more inputs from the user are employed and consequently greater involvement in the activity.

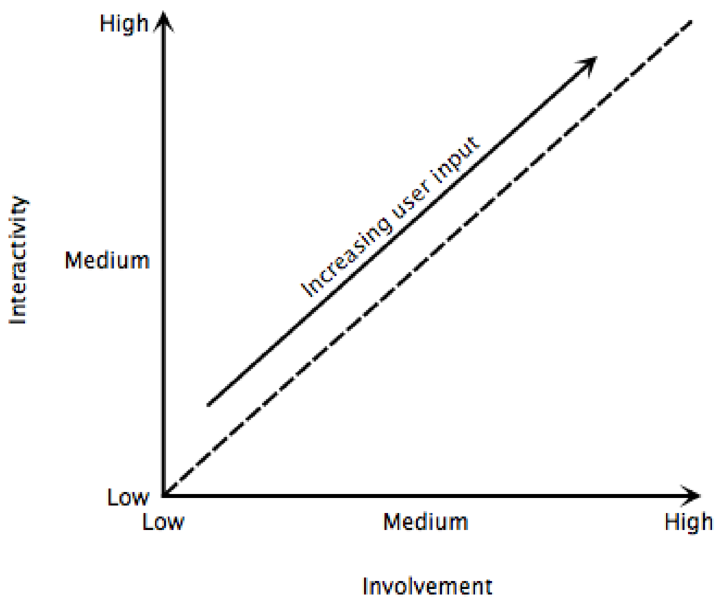


Figure 2.6 Relationship between interactivity and involvement

Source: Albayat, 2010 (Adapted from Anderson, 2002)

Anderson (2002) looks at assessing the levels of interactivity through differentiating between high and low levels of interactivity as a quantitative analysis. However, he also recognizes the qualitative nature of interactivity and individual involvement. The amount of information exchange between participants is one measure of interactivity, and the amount of information conveyed is relative to the needs of the receiver (the learner) (Cowley, 2002). The programme can present an electronic simulation of an environment and prompt the user to respond to simulated conditions with tools analogous to the controlling factors of real conditions in an actual environment (Zielinski, 1997). Interactive Multimedia facilitates individualized learning, privacy and immediate feedback. It also increases engagement and learning rate, control over pacing and sequencing of learning, and immediate access to support information (Shepard, 2003).

Levels of interactivity

The levels of interactivity from low to medium to high are not fixed levels; rather there is a transition from one level to another. Descriptions of the three levels were drawn up by Zielinski (1997), and they are summarised and discussed here:

Low - The most basic level of interactivity allows participants to set the pace of a presentation in multiple media or multimedia. This is like having an automated lecturer in the form of a presentation or screen cast which only asks for basic input in the form of turning the page forwards or backwards. There is no possibility to change the sequence of the presentation in any other way, so that the computer becomes “an expensive page turner” (Zielinski, 1997) and usage is limited to teaching certain sequential topics.

Medium - This level of interactivity provides participants with a variety of paths from which to choose, and the computer responds to these choices without engaging in dialogue (Zielinski, 1997). Interactivity at this level can be found in online reference works such as multimedia encyclopedias, where the user looks for, and deals with, information. This covers examples such as hypermedia where links do not move sequentially but can take a user to where they want to explore in the document and in linked multimedia experiences, with no teaching involved.

High – Here the computer and an end-user respond to each other electronically. This dialogue could be represented in a variety of formats, for example auditory or visual feedback, as the image changes or text appears. This can involve a simulated environment where the user is asked to respond with tools that correspond to the controlling factors of real conditions in a real environment. At this level, the programme can track the level of understanding, for example, of the user and select the best path for this user, including which events will take place in the simulation.

From this description, it is clear that high level interactivity is suitable for contexts where participants have to develop a skill, or master a concept, and apply what has been learned (Zielinski 1997). This means that programmes with a high level of interactivity can be developed to eliminate the need for further instruction, and to include testing as the programme is used (Anderson, 2002).

Teoh's study (2007) reports on interactivity in terms of students' opinions, and he found that that the majority of students in this research were more interested in the learning process when there was a high level of interactivity due to the enriching multimedia experience, which also gave them the opportunity to be more responsible for their own learning. On the whole, students agreed that learning with interactivity and multimedia was interesting and engaging. As Teoh says: "The effectiveness of multimedia and interactivity as a learning medium clearly supports knowledge transfer and, at the same time, promotes engagement in learning which surpasses its status quo of a mere tool of delivery" (Teoh and Neo 2007, p.36).

Moreover, Iskander's research (2007) suggested that perhaps the most crucial element in developing multimedia education modules is the level of interactivity implemented in the produced module. Such resources are best used in virtual laboratories or in conjunction with e-learning, and multimedia also enhances

guided use of simulation software. This allows gaming strategies to be made, which motivate and stimulate students' learning and enhance their understanding.
Another area where interactive multimedia can be a powerful learning and teaching tool is the senses, stimulating students to use all their senses through the reading, seeing, hearing, and active manipulation of materials that multimedia demands.

Taylor and Merabti (1995) define 'multimedia' as a technology that enables humans to use computers capable of processing information delivered through text, audio and video, images, and animation. They state that multimedia applications include entertainment, education, commerce, information provision, design (for example CAD/CAM), co-operative working such as video conferencing, application sharing, remote working, simulation and virtual reality experiences. Mitchell (2003) defines 'educational multimedia' in terms of an educational presentation made using primarily audio and images. He also explains that, unlike hypertext and web-based instruction, for example, the reliance on text is minimized (though not eliminated) in a multimedia product.

Mayer (cited in Mitchell, 2003), suggests that in order for multimedia design to be effective, it must conform to his nine guidelines, which may be re-organised into six key categories, encompassing integration, parsimony, narration, individual differences, personalization, and interactivity. In addition, Marks (cited in Mitchell, 2003), agrees that authentic multimedia based instructional work lead to higher levels of student engagement.

Zimmer (2003) rightly states that interactivity involves more than just clicking on the 'next page' button or selecting an option from a menu, it involves manipulating the content of the application, which helps students to develop technical and research skills that they cannot get from reading a textbook. Moreover, a computer-based application enables students to learn how to work with a keyboard, mouse, and to access online information (Zimmer, 2003). Mikett and Ludford (cited in Zimmer, 2003), state that when students can see what is going on, they can understand the important points in the lesson and 'jump off' so they can discover more about the topic by themselves. Cunliffe and Elliott (2003) believe that the interactive aspect of multimedia has not yet been fully developed and the majority of multimedia applications are not truly interactive.

The advanced multimedia materials created for this study will take what Zimmer and other authors have said into account as the designs will incorporate not just the basic interactivity used in navigation but the more sophisticated manipulation of a simulated camera to support student learning, so that they can develop their personal understanding of key photographic techniques.

However, it is important that the level of interactivity should match the learning needs and decisions about interactivity included as part of the design process in terms of usability and Human Computer Interaction. This is because the last thing that is needed in many simulations is for the interactive environment to be more complex than the real world. It is this capability to simplify complex real world activities into small programmes that moves the use of advanced interactive multimedia forward.

The more interactivity that is required the greater the level of involvement that is encouraged. This is the difference between materials that are information based screens with buttons saying next page i.e. low interactivity and low involvement compared to a simulation of a camera where controls affect the picture displayed so provide high interactivity leading to greater involvement.
Through a virtual camera, students can potentially visualize what effects occur to the finished picture by controlling the camera’s Aperture, focal length of the lens, and the distance from the object (by using a sliding bar for example). Such effects cannot be seen so directly in even real cameras.

2.5.2. Teaching using Advanced Multimedia

As suggested by the discussions above, teaching with multimedia can be used to optimize student learning by employing modern learning theory and adopting advanced multimedia technology systems and methods, of which there are several examples.

2.5.3. Examples of Websites with advanced multimedia

A new level of interactive multimedia for web authoring is now available for educators to access and create as supportive information for their curriculum, and this is Virtual Reality Modelling Language (VRML). The development of advanced web-based interactive 3D environments using VRML provides dynamic, engaging three-dimensional virtual environments on the World Wide Web (Lockett, 1999).

VRML is one of the technologies which enhances Hypertext Mark-up Language (HTML) with 3D content in the form of scenes, animations and events. It is a technology whereby 3D models of objects are given attributes such as colour and texture, and then placed in a digital space resulting in a visualization of the original environment. The objects can be assigned animated behaviours via events that visualize or simulate an activity. An intuitive on-screen user interface allows a learner to view and navigate through the environment while interacting with the objects (Heartman & Wernecke, 1996). The potential for VRML in UK Higher Education was addressed in an AGOCG publication from 1995, where the respondents identified the benefits as “increased and improved human-computer interaction; better visualization of information; a sense of "presence"; more rapid prototyping; improved simulation (Stapleton & Costello, 1997).

Specific applications of VRML projects are for instructional use in Science education dealing with Astronomy, Chemistry, Physics and Biology. Art and Humanities subjects are also being enhanced through on-line 3D visualizations and simulations created by educators and students. From a human factors standpoint, VRML is high-level multimedia comprised of detailed visual information. Text is the base-level media, but adding images to text yields more information. Moving images such as animation transmit even more information, and sound adds yet a higher level. This amount of information can be presented with HTML; however, VRML extends into the third dimension by placing visual elements into a Cartesian coordinate system, thus delivering a scene in three-dimensional space (Lee et al., 1996). VRML can go beyond this by allowing a user to interact with the virtual objects and experience the scene through self-navigation. Therefore, VRML environments combine the benefits of a hypertext construct (Spiro & Jehng, 1990) with a constructivist concept.

However, one of the drawbacks of VRML has been the need for specific plug-ins, for example QuickTime, Cortona or other media players.

A selection of sites offering VRML includes:

QuickTime VR – This uses the virtual reality aspects of QuickTime to show panoramic and 360° photographs of scenes, for example Greek archaeological sites at http://www.stoa.org/metis/.

VRML – A virtual tour of a Viking-age farm has been developed by the BBC at http://www.bbc.co.uk/history/ancient/vikings/launch_vt_viking_farm.shtml. A page from this is shown in Figure 2.7, below.

Figure 2.7 BBC History Viking Age Farm Virtual Tour, Source: BBC (2011).

More examples can be found on this web link, which has a list of worlds and galleries to choose from: http://vrmlworks.crispen.org/worlds.html.

2.5.4. Traditional Teaching vs. Teaching Using Advanced Multimedia

Advanced interactive multimedia is a powerful medium for education and training. It is also a very adaptive tool capable of changing attitude or belief.

As Wolfgram (1994) stated, "People only remember 15 percent of what they hear and 25 percent of what they see, but they remember 60 percent of what they interact with”.

The interaction or “doing” helps the learner achieve the learning objective and recall the information, skill, or behaviour that was learned (Dick & Carey, 1992).

Cunliffe and Elliott (2003) consider that interactive multimedia provides a range of interactivity for the benefit of effective learning-teaching, including simulations, games, quizzes, tests and puzzles, which allow user customization and personalization.

Active engagement is defined by reflection and validation of the content being explored. Consequently, effective interaction is a process of awakening students’ internal reflective processes as follows:

- Effective learning requires reflection and validation.
- Reflection and validation require interaction.
- Therefore, effective learning requires interaction (Cowley, 2002).

Support from multimedia for the learner lies in the following:

- It conveys information quickly and effectively to all students and keeps them interested in learning (Savage and Vogel, 1996).
- It addresses different learning styles and preferences (Moore et al., 1996).
- It obliges learners to interact both behaviourally and cognitively (Keating, 1997).
- It is a vehicle for a richer learning context (Moore et al., 1996).
- It involves and focuses the learner resulting in increased attention.
- It provides a motivating environment (Newby et al, 1996).

In his study, Teoh and Neo (2007) found that, in general, interactive learning using advanced multimedia environment is feasible, and is a viable alternative to the traditional classroom which has proved to be limited in satisfying the needs of the students in the modern learning context. Students are, on the whole, positive towards active learning and confident in enforcing self-paced strategy. Thus, this viable learning strategy should be encouraged by educationalists.

2. Table 2-3 below has been developed from my personal experience and from examples of teaching and learning using advanced multimedia and traditional methods employed by other photographic and non-photographic educators. The aim of the table is to differentiate clearly between traditional approaches and those using Advanced Multimedia.

An example of a traditional approach previously used by someone who now uses advanced multimedia is given by David Bryson (2011) "Traditionally teaching elements of how to use a camera in the classroom with a large number of students have involved presenting the technical theory material at the same time as demonstrating using an actual camera. The use of the camera in front of the students by the lecturer is enhanced by passing a camera/lens round the group so that they can see on the camera itself what is being explained; usually 2 cameras one to start going round from back of the class and one from the front. In a class of 30 or possibly 60 students even if they brought their own cameras in, they could all be different or not show the feature being discussed and whilst it may be possible to borrow a number of cameras from a central store one per person is not usually possible as cameras will be needed by other students to use in practical work at the same time as the lecture. The features of a camera are often demonstrated using an overhead projector for example putting a lens in the centre of the projector and altering the depth of field ring to show the changes in the aperture as the lens is stopped down or opened up.

Table 2-2 Traditional Teaching vs. Advanced Multimedia.

Parameters	Traditional Teaching approach	Teaching using Advanced Multimedia
Media	Limited use of media; individual photographs, illustrations, videos or cartoons.	Advanced level of Media Technology, including simulations
Teaching tools (Hardware)	White Board, PowerPoint presentation, overhead projector (OHP), real cameras	Local computer network, video on demand.
Teaching materials (software)	Textbook, 35mm slides, pictures, PowerPoint.	Advanced Multimedia tools e.g. Flash, 3D modelling software
Student-teacher interaction	Direct communication and more "intimacy"	Direct communication and less "intimacy"
Student-computer interaction	Not available	Interactive
Level of Interactivity	None to Low level	Mid to Higher Level
Level of Vividness	None to Low level	Mid to Higher Level
Activity	Little or limited activity depending on teaching style and group size.	More and richer activities
Formative Evaluation	Little and limited	More and increased diversity of types
Summative Evaluation	Yes. Non-interactive – Text based types	Yes. Highly interactive – with Drag and Drop type activities

2.5.5. Conclusion

The literature and examples of the use of advanced multimedia imply that the greater the engagement and enjoyment through a richer, more vivid and more meaningful real, if simulated, experience, the greater the learning.

This conclusion, together with those from 2.2.4 and 2.3.4, needs to be examined more closely to see if this is also true where advanced multimedia is used to support teaching and learning in photography. The effectiveness of advanced multimedia in photography then depends on the development of materials that meet the needs of the subject, the available technology and students.

2.6. Design approaches to developing advanced multimedia to support learning in photography

The previous sections in the literature review have looked at where multimedia and advanced multimedia have been used - from photography education (section 2.2), to where technology supports learning and teaching (section 2.3), and to the characteristics of advanced multimedia (section 2.4). However, they have not considered how the multimedia or advanced multimedia is designed and constructed. This section takes a step back to look at how the characteristics of advanced multimedia are brought together into a coherent mix to support the learning and teaching required in photography education.
The considerations that will be covered include:

- Review of the impact of limitations to the use of multimedia on design decisions
    - Digital divide
    - Broadband
- A review of Design Models

2.6.1. Review of the impact of limitations to the use of advanced multimedia on design decisions.

2.6.1.1. Digital Divide

Ironically, the general public believes that technology and the Internet will solve the inequalities in education among various socio-economic, racial, and gender groups but, unfortunately, this is not the case. The term *Digital Divide* was coined by Lloyd Morrisett in 1978 to represent "a discrepancy in access to technology resources between socioeconomic groups" (Roblyer, 2003, p. 191). Cooper and Gallagher's (2004) report, jointly published by the Economic and Statistics Administration and the National Telecommunications and Information

Administration, found that although more households and schools throughout the United States have access to computers, a new gap has been created, one that affects the way in which information is obtained.

On the one hand there are now faster Internet connections meaning there is the opportunity to develop more effective materials and tools for learning in this particular area. Downloading text and music as well as still and animated images takes a fraction of the time it previously did. For the creator of a learning multimedia tool, this has opened up opportunities to create and design more interesting, detailed and sophisticated interactive tools for learning all types of subjects including photography.

However, due to the lack of a fast internet connection, for many it is necessary to use materials copied onto DVDs, CDs or Flash Drives so the multimedia material can contain all that is needed (pictures, sound, text, animation and virtual environment) to produce an effective tool for aiding the understanding of the different stages in photographic processes.

2.6.1.2. Broadband connections

The gap referred to above is the use of broadband connections to access the Internet. As Cooper and Gallagher (2004, p.4) found: “Persons with broadband at home are more likely than other Internet users to use the Internet frequently and engage in a wider variety of online activities, such as entertainment and information gathering”.

A divide also exists in the resources available to students in various settings, and how they are used. Roblyer (2003) found that children in remedial programmes “may have access to computers, but may use them mainly for remedial work rather than for email and other personal empowerment activities” (p. 192). While students in non-remedial settings are offered opportunities to learn strategies that will help them in the work force by learning, for example, to produce PowerPoint™ presentations, communicate via email, and conduct informational searches, those who are not functioning at the required academic level will fall behind in yet another area so crucial to their future success. Furthermore, and importantly, this accessibility also applies to the home.

In order to establish the point, the researcher highlights the packages available from internet service providers in both Bahrain and UK for comparative purposes.

There are two key dimensions to Broadband usage: maximum download speed and the usage limit, which is usually worked out on a monthly basis. The cost of combinations of these two determines the affordability of broadband connections. Maximum upload speeds are not relevant in terms of student access to multimedia resources, but they are usually far less that the download speed.

It is to be noted that the Chairman and Acting General Director of the Telecommunications Regulatory Authority in Bahrain, Dr. Mohammed Al Amer recently commented that:

> *Broadband speeds below 256 kb/s are still common in most Arab countries. Speeds in this range are hardly offered in Europe any more. The prices of broadband are three times greater than the European average. High rates are likely to inhibit broadband penetration and the ability of countries to harness the potential of ICT. (Al Amer, 2010)*

Furthermore, in the same report he states that:

> *Broadband prices in Bahrain have gone down by up to 50% over the last two years but there is still room for improvement when compared to European benchmarks: the price of a business medium speed broadband (1-4Mbit/s) is still four times greater than the European average. High rates have a flow-on effect on broadband penetration and*

use and hence Bahrain's ability to embrace the knowledge economy. (Al Amer, 2010)

When comparing United Kingdom and Bahrain broadband prices (see Figure 2.8), it can be seen that a higher speed can be obtained for a much lower cost in the United Kingdom. This means that students in Bahrain are less likely to have access to Broadband outside the educational setting.

Internet usage statistics based on those published by Internet World Stats (2010) in a report entitled 'United Kingdom Internet Usage Stats and Market Report' showed that there were 51,442,100 internet users as of June 2010, accounting for 82.5% of the United Kingdom population (see Table 2-4).
As mentioned above, a comparison of United Kingdom and Bahrain broadband packages and their prices shows that there are significant differences between internet service providers in the two countries.

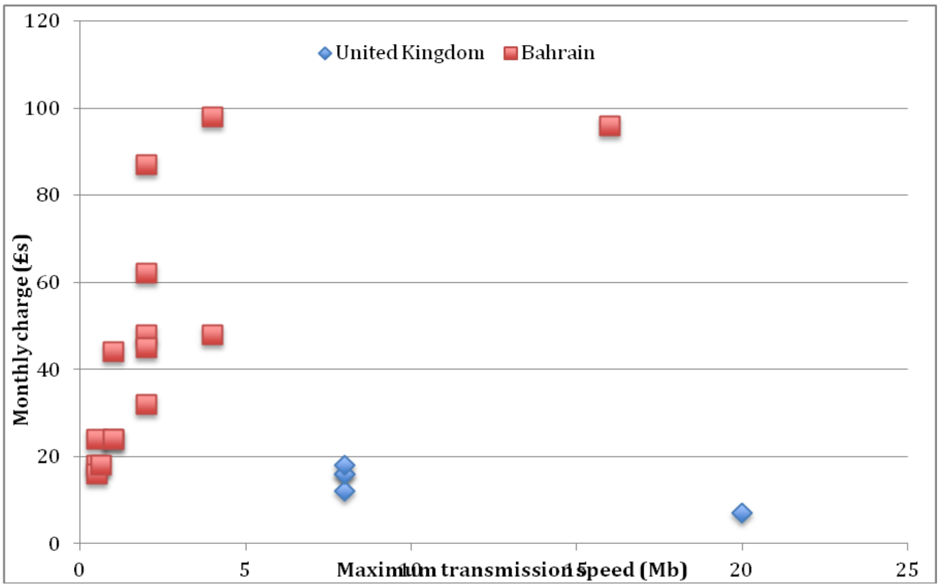


Figure 2.8 Monthly charge (£s) against maximum transmission speed (Mb)

Sources: Batelco (2010); Zain (2010); Menatelcom (2010); Light speed (2010).

The graph presented in Figure 2.9 illustrates this situation in 2010 and it is clear that using rich media online is more stable in the UK compared to Bahrain because, in Bahrain, users have to share the limited bandwidth with all common

users. For example, the Internet service in Bahrain University is a Leaseline of 20 Mb/sec which is shared with 6000 users at any given time.
(UOB IT Centre, 2010).

2.6.1.3. Teachers' use of multimedia-based instruction

The integration of multimedia into the classroom as well as into online teaching and learning is essential if multimedia is to become a truly effective educational resource. However, this integration and the subsequent changes in pedagogy are difficult, time-consuming and resource-intensive tasks. Research has shown that teachers need time to work with the technology before they will be at a level of comfort to change or modify their pedagogy (Redmann, 2003).
As the complexity of using multimedia in classroom continues, new teacher and student technologies will become robust, and ad hoc methodologies will give way to more interactive student competence for learning (Butcher-Powell, 2005).

2.6.1.4. Students use of multimedia based instruction

The online environment is full of time consuming tasks. Simply logging onto an Internet Service Provider (ISP) can take some time during peak hours, and the connection may be unreliable or simply slow due to server problems, scheduled maintenance, unscheduled outages, or congested data transmission lines. Inadequate connection speeds (that is slow modems) also present problems.

Most educational institutions tend to spend much of their technology budget to create and sustain a high-speed infrastructure. However, at the same time, PC prices have dropped dramatically, making it possible for more and more households to purchase computer systems, including Internet access, which is now ubiquitous and cheap. It is also common for many homes to have more than one computer connected to the Internet at the same time, if the service supports this. Students will also log onto the Web from home if they are not in residential colleges, or they will use their own laptop computers wherever they live during academic period, thus reflecting the fact that they choose convenience over speed. This saves them both time and money in that they do not have to physically be in a university computer laboratory, for example, in order for them to receive instruction or access materials. However, this means that the design and delivery of instruction needs to serve this common denominator (that is the 56K modem).

The broadband options that are available, in the form of DSL and cable modems, are now being subscribed to by the majority of homes where the services are available. Statistics show this increase in home broadband users, which began at approximately 14% at the beginning of this study (Pastore, 2002). The rate of growth in the United Kingdom, for example, has been continuous and has risen from 26% in 2000 to 82% in 2010, as illustrated in Table 2-3 below.

Table 2-3 Internet Usage and Population Statistics for the UK 2000- 2010

Year	Internet users	Population	Internet users as % of Pop^{n}	Usage Source
2000	15,400,000	58,789,194	26.2 %	ITU
2005	35,807,929	59,889,407	59.8 %	Nielsen Net//Ratings
2007	38,512,837	60,363,602	63.8 %	Nielsen//NR
2009	48,755,000	61,113,205	79.8 %	Nielsen Online
2010	51,442,100	62,348,477	82.5 %	ITU

Source: (Internet World Stats, 2010)

As a consequence of slow download speeds, multimedia tools developed for learning photography were initially problematic because retrieving information was time-consuming. This has changed and, nowadays, internet technology is much improved as broadband technology allows faster internet connection, faster downloading and retrieving. This improvement has led to further developments in advanced multimedia tools for learning different aspects of photography, for example model on lighting techniques. This new technology, therefore, has the potential to address the problem of increased student to staff ratios.

2.6.1.5. Authoring multimedia

The overall process of multimedia development involves creating the digital media elements, authoring the application and basic choices for delivering the application to the user. Multimedia applications are computer-based, both in their creation and in their use (though the machine the application runs on may not always look like a conventional computer). One of the aspects that is discovered quite quickly is that digitized media elements can take up much storage space. An approximate indication of the relative sizes of the different media types is shown in Figure 2.9 below.

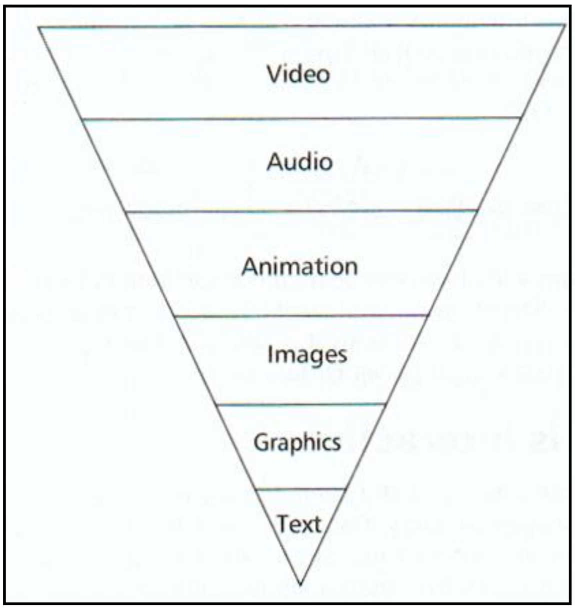


Figure 2.9 Approximate relative sizes of media types
Source: Cunliffe and Elliott (2003).

Another factor which contributes to problems in using multimedia is the design of the Web pages themselves. If they are complex, with lengthy pages and multiple graphics, it can be complicated and time-consuming to scroll through them. The often-used Java applets can further affect time efficiency. However, by far, the most time-consuming aspect of course navigation for online students concerns dealing with high-bandwidth multimedia files, which can come in the form of Flash objects, Virtual Reality files, movies (for example, Real, Windows

Media, QuickTime, AVI), audio excerpts (in MP3, WAV, AIF and other formats), and other multimedia file types.

A recent study by Koh et al. (2010) indicates that advanced multimedia can potentially enhance self-determination and motivation as well as a better understanding and application of learning. However, they found that the effects of advanced multimedia on students varied in accordance to their educational background, gender, and familiarity with IT. This supports the need, when implementing new approaches to teaching and learning, to consider the different profiles and needs of the students, including measures to ensure that all students are given sufficient help to overcome any constraints to their progress in using the multimedia materials

2.6.1.6. Delivery models for multimedia

There are two basic delivery models for multimedia applications, networked and local. Networked means that the application runs on a server and users access it from remote machines via a network. Examples of this include Web sites and services available over mobile phones. Typical concerns with this form of delivery are the bandwidth of the network, the load on the server and lack of control over the delivery platform.

In contrast, a local delivery model is one where the application is placed on some form of physical storage medium (for example, CD-ROM or DVD) and distributed to users, or is available to download via a network and install on a hard disk. Examples include computer games cartridges, educational software CD-ROMs and downloadable multimedia utilities. Typical concerns with this form of delivery are the capacity of the physical storage medium, the processing power of the local machine and the transfer rates from the storage medium (Cunliffe and Elliott 2003).

2.6.1.7. CD/Web Hybrids

Given the problems presented by both networked and local delivery, a solution had to be found, and one possible solution are CD/Web Hybrids, where the hybrid CD causes the CD-ROM and the Web to interact simultaneously. As Diaz (2002) points out, they allow students to access high-quality video and other content-based features while being able to search the rich resources of the Web. The factor of interactivity can be provided through links to list servers, message boards, and other synchronous or asynchronous technologies.

However, despite the possibilities offered by multimedia content, web-based delivery of this content is far from being at an optimal stage. Bandwidth restrictions continue to limit the ability to deliver high-quality multimedia content via the Web, and delays related to streaming result in students spending far too much time simply interacting with the technology rather than learning from it. Moreover, reduced quality in terms of size, image resolution, and "sync" between image and voice negatively affect the pedagogical usefulness of streamed multimedia files.

In fact, there has been much emphasis placed on the fact that a technology can be delivered at all, often instead of focusing on effective and efficient in terms of teaching and learning purposes. If the desired result is good student performance and high quality education, educators will need to address student success in terms of the efficiency of time spent online and the quality of the educational content delivered through this medium. As mentioned previously, the use of CD/Web hybrids can go some way to remedy these problems by enabling teachers and trainers to deliver compelling multimedia content via the Web. At present, it seems to be the best strategy until bandwidth concerns have been alleviated. (Diaz, 2002)

2.6.2. A review of Instructional Design Models

In this section the researcher will discuss three different design models, as follows:

- ADDIE model
- ASSURE model
- Laurillard model

2.6.2.1. Introduction to Instructional Design Models

Instructional design is a systematic approach to planning and producing effective instructional materials. It is similar to lesson planning, but more elaborate and more detailed (Siemens, 2002).
The need to design instructional materials that provide optimal learning environments has given rise to many learning and instructional theories. In the 1970s, Walter Dick (1997) and Lou Carey for example, created a systematic instructional design model which was influenced by Skinner’s behaviorist instruction and Gagné’s instructional events, in order to develop a step-by-step approach for designing instruction (Dick & Carey, 1997).

Of the more than 100 instructional design models which have evolved, the generic model which influences many is ADDIE (Analyse, Design, Develop, Implement, Evaluate) (Kruse, 2002), a model that has both a prescriptive and linear in design. However, critics (Gordon & Zemke, 2000; Kruse, 2002) point out that linear model does not meet the needs of the changes in the educational environment which have been brought about by the integration of the Internet and other technologies.

Wilson (2004) and Crawford (2004) consider that the online environment does not lend itself to being restricted by a systematic instructional design model, such as ADDIE, given that “learning outcomes develop from a combined effort of the designer and the learners’ needs in an ever changing and evolving process” (Wilson, 2004). Wilson affirms that “the instructional design theorists’

formula is to absorb original research in a related discipline, then develop a heuristic model of practice based on the original research, and finally offer a simplified model of practice to instructional design practitioners" (Wilson, 2004, p. 81).
The online community of learners creates an on-going need for an instructional design that reflects this changing environment, and the recent shift in instructional strategies has been from teacher-directed to learner-centred instruction (Reigeluth, 1999). As concluded by Daddagh and Denisar (2005), advanced technologies allow more learner focused aspects to be integrated into such programs. This is due to the fact that online learning is complex and, therefore, more suitable for interconnectivity and nonlinear possibilities. In this way, the linear process followed by models such as ADDIE is substituted by programmes that contain hyperlinks and multimedia to satisfy the range of learners' needs (Wilson, 2004).

Gustafson and Branch (1997) postulated that instructional design has to be revised, because of the constant development of technological options. Since the online environment enables, and empowers, students to construct their knowledge and skills through interactions with content, media, peers, and instructors, instructional design models must closely consider the broader outcomes that are inherent in this changing environment (Gustafson & Branch, 1997). Lee (2005) made a keynote speech to the Support Learning and Technology in Education (SLATE) Conference which emphasised the need to re-focus e-learning so that "The key relationship in the e-learning environment is amongst the educational theorist, learning technologist, and the practitioner" (Lee, 2005) Institutions which make use of online learning environments, therefore, need to consider other models and practices of instructional design in order to accommodate these changes.

Van de Wende (2002) estimated that around the world students in higher education would increase from the 42 million in 1990, to 97 million in 2010, and

159 million in 2025, with the growth particularly evident in transition countries such as those found in Middle East. This is one reason why, as Wilson argues, “it is wise for instructional designers and distance providers to step back, review the broad trends in the distance learning world, and reflect on what those trends mean for future distance learning practice” (Wilson, 2005).
One of the opportunities opened up to higher education institutions by global Internet availability has been the provision of online classrooms accessible by to students anywhere in the world, and this goes along with the increasing demand for a more highly educated and flexible work force (van de Wende, 2002). However, Marginson (2004) reports on attempts made by a number of organizations in the late 1990s to form a global virtual university, which did not take shape. These global learning attempts were constructed with the concept of designing what Ritzer (2002) refers to as a ‘McDonaldised’ style of education, where the aim is to develop “an efficient, controlled, predictable environment or product, which in other parts of the world have resulted in significant profits” (Ritzer, 2002).
This plan reflects the fact that investors in other areas of business looked to online learning as a way of generating income, being attracted by the possibility of developing an instructional model for the global educational environment that could potentially reach thousands of global learners and yield increasing profits (Marginson, 2004). As Richards (2004) states, this idea goes directly against that of technology enabling students to build their own educational experience, but this did not deter some institutions.

In the late 1990s, a consortium of three established universities, Gardean University, New York University Online and the UKe-University, attempted to become global providers of online degrees, with major investments from multiple sources. One was by the UK e-University, which, by targeting 5,600 students in the first year, hoped to recover government funding of 62 million GBP within four years (Marginson, 2004). The Third Report of Session 2004-05 of the British House of Commons Education and Skills committee stated that

this attempt failed with only 900 students enrolling in four years instead of the targeted number. Another attempt was made by Cardean University, with an initial investment of $100 million USD (Marginson, 2004) but, although Cardean University implemented its first online course in 2000, it did not attract the anticipated number of students either. This was not the last that was heard of Cardean University's attempt however, as, according to the Web site in 2007, the Cardean University classes starting in February of that year would be taught by Ellis College of the New York Institute of Technology, as the two joined efforts for online learning, this time with a lower rate of enrolment.
A third attempt to gain an estimated 32 million global students with a 25 million USD investment was Universitas 21, which was comprised of universities from a group of English-speaking nations, and Singapore, China, Germany and Sweden (Marginson, 2004). As in other attempts, the 32 million global students were not attracted.

The goal of many courses was to convert successful face-to-face courses to online delivery with the first courses often being business orientated, for example courses leading to Masters of Business Administration. As these online courses were direct translations of existing courses, the necessary elements of interactivity were often limited or, in many cases, totally lacking. This led to the courses being online versions of books rather than innovative forward-thinking multimedia developments. They were also predominantly created by UK, US or Australian Universities, so had a bias towards Western models of teaching and thinking about subject matter.

When considering the learning process, culture is a great influence and can hamper the acceptance of online educational environments on the part of students. A case in point is that of Arab learners, who tend to hold teachers in high regard and, as such, they are more reliant on teacher instruction or approval (McLoughlin & Oliver, 2000; Shafqat, 2005). Thus, as students' needs regarding online learning differ worldwide, McLoughlin and Oliver (2000) see that culture has to be a key factor in instructional design, since it has an impact on the design, communications, and structure of information.

As learning is a cultural activity, and designers and developers of Websites have their different cultural viewpoints and identities, the design of a Website is bound to be “infused with cultural meaning and with cultural nuances and identity issues” (McLoughlin & Oliver, 2000, p. 59). The instructional design models encourage development of a wider viewpoint as they place emphasis on the end-user; that is on the personal rather than the global. This may often conflict with the needs of the provider’s or commissioner’s requirements.

2.6.2.2. ADDIE (Analyse, design, develop, implement, evaluate)

As mentioned above, ADDIE is an instructional design model, which came into use by the United States Armed Forces in the mid 1970's (Molenda, 2007). The model was meant to enhance the existing military training programmes by providing greater structure to the learning process. Since then, the ADDIE model has taken on many variations, but the core five phases of the design remain throughout the many interpretations (Allen, 2006).

The ADDIE process begins with the analysis phase, where the needs of the learner are outlined and the various options to address those needs are created, along with learner objectives. The design phase acts as a blueprint for the learner activities that will take place. Objectives are well-defined, while learning methods and assessments are explored and chosen. Then, in the development phase, the finer details for the methods of learning are decided on. This involves the analysis of various 'types of learning' as referred to by Leshin et al. (1992), and choosing which type of learning is suitable for the various individuals in the program.

The types of learning in the ADDIE instructional design model are:

- Memorization of information which involves rote learning;
- Understanding information by using prior knowledge to form a relationship to make meaning of new information;
- Applying skills which requires the learner to transfer existing skills to simple and then more complex tasks; and
- Higher-level thinking, which involves all the previously mentioned types of learning and is taught by working through and understanding simple to complex case-based scenarios (Glaser, 1990; Leshin et al., 1992).

The development phase focuses on instructional strategies and tactics to follow, and the sequencing of instructional content. This phase identifies what type of cognitive learning is applicable to the task at hand and results in choosing a media form to convey the information, such as review and discussion of a document, video, computer-based programme or role-playing techniques. The implementation phase follows and outlines exactly how the design will be conducted. It takes into account people, resources, time and impact the learning activities will have in other areas of the participant's life. Finally, the evaluation phase outlines the data collection that is required to track the instructional design and its successes and areas of improvement (Leshin et al., 1992; Schlegel, 1995). ADDIE works best when all stages of the process are given equal emphasis and, thus, flow seamlessly into each sequential phase (McGriff, 2000). However, evaluation of the complete design model is crucial to ensure the goals and objectives are met.

Formative and summative evaluations are recommended at the end of the developed model to track the finer details which will produce a more comprehensive evaluation report. The report can then be used to modify and enhance the instructional design model (McGriff, 2000). The five steps in the process become a circular method whereby after formative and summative evaluations, the developer of the model constantly makes adjustments to the design. This is done by analysing the learning requirements and adjusting the learning objectives and processes as necessary (Crawford, 2004; Leshin et al., 1992).

2.6.2.3. The ASSURE Model

There are many studies of the use of Computer Assisted Instruction (CAI) in a wide range of fields from preschool to graduate school and beyond. A general model known as ASSURE (Analyse learners, State objectives, Select media and materials, Utilize media/materials, Require participation, Evaluate and revise) has been used widely to guide educators with the implementation of technology in the classroom (Heinich et al., 1989; Russell, 1994).

The first step of the ASSURE model involves the *analysis of learners* as identifying the audience can theoretically help the educator select the most appropriate teaching medium. This step is consistent with the Teaching for Understanding theory where getting to know the students is emphasised in order to adapt learning situations to the learner (Cohen et al., 1993). According to Heinich et al. (1989), the target population can be analysed in terms of general characteristics such as age, level of education and socioeconomic factors; and by specific entry competencies such as prerequisite knowledge, and attitudes about the topic.

The second step of the ASSURE model is to *state the objectives*. The proponents of the ASSURE model recommend that specific instructional objectives are also identified. Traditionally, instructional objectives are "stated in terms of what the learner (audience) will be able to do as a result of instruction (behaviour). The conditions under which the student or trainer is going to perform and the degree of acceptable performance should be included(Heinich et al, 1989). The ASSURE model theory adds that the objectives should be related to an authentic, "real-world" situation or skill that the student might demonstrate. An example of such an instructional objective could be: 'While examining the definition of a peer, the student will be able to name the things he/she has learnt'.

Conversely, Hienich et al (1989) suggest that instructional objectives are not meant to restrict what is learned, but to "provide a minimum level of expected achievement" and that incidental learning can and should occur as the student works towards the instructional objectives (p. 46). Several constructivist authors suggest that instructional objectives be used to guide design while encouraging the students to develop and pursue personal learning goals (Dick, 1995; Johassen, 1994; Wilson & Cole, 1995). Learning objectives are also recommended within the Teaching for Understanding framework. The second tenet of the Teaching for Understanding theory involves "understanding goals." According to Perkins and Blythe (1994, p. 7), "there is never a 'right list of understanding goals'. The point is to lend focus to the ensuing instruction". Instead of using behaviourist terms, the same authors recommend using 'understanding' terms, such as "the student will understand that ..." (ibid).

The next step in the ASSURE model is to *select media and materials* to help build a bridge between the current knowledge, skills and attitudes of the audience, and the learning objectives. There are several media selection models that have been proposed but they may be of limited value since each case is context specific. Heinich et al (1989) suggest that only the educator can "decide which learner characteristics are most critical, and what elements of [his or her] own objectives are most important in [his or her] own situation" (p. 46).

The next step in the ASSURE model is to *utilize the material*. Heinich et al (1989) recommend that the instructor preview the material in order to gear the lesson to the material. Constructivists also emphasize the cultivation of a learning environment that is conducive to learning as opposed to simply selecting a teaching strategy (Wilson & Cole, 1995): in other words, the tool is adapted to the context. Utilization issues also include classroom preparation (making sure the computes are all working properly, the software is loaded, and so on), and presentation of the module to the students (for example share learning objectives, discuss the relevance of the medium, model or indicate the use of particular software features) (Heinich et al. 1989). Consistent with the Teaching for Understanding framework, the teacher tries to facilitate student learning in the design of the learning situation.

The final step of the ASSURE model is to *evaluate and revise*. Traditional student evaluation involves the paper-and-pencil test of the ‘product’ of instruction (Heinich et al. 1989, Wilson & Colre, 1995). In line with constructivists, the ASSURE model emphasizes the importance of evaluating the learning process and not simply the end product.

Three areas of evaluation are discussed by Heinich et al. (1989): evaluation of learner achievement, evaluation of media and methods and evaluation of the instructional process. This methodology is more compatible with an educational approach as most methods applied to instructional design are taken from product design and computer programme design, where the evaluation processes emphasize functionality; that is, the focus is on whether it works, not on if someone can learn from it.

The reason for choosing these models is discussed in detail in Chapter 7 of this study - Development of the design model.

2.6.2.4. Laurillard’s Conversational model

Laurillard’s work (1993, 2002) on integrating technology into educational environments offers examples of how learning and teaching methods, media and tools can contribute to a didactic or dialogic relationship between lecturers and students. For example, she illustrates how different e-learning tools relate to the different media forms which represent the ‘conversations’ instructors and learners might have. Laurillard’s Conversational Framework, developed in her later work (2002), provides a detailed explanation of discursive, adaptive, interactive and reflective stages. Simard adapted these and a summary of this work (2003), in terms of the type of activity and what the teacher must do at each stage, is charted in Table 2-5 below:

Table 2-4 Facilitation Strategies adapted from Laurillard's Conversational Framework

Activity	Teacher's responsibility
Discursive	• Provide an environment where discussion of the topic goal will generate feedback from and to group members • Provide objectives and proposed outcomes
Adaptive	• Facilitate final goals and objectives • Present a scenario and frame the topic according to members' goals and task focus. • Formulate a challenge question that arises from learners' combined goals.
Interactive	• Provide a task, based on the challenge question, where learners are required to act, and generate and receive feedback regarding their actions. • Provide meaningful feedback on learners' actions that relate to the nature of the task goal. • Guide learners to additional sources relevant to the task.
Reflective	• Support the process by which learners link the feedback on their actions to the topic goals.

Source: Simard (2003).

Simard's model explains that, during the discursive stage, teachers should begin to build connections and get to know their students, and vice versa. In addition, teachers should provide an overview of the initiative. Characteristics of the discursive phase include: teacher conceptions; agreement upon learning goals; discussion of the topic goal within which members can generate and receive feedback on descriptions appropriate to a specific topic.

In the adoptive stage, facilitators present content or a scenario, and seek feedback from members. Throughout the adaptive stage, the teacher has the responsibility to use the relationship between his or her own ideas to establish the focus of the continuing dialogue.

As discourse progress to the interactive phase, the teacher must provide an environment within which the learner can engage in, generate, and receive feedback on actions that pertain to the task goal. In addition, the teacher must offer meaningful feedback to learners with the focus on the task objective.

Within the reflective portion of the discourse, the teacher must support the process in which learners link feedback about their action to the topic goal for every level of description within the topic structure. The learner then reflects on the task goal and the feedback received, and relates this to his or her original concept of the topic goal. Laurillard (2002) emphasizes that it is imperative to remain focused on learner conceptions and epistemologies within the iterative teacher and learner dialogue. In this way, the teacher works as a coach promoting learner learning and reflection (McDermott, 1999).

Table 2-5 Laurillard's taxonomy of educational media.

Learning experience	Methods/technologies	Media forms
Attending, apprehending	Print, TV, video, DVD	Narrative
Investigating, exploring	Library, CD, DVD, Web resources	Interactive
Discussing, debating	Seminar, online conference	Communicative
Experimenting, practicing	Laboratory, field trip, simulation	Adaptive
Articulating, expressing	Essay, product, animation, model	Productive

Source: (Laurillard, 2002, p. 90).

Using this model produces a course design profile by mapping the tools used and showing how they link to resulting learning outcomes, based on the different kinds and directions of dialogue supported.

2.6.2.5. Evaluation of the instructional models

In the previous sections, Laurillard's Conversational framework (2002), the ASSURE (Analyse learners, State objectives, Select media, and materials, Utilize media/materials, Require participation, Evaluate and revise) model, and ADDIE (analyse, design, develop, implement, evaluate) have been discussed in detail. The discussion of these models shows that not all of them are perfect on their own for meeting the requirements of the instructional designs in the photographic learning environment due to certain limitations. However, Table 2-7 below presents a comparative analysis of the models in order to better evaluate their individual strengths and weaknesses, based on research (Albayat, 2007C, Stables,2004, Culatta & Wilkinson, 2009, Laurillard's, 2002)

Table 2-6 Analysis of the Instructional models.

Model	**Strengths**	**Weaknesses**
ADDIE	1-The ADDIE model can be used by educators both in academia and in the workplace. 2-The effectiveness of the ADDIE model is partly determined by the amount of personal experiential learning implemented in the design process, because sense making is more or less limited by our experiences	1-Creativity, communication and evaluation of alternative designs are not supported. 2-Cannot accommodate faults or good ideas due to already laid down processes. 3-Instruction is not enhanced by post-tests.
ASSURE	1-The step-by-step process of the ASSURE model is user-friendly. 2-Through media use, the contents of lessons are learnt effectively. 3-Can be used by all presenters 4-A procedural guide for planning and delivering instruction that integrates technology and media into the teaching process	1-For some designers it seems too rigid to involve innovation. 2-Does not allow support services 3-Does not provide guidance on use of media and types of learning experience

Laurillard's Conversational Framework	1-Learning is a theoretical part of Laurillard's model. 2-A guide for selecting media technologies to enhance the quality of teaching and learning. 3- Achieves quality in teaching and learning in higher education 4- Disaggregates learning into different kinds of experience. 5- Adjusts descriptions to fit experience. 6- These five different kinds of learning experiences are best supported by different media types.	1- Limited in selecting media technology types. 2- Does not address advances in multimedia, or cultural context.

2.6.2.6. Conclusions

The current design models identified through the literature review have their individual advantages and disadvantages. However, no one model can be specifically applied to support photographic education as they fail to consider advances in multimedia, the cultural context, or the human or physical resources used in teaching photography.

2.7. Chapter Summary

This chapter has reviewed the classic and contemporary research on the use of information technology in teaching and learning. The special interest of this study was how the use of advanced multimedia can enhance the learning process among photography students.

This positive aspect of visual aids has been realized very effectively in information technology through the use of online learning, e-learning and hypermedia. Online learning and e-learning allow users to control the sequence and the pacing of the materials, thus facilitating greater individualization in learning by allowing students to proceed at their own pace in a tailored learning environment.

The author has learned much from the literature that can be used to support face-to-face learning, and how Web-based learning can support or supplement this very common type of instruction, and this underscores both the challenges and the advantages. The range of e-learning opportunities within Further Education and Higher Education is vast, and if the technology is used appropriately within a particular course, it can have a great impact on the learners.

However, it is important to remember that the technology can improve the learning, but it depends on how these technologies are used by educators and learners. Technology should only be used where it adds value to the students' learning; otherwise it cannot be useful and can be counter-productive. As photographic education has developed, there has been a sharp increase in the number of students studying this subject, as illustrated in section 2.2. In Bahrain, traditionally only art or journalism courses required students to have a good working knowledge of photography; however, students from a wide range of disciplines are now studying photography as an academic subject.

With the introduction of the Internet, photographic teaching methods now include web-based tools for learning, such as e-books which enable students to find out about photography from an online source. However, early developments in multimedia tools for learning photography were problematic because the technology for downloading and retrieving information was still very slow. As Internet technology becomes better, and broadband technology allows faster Internet connections, with faster downloading and retrieving of information, further developments have been made possible in advanced multimedia tools for learning different aspects of photography.

Moreover, it is argued that this technology can help resolve the problems of the disproportionate growth of students and less than proportionate increase in the number of staff, as well as a lack of resources. However, the use of this technology alone may not improve photography teaching and learning. It is proposed that learning and teaching can be best optimized by a blended approach including theory and practice, which also entails a range of different forms of both traditional and electronic media. Based on this literature review, and after critically reviewing some existing instructional design models, the researcher felt that there is a need for an advanced multimedia design model specifically to support the teaching of photography at undergraduate level.

Sections 2.3 and 2.4 of this literature review indicate that the application of technology such as ICT, e-learning and interactive CD-ROMS can facilitate teaching and learning in photography. Such rich media technology can help the teachers to effectively deliver educational programs that provide the students with better access to information and resources, and enhance learning.

To conclude, and following on from the literature covered and conclusions drawn in section 2.4.4, it is proposed that the use of advanced multimedia can result in greater engagement, more enjoyment and more effective learning, as depicted in Figure 2.10 below. This study considers such a conclusion as a set of hypotheses to be experimentally tested using the DOF simulation software as indicated previously in chapter one.

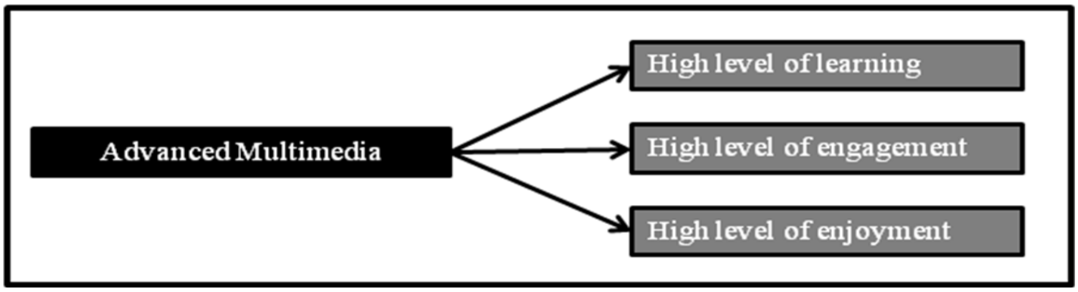


Figure 2.10 Use of Advanced Multimedia

Source: Albayat (2010).

The conclusions drawn from the literature review, as summarized in Figure 2.10, consider the function of advanced multimedia as a medium for teaching and learning which, with a high level of student enjoyment and of student engagement, will lead to a high level of student learning. These statements are used as the basis of the hypotheses for the present research and will be tested in a course of study in photography at Bahraini universities. The initial hypotheses for the study are formulated as follows:

1. Advanced multimedia-based learning applications give a higher level of learning when compared to traditional approaches. (See page 38 for definition of level of learning)

2 Advanced multimedia-based learning applications give a higher level of engagement when compared to traditional approaches. (See page 39 for definition of level of engagement)

3 Advanced multimedia-based learning applications give a higher level of enjoyment when compared to traditional approaches. (See page 40 for definition of level of enjoyment)

In the next chapter, the researcher conducts and discusses a detailed primary study to further analyse the need for an advanced multimedia design model for teaching photography. For this, the researcher has proposed improvements on the design models and amended them to be more suitable for the students undergoing photographic education.

Chapter Three

Research Methodology

3. Research Methodology

3.1. Introduction

This chapter will provide an overview of the overall process and different stages of the research, the principles upon which the study is based and the different research techniques that have been chosen to gather sufficient and relevant information in order to fulfill the objectives of this study.

In this chapter the researcher introduced the mixed methods approach used to investigate the teaching of photography to a group of undergraduate students in Bahrain.

The methodology has been carefully developed keeping in mind the purpose of the exercise and the research questions to be answered. The identified research objectives have been the guiding factor in determining the appropriate research methodology in this study.

3.2. Determining the Research Objectives

Determining the purpose of any research task is of utmost importance as, without preset objectives, decision-making is uncoordinated. When undertaking a project, the purpose and boundaries must be defined in order to avoid project creep

Project creep can be in the form of functionality, look and feel, feature, objective and scope. Project creep is usually a project management failure where the initial objective of a particular project is overshadowed by the immediate short term objectives attainable as the project gradually develops. These new objectives can divert resources allocated for the overall project, resulting in low quality, missed deadlines and project objectives.

The methodology follows purpose and, without a purpose, there can be no logical methodology. There are also different stages involved in the setting of an objective, and these form specific research goals.

The overall objective of a project must be well-defined and clearly communicated. Each objective can be broken down to determine a series of tasks that must be accomplished. These tasks will result in the acquisition of quantitative or qualitative data, or a combination of both, which can be analyzed. Ideally the completion of a task and subsequent analysis must contribute to the attainment of the overall objective.

As a guide, the entire research strategy is divided into five stages, as described in Table 3-1 below. Each stage has its own objective, which are summarized below for the benefit of the reader.

Table 3-1 Determining Objectives of the study.

Chapter Number	**Stage/Activity**	**Research Objectives**
Chapter 4	**1A**.Student Survey	To determine the difficulties and problems faced by photography students.
Chapter 4	**1B**.Interview	To determine the difficulties and problems faced by photography lecturers.
Chapter 5	**2**.Critical Review	To critically review the existing e-learning and interactive multimedia materials in photography.
Chapter 6	**3**.Student Feedback	To test the existing e-learning materials among the photography students
Chapter 7	**4A**.Design model	To design an innovative design model using interactive multimedia to support learning and teaching of photography.
Chapter 8	**4B**.Prototype	To develop a prototype suitable for multimedia learning and teaching of photography.
Chapter 9	**5**.Evaluation	To determine the effectiveness of the prototype e-learning application for photography

3.3. Definition of Methodology

Methodology is defined as

(1) "a body of methods, rules, and postulates employed by a discipline",

(2) "a particular procedure or set of procedures", or

(3) "the analysis of the principles or procedures of inquiry in a particular field" (Nance, 1994, p. 2).

Research methodology refers to more than a simple set of research methods; rather it refers to the overall rationale and the philosophical assumptions that underline a particular study.

3.4. Research Methodology

The researcher developed a multi-stages research methodology to achieve the objectives of this study.

The researcher has attempted to generate a diagrammatic view of the proposed research methodology adopted in this study, and this is shown below. The stages are organized in a manner to facilitate a step-by-step approach, not only for the researcher but also for the reader.

The research methodology to be used in this study is presented in Figure 3.1 and Figure 3.2 below. The diagrams present the methodology sequence that has been developed to carry out this study in a systematic and organized manner, in its different stages

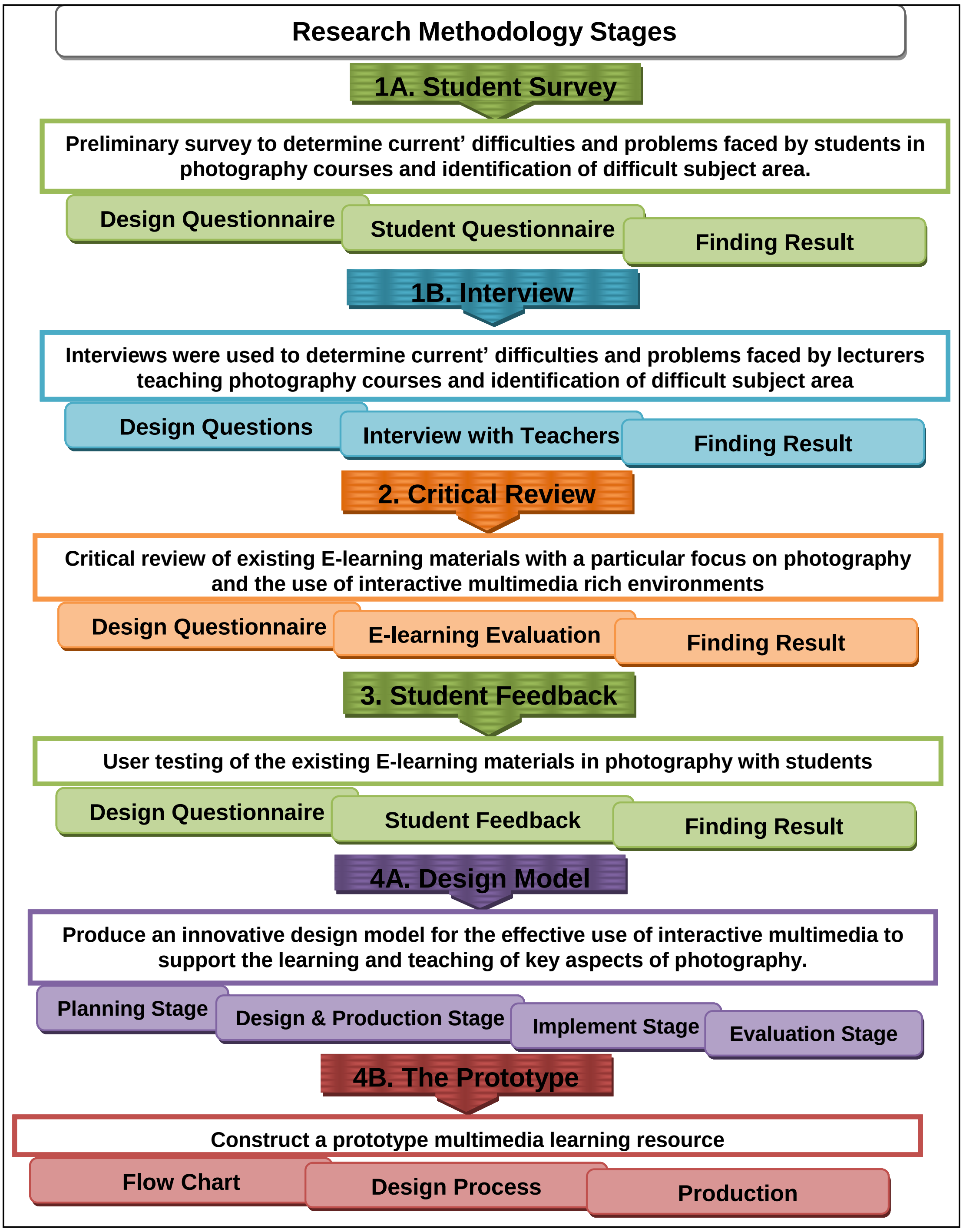


Figure 3.1 **Research Methodology (Partial Stages 1 to 4).**

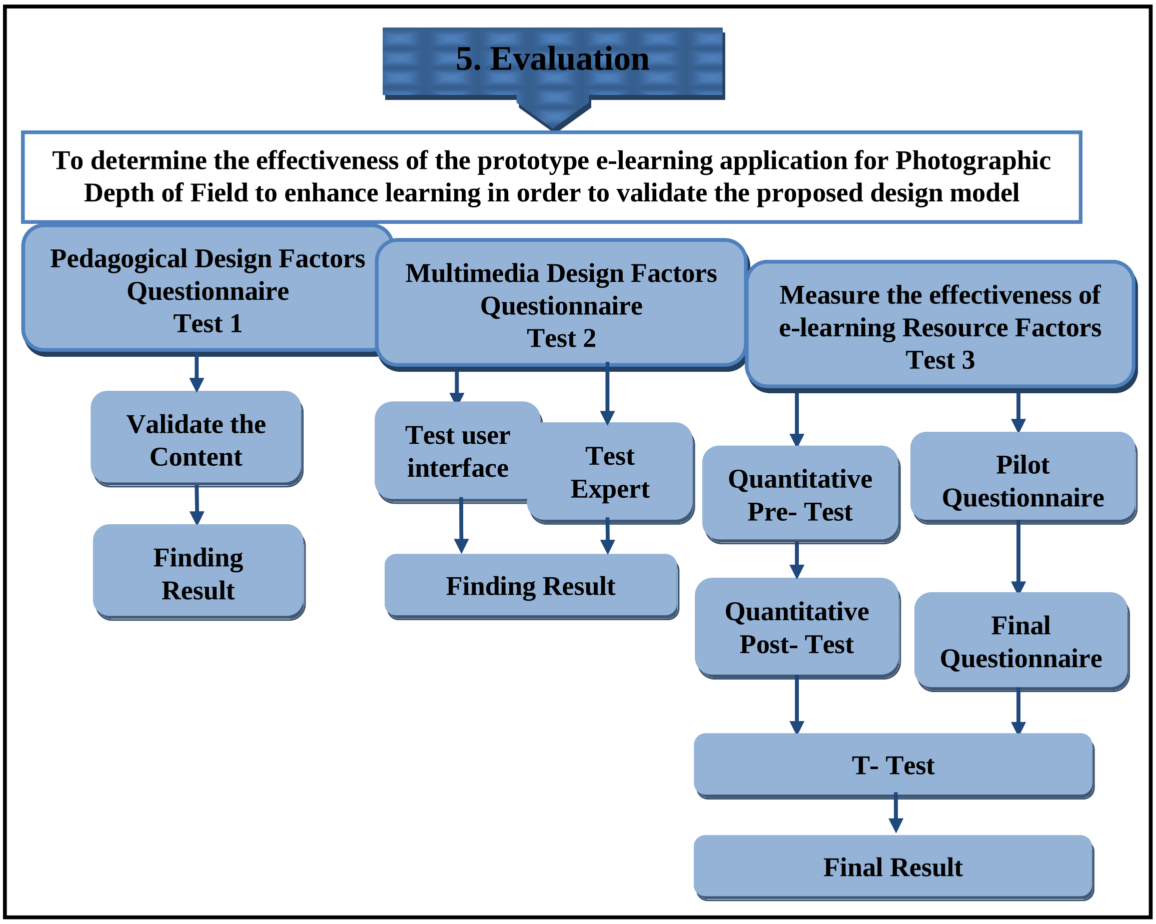


Figure 3.2 **Research Methodology (Partial Stage 5).**

An overview of all the stages is provided in this section of the study. All these procedures have been carried out and the stated methodologies adapted as the basis for addressing the research objectives and questions.

Therefore, the methodology detailed above acts as the basis for this study and provides the framework needed for data collection and data analysis.

3.5. Research Method

The researcher adopted a mixed method approach in this study. Both qualitative and quantitative data were collected from students and teachers of photography and analyzed extensively in this study.

3.5.1. Qualitative data

The qualitative data of this study includes non-numerical data obtained from interviews conducted with teachers of photography, and its interpretation.

In this study, the researcher used qualitative data at stage 1b to conduct interviews with photography teachers. In addition, the researcher resorted to qualitative method at stage 3 in order to conduct observations, as highlighted in Table 3-2 below.

3.5.2. Quantitative data

Quantitative data communicate meaning and interpret information by means of numerical analysis. This is accomplished by statistical methods that help to generalize findings. Quantitative researchers take an objective stance regarding participants and their settings, and use sample research to apply their findings to a larger population (Neuman, 2000; Dillman, 2000).

The quantitative data of this study emerges from the 5-point Likert Scale questionnaire used in this study, and its analyses.

3.5.3. Mixed method

Using more than one research method for data collection to achieve the research aims and objectives is known as a Mixed Method. The mixed method of data collection used in this study employs both qualitative and quantitative methods as they are regarded as highly complementing rather than mutually exclusive to one another (Creswell, 2003). Moreover, the mixed method of data collection allows the researcher to do “triangulation”, which was first developed by Campbell and Fiske (1959). However their work did not use the term “triangulation”. This seems to have been applied to their approach later by Webb et. al., (1966).

3.5.4. Triangulation

Leedy (1997) defines triangulation as the way in which different methods of data collection, varying data sources, different analyses or theories can be used to check the accuracy and validity of the findings. Creswell, (1994) puts forward the argument that the use of varying methods of data collection and analysis should lead to greater validity and reliability than a single method of data collection and analysis. Therefore, both qualitative and quantitative methods were used for the purpose of triangulation. The researcher is of the opinion that by deploying the qualitative and quantitative method data collection and analysis, the credibility of findings and interpretation of the findings can be enhanced as the evidence and theme emerges from different sources.

3.6. Research Design and Approach

Various methodologies are implemented in research, each serving a different purpose and providing a different outcome. Researchers need to understand what information they wish to obtain prior to the collection of data. Babbie (1990) indicated that research methods include analysis of existing data, case study, controlled experiment, interview, questionnaire and participant observation.

In the present study, different types of data collection methods were used at the different stages of the research. The details of the data collection methods and the reason for choosing these methods are summarized in Table 3-2 below.

Table 3-2 Chosen Method for each stages.

Stage/Activity	Data collection	Method	Aim
1A.Student Survey	Questionnaire	Quantitative	To affirm the research problem using empirical data.
1B.Teacher Interview	Interview	Qualitative	To establish if there is a common problem among photography teachers.
2.Critical Review	A critical review form	Quantitative	To measure the differences among the medias used.
3.Student Feedback	Questionnaire Observation	Quantitative Qualitative	To evaluate the problems faced by students empirically. To discover if there is a common behavior.
4A.Design model	A review of existing design model classification	Qualitative	To identify different types of design models. See the above table
4B.Prototype			To construct a prototype multimedia learning resources.
5.Evaluation	Questionnaire Pre and Post test	Quantitative Quantitative	To use facts and figures to measure effectiveness of the proposed advanced multimedia. To use statistics as a measure of effectiveness.

It can be observed from the above table that, in the combination of qualitative and quantitative methods used, the qualitative method comprises Interviews and observation, while the quantitative method comprises questionnaire survey and pre- and post- tests.

3.7. Questionnaire Survey

The researcher planned to conduct some questionnaire surveys at varying stages of the study. Those questionnaire surveys carried out with the students were conducted through a questionnaire distributed to the students in the classroom at the beginning of the class and the students responded the questionnaire at the end of the class.

According to Milne (1999) from the Centre for CBL in Land Use and Environmental Sciences\ Aberdeen University, there are certain advantages and disadvantages of conducting such a questionnaire, as discussed below.

3.7.1. Advantages

- The responses are gathered in a standardized way, meaning that questionnaires are more objective, certainly more so than interviews.
- Generally speaking, it is relatively quick to collect information using a questionnaire. However, in some situations they can take a long time not only to design but also to apply and analyze
- Potentially information can be collected from a large portion of a group, although this potential is not often realized, as returns from questionnaires are usually low. However, return rates can be dramatically improved if the questionnaire is delivered and responded to in class time (Institute for Computer Based Learning, 1998, p. 52).

3.7.2. Disadvantages

- As many evaluation methods occur after the event, participants may forget important issues.
- Questionnaires are standardized so it is not possible to explain any points in the questions that participants might misinterpret. This could be partially solved by piloting the questions on a small group of students or at least friends and colleagues, which is advisable in any case.
- Open-ended questions can generate large amounts of data that take a long time to process and analyze. One way of limiting this would be to limit the space available to students on the questionnaire itself so that their responses are concise, or to sample the students and survey only a portion of them.

- Respondents may answer superficially especially if the questionnaire takes a long time to complete. The common mistake of asking too many questions should be avoided.
- Students may not be willing to answer the questions, as they might not wish to reveal the information; or they might think that they will not benefit from responding, perhaps even being penalized by giving their real opinion. Students should be told why the information is being collected and how the results will be beneficial. They should be asked to reply honestly and told that if their response is negative this is just as useful as a more positive opinion. If possible the questionnaire should be anonymous (Institute for Computer Based Learning, 1998, p. 52).

3.8. Details of participants, number and selection method

In this section, the researcher summarizes the details of the participants in the different stages of the research methodology. The relevant details of the participants, the number of participants and the selection method at the different stages of the tests are shown in Table 3-3 below.

Table 3-3 Details of participants, number and selection method.

Stage/ Activity	**Participants/Items**	**Number (N)**	**Selection method**
1A.Student Survey	1. De Montfort University UK 2. University of Bahrain	38 38	A random selection of photography students.
1B.Interview	Photography teacher in UK Photography teachers in Bahrain	3 4	Teachers from the photography department.
2.Critical Review	The researcher critically reviewed 9 different e-learning resources reviewed (websites and CD ROMs).	1	Commonly used, high level of interactivity, varieties of media, public, rich in learning activities and continuous feedback.
3.Student Feedback	Bahraini students	48	2 classes comprising of 2 groups available at the time of study
4A.Design model	Planning stage Design and Production stage Implement stage Evaluate stage	N/A	Literature review
4B.Prototype	Depth of field	N/A	Identified from preliminary survey.
5.Evaluation -Learning Engagement Enjoyment	Test 1 - Pedagogical design factors 2 Bahraini photography experts 2 UK photography experts 1 Omani expert I Kuwaiti expert 1 Canadian expert	7	Highly educated photography lecturers from College and Universities
	Test 2 - Multimedia design factors Multimedia Designers Photography Students	28 3 25	2nd. year students
	Test 3 - The effectiveness of E-learning resource	100	1st. year students

3.9. Pilot testing

Pilot testing was conducted to test the reliability of the questions used in the questionnaire survey in this study. Questionnaires were used in:

- Student Feedback (Chapter 6) and
- Student Final Evaluation: Engagement, Enjoyment and Effectiveness (Chapter 9).

The researcher compiled responses from twelve students to assess the reliability of the student feedback questionnaire. The researcher conducted a preliminary testing of the questionnaire among twenty-five students selected at random. The researcher was able to collect all twenty-five responses for the purpose of this pilot study.

3.10. Pilot Test Outcome

At this stage, the researcher conducted a Reliability test to ascertain the internal consistency of each questionnaire whenever a questionnaire was used. The Reliability confidence (Cronbach's Alpha) for the questions was calculated for each of the set of questionnaires used in this study. It was also done for student feedback, the three groups of Engagement, Enjoyment and Effectiveness, and a final one for all three groups combined. The results are in the range of .751 to .959, as shown in Table 3-4 below. These are to be regarded as a satisfactory level as they are all above 0.70 as the acceptable value.

Table 3-4 Reliability Statistics for Pilot study.

No.	Factor	Cronbach's Alpha	Number of Items	Result
1.	Student Feedback	.751	32	> 0.70
2.	Engagement	.885	8	> 0.70
3.	Enjoyment	.881	10	> 0.70
4.	Effectiveness	.906	10	> 0.70
5.	Overall 2, 3 & 4	.959	28	> 0.70

3.11. Chapter Summary

This chapter outlined the entire research methodology used in this study. The actual detailed methodology will be discussed at the relevant stages of the research activities in the following chapters.

In the next chapter, the researcher introduces the preliminary study conducted in order to identify and ascertain the level of problems faced by the photography students and teachers. In order to identify the problems, the researcher conducted a preliminary survey among the students, and interviews with the photography teachers. Details of these are presented in Chapter 4.

Chapter Four

Primary Research

4. Primary Research

4.1. Introduction

This chapter introduces the primary research conducted in this study to identify the fundamental issues and problems faced by both students and teachers of photography.

This primary research is necessitated by the fact the researcher needs to identify the current problems faced by students and teachers in order to confirm the problem statement presented in the introduction to this study. The primary research was conducted among students and teachers of photography both in Bahrain and the United Kingdom, with the broader objective of reflecting / tapping into the experience of photography teaching and learning in both countries.

Bahrain, a developed country where the researcher lives, has many areas of similarity with the UK context, where the researcher studies. Furthermore, the surveyed issues relating to higher education are of a global nature. As the similarity between the Bahraini and the UK contexts was realized, the primary research was conducted to discover problems shared by these contexts. It was conducted with the intention of improving the working situation in Bahrain by benefiting and learning from the UK experience. Therefore, the researcher conducted the survey and interviews with both UK and Bahrain respondents.

After collecting the initial data from the primary research, the researcher proceeded to concentrate on the respondents from Bahrain only, as shown in Table 4-1 below. This was due to the practicalities and ease of doing the final testing and development in Bahrain where the final stage of the study was conducted as the author had had to return home. The field work thus focused, at this stage, on Bahrain since the need to provide solutions was urgent.

Table 4-1 Study Respondents.

Stage/Activity	**Respondents**
1a.Student Survey	Bahrain and United Kingdom
1b.Teacher Interview	Bahrain and United Kingdom
2.Critical Review	Bahrain only.
3.Student Feedback	Bahrain only.
4a.Design model	Bahrain only.
4b.Prototype	Bahrain only.
5.Evaluation	Bahrain only.

This chapter discusses the primary research in the following two sections:

- Student Questionnaire Survey
- Teachers' interview

4.2. Advanced Multimedia in Teaching Photography

Advanced Multimedia is defined as a combination of rich interactive media, which provides high levels of interactivity and vividness. It uses advanced media hardware and software tools. (Albayat, 2007)

Advanced Multimedia has been discussed in detail in Chapter 2 of this study.

4.3. Student Questionnaire Survey

4.3.1. Background to the Primary Research

The literature review revealed that the current problems in teaching photography are due to the growing number of students enrolled on photography courses and, consequently, the size of student groups. Another issue identified is a less than proportionate increase in the number of staff, and resources such as digital cameras used as teaching aids.

In light of the above, a questionnaire was used to confirm these difficulties with photography students in universities in Bahrain and the United Kingdom and to recommend suitable actions for modification or correction. The first section of the questionnaire aimed to understand the demographic background of the students, covering gender, age, nationality, subject studied and experience in photography.

4.3.2. General questions

The second section focused on obtaining information regarding the various difficulties and problems faced by the students when studying photography generally. In addition, the researcher wanted to obtain their views on, and usage of, different media resources particularly multimedia. This was done in line with the proposition of the study that multimedia technology can be used to address the problems identified with photography teaching.

The third section of the questionnaire covered general questions regarding the difficulties and problems faced by the students when studying photography, as well as related subject matters such as student numbers in class, access to resources, camera availability, material costs and the availability of laboratories.

4.3.3. Choice of Method

Birley and Moreland (1998) described surveys as useful methods to gain an overview of a particular situation, which are often used by policy makers and by those who wish to inform policy makers. Bell (1999), on the other hand, stated that the aim of a survey is to obtain information which can be analyzed, and patterns extracted and comparisons made.

Gill and Johnson (1997) and Cooper and Schindler (1998) stated that there are two types of surveys available. The first is the descriptive survey, which deals with counting the number of respondents with certain opinions and attitudes towards, a specific object. The second type is the analytical survey, which aims to establish relationships and associations between the attributes and objects of the questionnaire. Here, the descriptive method was chosen as it suits the aim of this study, which is to collect the opinions of students regarding the difficulties encountered in the process of learning photography, through the design and application of a questionnaire.

The questionnaire survey was found to be the most appropriate method to collect the required feedback, opinion and experience from a large number of students, a factor which ruled out other methods as inappropriate. Any other possible method was also likely to take more time and resources to complete.

4.4. Aims of the student survey

The Student Survey was necessary to confirm current difficulties and problems faced by students in photography courses and identify difficult subject areas. The researcher’s aim was to obtain the details of problems faced by students for further in-depth investigation in the course of this study.

4.5. Methodology

In this study, a quantitative questionnaire was administered to the students of photography course, in universities in both United Kingdom and in Bahrain, to illustrate the difficulties and problems associated with learning photography.

The universities were chosen for their convenience in terms of accessibility to the targeted students. And the ease associated with administering the evaluation tools to them based on the fact that the author serves as a faculty staff member at University of Bahrain and a doctoral student at De Montfort University in UK. It was also believed that these institutions were representative of their respective countries.

In United Kingdom the questionnaire was administered in English language whereas in Bahrain it was administered in Arabic supported with main vocabulary in English. The questionnaire was initially developed in English, which was then forward-translated into Arabic. The translation was reviewed by the researcher and upon confirmation that the questionnaire was acceptable, the Arabic form of the questionnaire was put through back-translation into English to ensure that the original meaning and intention was not lost in the translation.

4.6. Validation

The questionnaire was initially sent to photography lecturers in both De Montfort University in UK and University of Bahrain who were asked to determine their opinion of the test items, to ensure the test questions reflected the content and teaching of the photography courses in their institutions.

4.7. Respondents

Upon validation with some minor modifications and alterations in the artistic and technical aspects, the questionnaire was distributed to 194 students, 38 being from De Montfort University in UK and 156 from University of Bahrain. The pilot respondents were discarded in the main study. As mentioned above, these two universities were selected for logistical reasons since the researcher works and has studied at both universities. This allowed more accessibility to the students and aided the research procedures. For representation purposes, the researcher randomly selected 38 responses out of the 156 Bahraini students to allow an equal comparison with the UK students. This number constitutes 24.36% of the total population of students enrolled in the photography courses at University of Bahrain in the second semester of the academic year 2004/2005.

Therefore, the questionnaire was administered to 76 students in total, 38 being from University of Bahrain and 38 from De Montfort University in UK. The survey was subjected to a comparative analysis of the different perceptions of the students, regarding the difficulties and the problems in learning technical and artistic aspects of photography.

The technical aspects of photography were chosen for this study because these are the most practical ones for the students. In addition, they were identified as the most difficult part of the subject by the student feedback which was collected in 2005. The student feedback is extensively discussed in detail in Table 4-5 to Table 4-11 and Figure 4.1 to Figure 4.5. They also affect all other aspects of photography as artistic, historical and general aspects are based on the technical ones. Furthermore, it is believed that the technical aspects of photography will provide sufficient knowledge and skill for the photography student to learn other aspects of photography.

4.8. Design of the questionnaire

There were seven questions altogether in this questionnaire. The details of each question are described below:

1. The first section of the questionnaire aimed to understand the demographic background of the students, covering name, gender, address, age, nationality, course, subject, email address and photography experience.

2. The second section focused on obtaining information regarding the photography background of the target student respondents. This comprises the month/years of experience in photography, effectively verifying the respondent's photographic experience.

3. The third section focused on measuring the difficulties faced by the photography students in nineteen different items using a scale of 1 to 5 (1 Very Easy to 5 Very Difficult). The questions in this section were specific questions regarding resources difficulties, such as number of students in a class, access to equipment (e.g. camera), availability of laboratories and materials. These were necessary questions to gauge the difficulties faced by the photography students. This was followed by an open-ended question to investigate the main difficulty in studying photography and the reason for it.

4. The questions in the fourth section aimed to understand the 'ease of grasping technical aspects of photography', based on a scale of 1 to 5 (1 Very Easy to 5 Very Difficult). The thirteen different question items in this section were included

to elicit responses about the difficulties faced by students in grasping the technical aspects of photography, such as shutter speed, depth of field, loading the film, exposure, daylight and focusing techniques. This was followed by an open-ended question on which was the most difficult technical aspect to learn and why.

5.The fifth section focused on understanding the ease of grasping artistic aspects of photography, based on a scale 1 to 5 (1 Very Easy to 5 Very Difficult). The aim of the nine question items in this section was to determine the level of difficulty faced by students in grasping the artistic aspects of photography, such as 'the rule of thirds', 'freeze and blur motion', 'desired exposure' and 'creative use of depth of field'. An open-ended question followed to find out which artistic aspect was most difficult to learn and why.

6. The purpose of sixth section was to find out how often students used certain media to learn photography, based on a scale of 1 to 5 (1 Never to 5 Always). The ten question items examined the usefulness of media to learning photography; for example books, photography magazines, CD-ROMs and the Internet. This was followed by an open-ended question to elicit which one of those was most useful, why, and how it helped the respondents.

7. The aim of the seventh section was to find out how useful advanced media resources were in learning photography, based on a scale from 1 to 5 (1 Very Useful to 5 Not Useful at all). The seven question items in this section elicited responses from the students regarding usefulness of media, such as interactive multimedia CD-ROMs, interactive websites and the virtual camera, in learning photography. This was followed by an open-ended question to find out which was the most useful resource for study in photography.

The questionnaire is attached as Appendix 4.1 Preliminary study Student Survey.

4.9. The scale used in the questionnaire survey

There are three different types of scale used in this section of the study. The Likert scales 1-5 were used to acquire quantitative data through the questionnaire survey to facilitate data analysis of this study. The first scale is used for questions 1 - 5. The scale is from 1 Very Easy to 5 Very Difficult, as shown in Table 4-2 below. In the scale of 1-5, the median is the scale of 3 and it is defined as Indifferent for the purpose of this study.

Table 4-2 Likert Scale used for questions 1-5.

Scale	Description
1	Very Easy
2	Easy
3	Neutral
4	Difficult
5	Very Difficult

Question 6 uses another scale, from 1 Always to 5 Never as shown in Table 4-3 below.

Table 4-3 Likert Scale used for question 6.

Scale	Description
1	Never
2	Seldom
3	Sometimes
4	Usually
5	Always

Question 7 uses a different scale, from 1 Very Useful to 5 Not Useful as shown in Table 4-4 below.

Table 4-4 Likert Scale used for question 7.

Scale	Description
1	Not Useful at all
2	Not Useful
3	Somewhat useful.
4	Useful
5	Very Useful

4.10. Analysis of student questionnaire results

4.10.1. Demographics and background details

The collection of participants' demographics and background details was included in the design of the questionnaire, with sufficient data being collected on both the demographics and background details of the student respondents.

The analysis is presented in Table 4-5 below, and shows that the sample has a wide range of backgrounds.

Table 4-5 Student demographics and background.

Student demographics and background		Bahrain/ 38 students		UK/ 38 Students	
		No.	%	No.	%
Gender	Male	6	15.8%	13	34.2%
	Female	33	86.8%	26	68.4%
Age	Less than 20	3	7.89%	21	55.3%
	Between 20 - 25	35	92.1%	16	42.1%
	Between 26 -30	1	2.63%	2	5.26%
What is your previous photography experience?	None	6	15.8%	17	44.7%
	Family snaps	29	76.3%	16	42.1%
	GCCE Photography	4	10.5%	0	0%
	A' Level Photography	0	0%	6	15.8%
How many months / years of experience in photography?	Less than 6 Months	9	23.7%	15	39.5%
	From 6 to12 Months	13	34.2%	6	15.8%
	1 to 2 Years	5	13.2%	7	18.4%
	More than 2 years	12	31.6%	11	28.9%
Reason for attending photography course	Hobby	2	5.26%	12	31.6%
	Course Requirement	37	97.4%	18	47.4%
	Other	0	0%	9	23.7%

4.10.2. Difficulties and problems faced by photography students

Figure 4.1 shows the results from the questions regarding the resources and problems faced by the students while studying photography.

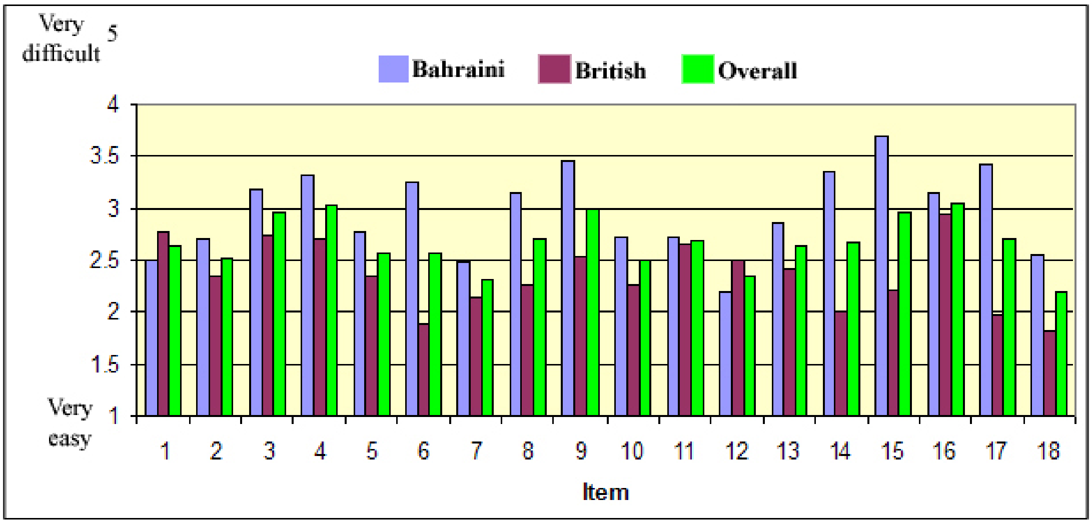


Figure 4.1 Mean for difficulties and problems in photography.

The legend for items in this questionnaire is shown in Table 4-6 below.

Table 4-6 Legend for difficulties and problems in photography.

Items: Legend			
1	Grasping the technical aspects	10	Confidence in taking photos of outdoors
2	Grasping the artistic aspects	11	Cultural concerns regarding taking photographs
3	Grasping the historical aspects	12	Religion concerns regarding taking photographs
4	High student numbers in class	13	Gender concerns regarding taking photographs
5	Applying the techniques demonstrated	14	Camera availability
6	Access to resources	15	Camera accessories availability
7	Student interaction during class	16	Material costs
8	Access to outdoor photography activities	17	Availability of laboratories
9	Confidence in taking photos of people	18	Understanding the teacher

As can be seen in Figure 4-1 above, the overall results of UK and Bahraini students are shown by the green column. High student numbers in class (item 4), confidence in taking photos of people (item 9), and material costs (item 16) appear to be the main concerns. It can also be concluded that there are considerable differences between Bahraini and UK students in their difficulties and problems while studying photography. In particular, Bahraini students find the following more difficult in comparison to their UK counterparts: access to resources to learn photography (item 6), camera availability (item 14), camera accessories availability (item 15) and the availability of laboratories (item 17).

4.10.3. Technical aspects of photography

The fourth section of the questionnaire aimed to find out how easy it is to grasp the technical aspects of photography such as shutter speed, depth of field, loading the film, exposure, daylight and focusing techniques. The results obtained from this section are shown in Figure 4.2 below.

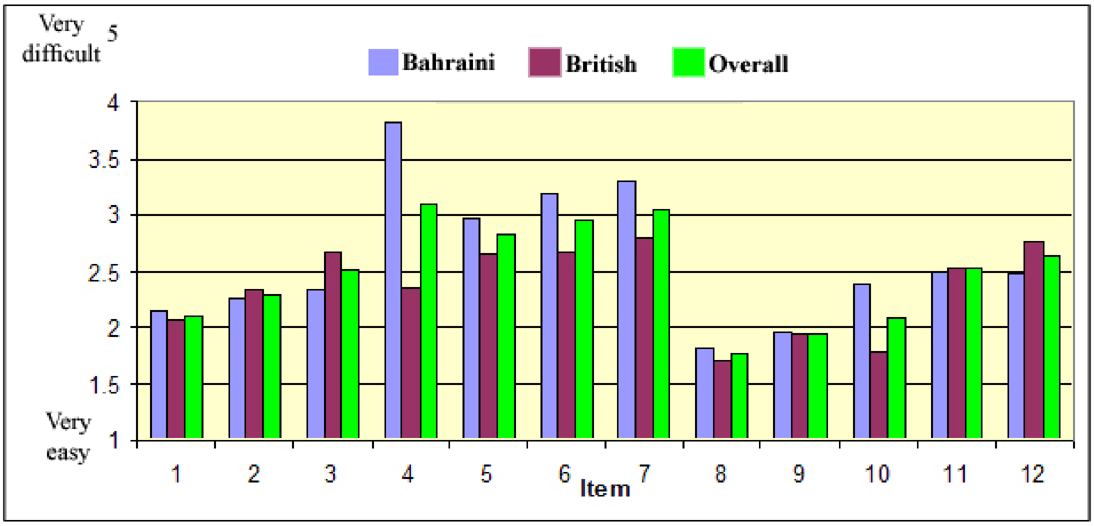


Figure 4.2 Mean to understand technical aspects of photography.

The legend for items in this questionnaire is shown in Table 4-7 below.

Table 4-7 Legend for grasping the technical aspects of photography.

Legend for grasping the technical aspects of photography.			
1	Understanding the lenses	7	Exposure and flash
2	Shutter speed	8	Loading the film
3	Aperture	9	Use of view finder
4	Depth of field	10	Focusing Techniques
5	Exposure and daylight	11	Tripod
6	Exposure and indoor light	12	ISO Rating

As can be seen in Figure 4-2 above, the overall results of UK and Bahraini students are shown by the green column, and depth of field (item 4), exposure techniques (item 5, 6 and 7) appear to be the main concerns. There also seem to be considerable differences between Bahraini and UK students in understanding the technical aspects of photography. In particular, Bahraini students find depth of field (item 4).more difficult in comparison to their UK counterparts. Bahraini students are not familiar with photography and Single Lens Reflector (SLR) camera whereas the UK students are familiar with photography. This is also compounded by the fact the Bahraini university do no provide enough cameras for students practice. Another reason could also be because the lack of English mastery among the Bahraini students.

The UK students find exposure and flash exposure techniques to be the most difficult technical aspects of photography. Bahraini students share the same difficulties, and this is reflected in items 7, 6, 5 in Figure 4-2.

4.10.4. Artistic aspects of photography

The aim of the fifth section of the questionnaire was to find out how easy it is for the respondents to understand the artistic aspects of photography such as the rule of third, freeze and blur motion, achieving desired exposure and creative use of depth of field. Figure 4.3 below highlights the results obtained.

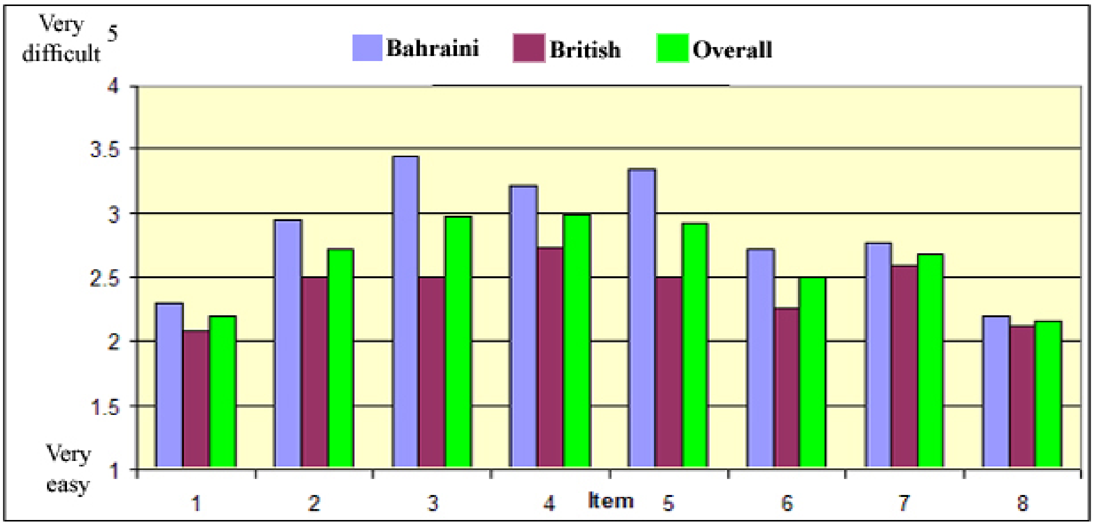


Figure 4.3 **Mean for understanding the artistic aspects of photography.**

The legend for items in this questionnaire is shown in Table 4-8 below.

Table 4-8 **Legend for grasping the artistic aspects of photography.**

Items: Legend			
1	Under the lens and picture perspective	5	Creative use of depth of field
2	The Rule of Thirds	6	Framing Techniques
3	Freeze and blur motion	7	Lighting Techniques
4	Achieving desired exposure	8	Choice of film

As can be seen in Figure 4-3 above, the overall results of UK and Bahraini students are shown by the green column. Freeze and blur motion (item 3), Achieving desired exposure (item 4) and Creative use of depth of field (item 5) appear to be the main concerns. It can also be concluded that there are considerable differences between Bahraini and UK students in the difficulties they have in understanding the artistic aspects of photography. In particular, Bahraini students find the following more difficult in comparison to their UK counterparts: Freeze and blur motion (item 3) and Creative use of depth of field (item 5).

The UK students find exposure (item 4) to be the most difficult artistic aspect of photography.

4.10.5. Use of media to learn photography

The sixth section of the questionnaire aimed to find out how media is used to learn photography; for example books, photography magazines, CD-ROMs and the Internet. The results are shown in Figure 4.4 below.

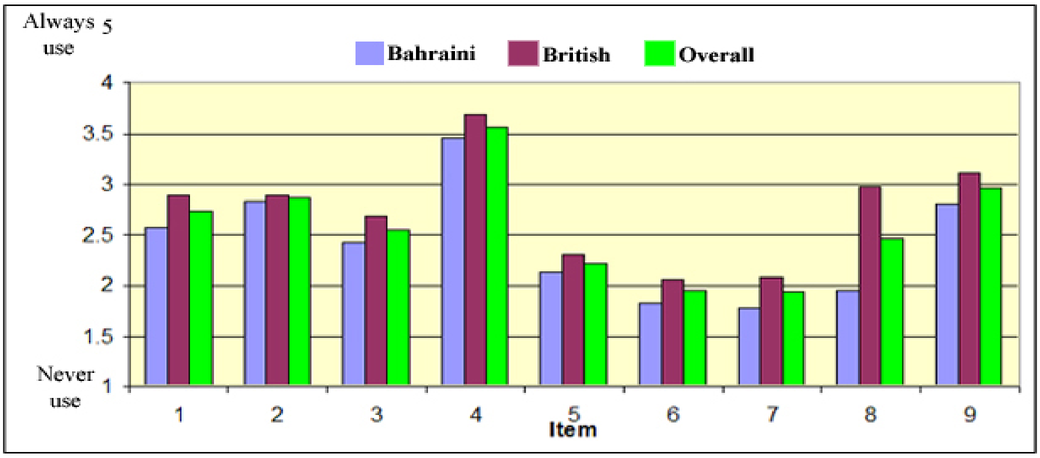


Figure 4.4 Mean of different media used to learn photography.

The legend for items in this questionnaire is shown in Table 4-9 below.

Table 4-9 Legend for different media used to learn photography.

Items: Legend			
1	Books	6	Videos
2	Photography magazines	7	CD-ROMs
3	Exhibitions	8	Internet
4	Photo examples	9	Other Photographers
5	Workshops		

The overall results of the UK and Bahraini students, as represented by the green column in Figure 4-4, shows that photo examples (item 4) are the media most used to learn photography.

There is very little difference between the students in UK and Bahrain in all the fields studied. However, the largest gap is in the use of internet to learn photography, with Bahraini students using the internet (item 8) less in comparison to UK students.

4.10.6. Usefulness of advanced media in learning photography

The aim of the seventh section of the questionnaire was to find out how useful advanced media resources were to students while learning photography. These include interactive multimedia CD-ROMs, interactive websites and the virtual camera. The results are shown in Figure 4.5 below.

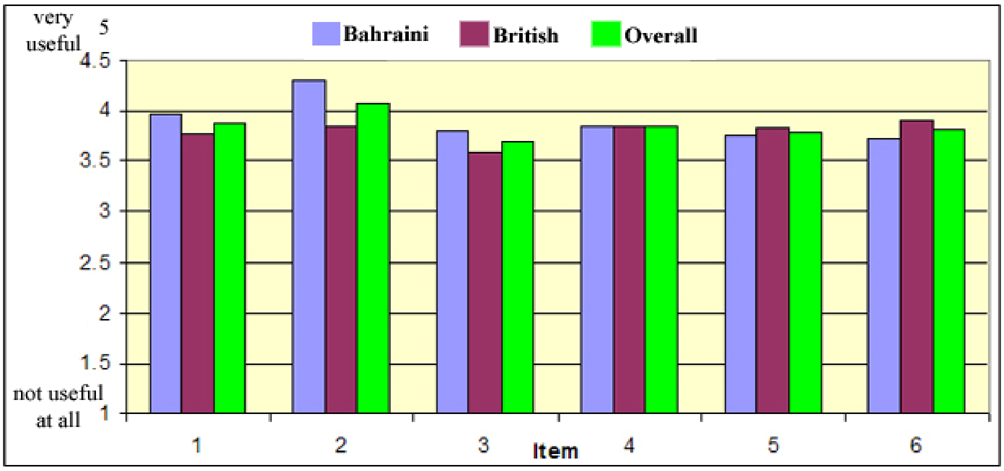


Figure 4.5 Usefulness of advanced media to learn photography.

The legend for items in this section of the questionnaire is shown in Table 4-10 below.

Table 4-10 Legend for usefulness of media to learn photography.

Items: Legend			
1	Interactive multimedia CD-Rom	4	Virtual Reality
2	Interactive website (Internet)	5	Video
3	3D Animation	6	Virtual Camera

As can be seen from the overall results of UK and Bahraini students shown by the green column in Figure 4-5, all advanced media is generally deemed to be highly useful, with interactive websites being the most valued by Bahraini students.

4.10.7. Student comments

From the results of the questionnaire presented above, it is clear that traditional photography examples are the most used learning resource in both the UK and Bahrain, with internet resources also particularly well used in UK. This may be due to the greater availability of the internet in UK Higher Education compared to Bahrain. Certainly both sets of students find the internet very useful as a learning resource, with UK students having a particular preference for a virtual camera resource. The latter value may again illustrate the problem of access to real cameras as a means to learning through experimentation.

Table 4-11 below shows students' comments and conclusions on this particular issue. While some Bahraini students gave comments (highlighted in the table), almost half of them did not. These Arabic comments were translated precisely into English to give the same meaning. Very few UK students commented.

Table 4-11 Student comments.

No	Comments	UK		Bahrain	
		Number of students	%	Number of students	%
4	We found that technical aspects are most difficult such as controlling the aperture and visualizing the concept of depth of field.	1	2.63	5	13.16
8	The rich media could help and facilitate difficult aspects of photography like visualizing the concepts like aperture, shutter speed, lens view and depth of field.	0	-	5	13.16
5	Internet is unavailable at home	0	-	5	13.16
1	There is a shortage of cameras for observation purposes.	0	-	4	10.53
6	Internet materials are not available in Arabic.	0	-	4	10.53
2	We are not confident to practice photography outdoors especially as female students.	0	-	3	7.89
3	We lack cameras for practice.	0	-	3	7.89
9	We cannot focus on the lecturers' demonstration in large number groups in the class especially if the lecture period is short.	0	-	3	7.89
10	We do not like to share the camera with other members of large groups.	0	-	3	7.89
7	The available internet materials are not suitable for beginners and look like e-books with text and images only.	0	-	2	5.26

As shown in Table 4-11 above, some students suggest that the adoption of a 'virtual camera' may solve the problem associated with camera non-availability and also reduce the cost of developing and printing compared to using real cameras. Furthermore, the respondents feel that the internet may be valuable in alleviating problems created by large numbers in a classroom or studio, as it can support their learning at any time in any place.

In the current status of advanced media technology the students are well exposed in one way or another to the Virtual Reality, 3D animation, and interactive multimedia.

4.11. Student questionnaire conclusions

It can be concluded from the student survey that the presence of 'high number of students in a class room', coupled with 'insufficient resource availability', in terms of 'cameras' and 'accessories' and 'laboratories' are the main resource concerns of photography students. Depth of field', and exposure are the main topics from both a technical and creative perspective that photography students have difficulty with. It is possible that these difficulties are related to, or at the very least compounded by, the lack of equipment.

4.12. Interview with the Photography Teachers

4.12.1. Introduction

Interviews were used to determine current difficulties and problems faced by teachers teaching photography courses in Bahrain and UK, and to identify suitable areas for the use of advanced multimedia.

Burgess (1982) defined interviews as the opportunity of the researcher to probe deeply to uncover clues, open new dimensions of a problem and secure vivid, accurate and inclusive accounts that are based on personal experience. Patton

(1990, pp.280-290) and Oppenheim (1992, p. 65) stated that unstructured interviews allow direct interaction between the researcher and a respondent or group. However, there is a price to pay for lack of structure because each interview tends to be unique with no predetermined set of questions asked of all respondents. Eventually, data analysis of unstructured interviews becomes difficult, especially when synthesizing across respondents. Silverman (1993), Zikmund (1997) and Bell (1999) point to criticism of interviews in that they require a personal sensitivity, adaptability and a need to stay within the bounds of the designed protocol. In addition, interviews are very time-consuming and they are resource intensive. Despite their disadvantages, however, interviews are useful in finding out participant’s opinions regarding the difficulties and problems which cannot be measured by questionnaires only.

4.12.2. Aims of the interview

The researcher intended to conduct interviews with a sample of lecturers teaching Photography, as well as with relevant members of the photographic community in UK and Bahrain. The selected respondents are lecturers, with a specific focus on those from formal educational institutions and community organizations. The aim of these interviews was to pinpoint and extract the specific problems with regard to the difficulties and problems faced by photography lecturers, and also to get their views on the use of multimedia as a teaching and learning resource.

4.13. Design of the interview

Structured interviews were used to determine current difficulties and problems faced by higher education lecturers teaching photography courses in Bahrain and United Kingdom. The study further probed into identification of suitable areas for using advanced multimedia. Interviews were conducted with seven photography teachers, four employed in Bahrain and three in UK, who were accessible to the author.

The interview questions were divided into two parts. Part 1 dealt with the demographic data of the respondent. Part 2 consisted of ten questions related to the subject matter being investigated.

4.13.1. Part 1

The details extracted from the respondents in this demographic part were as follows:

- Full Name:
- Job Title:
- Gender:
- Address:
- Age:
- Nationality:
- Telephone Number:
- Email Address:

Further to the general demographic details, the researcher asked about some further background details, which were as follows:

- What is your formal photography qualification?
- How many years have you taught photography?
- Which levels of students do you teach?
- What aspects do you teach on your introduction to photography course
- What is your class size?

4.13.2. Part 2

The interview consisted of the following ten questions:

1. The number of students taught per class.
2. The problems faced in teaching large numbers of students.
3. What solutions may solve these problems?
4. The current media resources used in teaching photography.

5. The current problems faced when teaching technical aspects of photography.
6. The current problems faced when teaching artistic aspects of photography
7. What are possible solutions to resolve these issues?
8. The main difficulties students face when learning photography.
9. Usefulness of advanced multimedia in teaching photography.
10. Further comments regarding learning photography by the students.

The teacher interview questions are attached as Appendix 2

4.14. Analysis of the Teachers' Interview Results

4.14.1. Demographics and background

The demographics and background details of the teacher respondents, three from UK and four from Bahrain are presented collectively in Table 4-12 below.

Table 4-12 Demographics & background of photography teachers.

Background details of the Respondent UK- United Kingdom, BH- Bahrain							
Respondent	UK-1	UK-2	UK-3	BH-1	BH-2	BH-3	BH-4
Gender	F	M	F	M	M	M	M
Qualification	PG in Photography	MA in Photography	MA in Photography	PhD in Ed. Tech	PhD Digital photography	PhD in Ed. Tech.	MA in Mass Comm.
Years of Teaching photography	8	13	7	20	10	18	30
Level of teaching	BA			BA			
Aspects of teaching photography	Basic technical and Art aspects			Basic technical and Art aspects			
Current Size of class taught	30	24	20	25	30	30	22

In response to the question associated with 'number of students' taught in each class, the interviewees' responses are shown in Table 4-13 below.

Table 4-13 Number of students in classes.

Code	Responses
UK-1	I, as a lecturer, teach 30 students per class. In addition, I supervise the work of 30 students for their 'practical' and another 15 students for 'tutorial'
UK-2	I, as a lecturer, teach 24 students per class. In addition, I supervise the work of 24 students for their 'practical' and another 24 students for 'tutorial'
UK-3	I, as a lecturer, teach 20 students per class. In addition, I supervise the work of 20 students for their 'practical' and another 15 students for 'tutorial'
BH-1	I, as a lecturer, teach 25 students per class. In addition, I supervise the work of 25 students for their 'practical'.
BH-2	I, as a lecturer, teach 30 students per class. In addition, I supervise the work of 30 students for their 'practical'.
BH-3	I, as a lecturer, teach 30 students per class. In addition, I supervise the work of 30 students for their 'practical'.
BH-4	I, as a lecturer, teach 22 students per class. In addition, I supervise the work of 22 students for their 'practical'.

Based on the above responses, it is clear that the teachers have been managing large classes (the average number of students being twenty-six) where it may be difficult to pay sufficient attention regarding the 'individual learning aspect' of each student. Moreover, it may not be possible to supervise the work of each individual student during the practical classes where the teachers endeavour to impart training on complex technical aspects of photography, involving 'depth of field', 'exposure control techniques', and so on. Under the circumstances, it may not be impertinent to assume that teaching-learning in the conventional class room environment suffers and the students do not benefit. As suggested by the data obtained later (see Table 4-14), it seems that, in practical classes teachers are not able to observe student performance in large groups. In addition, it is difficult for the teacher to provide each student in these groups with the cameras and equipment necessary for extensive practice during class time. This specifically applies to the educational environment in Bahrain.

4.14.2. Preferred class size

In response to question 1 regarding the preferred class size, all the respondents answered in favor of a class size of fifteen students to effectively deliver their lectures, pay individual attention to students and improve quality of training during the practical sessions.

4.14.3. Problems and solutions for teaching large groups

In respect of questions 2 and 3 regarding the problems of teaching Photography courses, and possible solutions; the responses of the faculty members are shown in Table 4-14 below.

Table 4-14 Problem faced by teachers when teaching large groups.

Code	Responses from Teachers opinion	
	Problem and the reasons	**Solve problems**
UK-1	Difficult to see everyone's work in a short session. Too many projects are set within 12-weeks model so the student does not have time to develop.	Make classes smaller, set less projects but redevelop existing ones, giving students personal tutorials and feedback from their work.
UK-2	Difficult to spend time with individuals	Small groups.
UK-3	Making sure that each student is accompanying the lecture and understanding the information imparted.	Run additional tutorials, repeating the process or procedure several times.
BH-1	Lack of cameras and lack of the time in general to make sure that every student understands the lecture	Have several individual assignments in particular aspect of photography. Repeat the class more than once
BH-2	Lack of cameras, shortage of time, large student groups, difficult to teach technical aspects	Keep showing them new work on particular aspects of photography, make small groups
BH-3	Large student groups and difficulty in teaching technical aspects	Make small groups, repeating the process several times.
BH-4	Concentration, different attitudes and cultural backgrounds	Make smaller groups

Most respondents, such as UK-1, UK-2, UK-3, BH-2, BH-3, suggest that teaching and learning suffer due to large class size and a compressed time schedule. They refer to the lack of scope for individual attention in an effort to deliver knowledge. This difficulty is compounded in Bahrain due to the lack of cameras for teaching (BH-1, BH-2). This means that both UK and Bahraini teachers prefer to teach smaller groups, which might improve the situation although the resources might not always be available in this case. This results in the need to provide them with innovative and feasible solutions, such as using cost-effective technologies, for example 'virtual camera'.

4.14.4. Current usage of media to teach photography

In response to question 4 associated with the usage of media to teach photography, the results are shown in Figure 4.6 below.

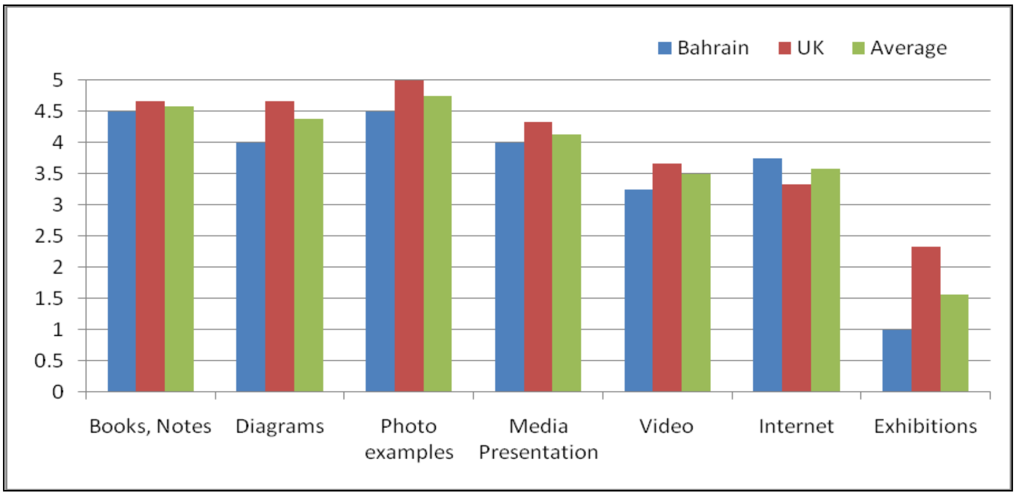


Figure 4.6 Current usage of media to teach photography.

This question uses the scale from 1 Never to 5 Always, as shown in Table 4 3 below.

Table 4-15 Likert Scale used for question 4.

Scale	Description
1	Never
2	Seldom
3	Sometime
4	Usually
5	Always

It is apparent from Figure 4-6 above that book, notes and photo examples are most used to teach photography, with media presentations to increase their own knowledge of photography. It can also be observed that the internet is sometimes used to teach, although some teachers (UK-2, BH-2 and BH-3) never use it at all. Data shows that the poor response in favour of the use of internet may be attributed either to lack of resources, the speed of internet (which is discussed extensively in section 2.6.1.2 of this study) or availability of suitable photography websites for teaching. These are reviewed in Chapter 5 Critical Review, particularly in section 5.6.2, regarding Kodak, Photonet, Photonhead and Foto Info.

4.14.5. Problems in teaching technical aspects of Photography

In relation to question 5 of the interview, the responses obtained are shown in Table 4-16 below.

Table 4-16 Problems in teaching technical aspects of Photography.

Code	Responses
U-1	Difficult to teach technology to a large group of 30, also student forgets when they get the camera out for shooting.
U-2	Equipment
U-3	Students get confused especially with large and short depth of field. They also get confused while controlling and getting the correct exposure.
B-1	Exposure control , motion blur, elements affecting the depth of field
B-2	Elements affecting the depth of field, camera parts and how it works, the lens reflecting the image.
B-3	Elements affecting the depth of field.
B-4	I, as a lecturer, teach 22 students per class. In addition, I supervise the work of 22 students for their 'practical' classes, which is a large number of students in a practical class.

With reference to the 'teaching of technical aspects of photography', it can be observed that most of the teachers seem to experience difficulties in teaching technical aspects, such as depth of field and managing exposure. Moreover, large class size, as observed in Table 4-16 above, also hinders the quality of teaching, since it becomes difficult to explain the complex technical aspects of photography to individual students, especially in practical sessions.

4.14.6. Problems in teaching artistic aspects of Photography

The responses obtained for question 6 of the interview are shown in Table 4-17 below.

Table 4-17 Problems in teaching artistic aspects of Photography courses.

Code	Responses
U-1	Smaller classes are better for getting ideas across. Project can be restrictive.
U-2	Prior knowledge
U-3	Accessing information on an artist’s work and making sure that it is correct. Framing composition, camera angle, the fact that students tend to use the cameras at eye level.
B-1	Prior knowledge and framing techniques (rule of third)
B-2	Framing and rule of third, focusing techniques
B-3	Framing and rule of third, focusing techniques, camera angle

Difficulties in teaching artistic aspects of photography, as stated by U-1, U-2, U-3, B-1, B-2 and B-3, include camera angle, framing composition and techniques, and large class sizes.

4.14.7. Possible solutions to the problems

Question 7 was associated with the possible solutions to the problems raised by the teachers in questions 5 and 6 above. The results obtained are shown in Table 4-18 below.

Table 4-18 Perceived solutions to the problems.

Code	Responses
U-1	Slide library is needed as a resources area. Power point digital slides are better. More open-minded attitude needed for project results to add a broader understanding of photography.
U-2	Better resources. Time spent on critical / historical issues.
B-1	Virtual camera may solve lack of camera
B-2	Virtual camera may solve lack of camera and using e-learning material or Interactive multimedia to simulate some aspects effectively.
B-3	Virtual camera may solve lack of camera, multimedia presentation.

In terms of multimedia learning resources, U-1 proposed the use of digital slides and a slide library as a virtual solution. The teachers from Bahrain (B1, B2 and B3) suggest the use of virtual camera resources to allow the students to simulate some aspects of camera use.

4.14.8. Main problems and difficulties experienced by students

In response to question 8 of the interview, associated with the perception of the teachers regarding the problems and difficulties experienced by students in learning photography, the results are shown in Table 4-19 below.

Table 4-19 Problems and difficulties faced by photography students.

Code	Responses
U-1	Getting to grips with the technology and creating original works of photo art.
U-2	Technical inexperience
U-3	Some are not prepared for the technical aspects
B-1	Lack of camera, lighting control , exposure control
B-2	Visualize depth of field and how it work
B-3	Most technical aspects such as depth of field and lack of cameras
B-4	Lack of camera and photo labs

With regard to the above question, the respondent from UK, U-1, refers to the inability of the students to understand technology in creating photographs, and the other teachers interviewed appear to agree with this, as can be observed in

Table 4-19 above. The responses of the teachers from Bahrain, B-1, B-2, B-3 and B-4, primarily relate to the insufficiency of teaching aids, as well as the students' inability to grasp the complex technical aspects of photography, as also observed in Table 4-19.

4.14.9. Usefulness of multimedia in teaching photography

In response to question 9, associated with the perception of usefulness of advanced multimedia in teaching photography, the results are shown in Figure 4.7 below. The scale used is from 1 Not useful at all to 5 Very useful, as described in

Table 4-20 below.

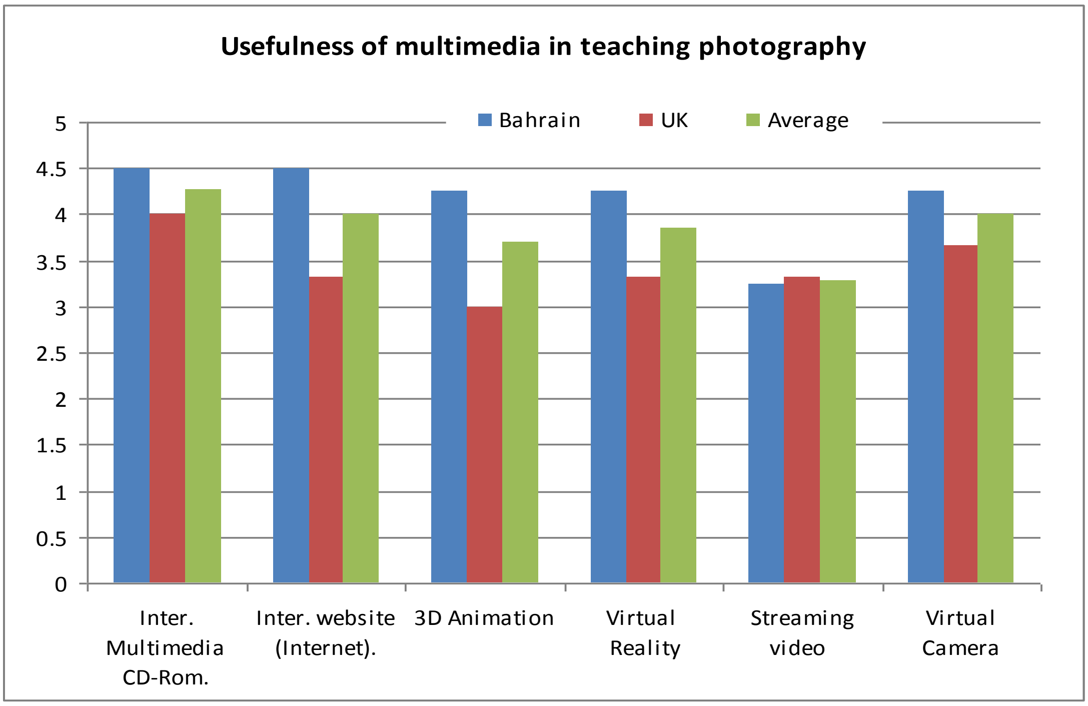


Figure 4.7 Usefulness of multimedia in teaching photography.

Table 4-20 Likert Scale used for question 9.

Scale	Description
1	Not useful at all.
2	Not useful.
3	Do not know.
4	Useful.

5	Very useful

Interactive Multimedia CD-ROMs, followed by interactive websites (internet), are seen as being the most useful types of multimedia resource by the respondents. The teachers believe they can help to teach photography as they may help students to visualize depth of field, or show how to achieve the desired exposure by a combination of shutter speed and exposure, while enjoying the benefits of camera simulation as there is a shortage of cameras. Using an interactive multimedia CD-Rom would also give the students opportunities to interact with self-learning any time, online or offline. The virtual camera or simulation is also seen as being very useful by both UK and Bahraini staff. Bahraini teachers also favour the use of animation. However, there are no clear results in favour of streaming video.

4.14.10. Additional feedback

At the end of the interview the teachers were asked to give additional feedback, which was presented in the form of an open-ended question captioned "further comments". This was requested by the researcher in order to have some additional feedback from the respondents. This was the last question, number 10, of the interview with the teacher respondents. The UK respondents answered in English. The Bahraini teachers' responses were in Arabic which were translated into English language.

The comments obtained from the teachers are appended in verbatim form in Table 4-21 below. The responses are presented in an unedited format to show the teachers' exact responses.

Table 4-21 Teachers' verbatim comments.

UK1	Could be good with a lot of information on Interactive Multimedia CD-ROM.
UK2	No comment
UK3	If Advanced Multimedia would show students what it looked like through the virtual camera.

BH1	1-Use advanced Multimedia always available to student. 2-virtual camera may solve lack of camera
BH2	Using virtual camera to see all camera features.
BH3	1-Effective to show depth of field by using virtual camera, always available to student. 2-Virtual camera may solve lack of camera, multimedia presentation.
BH4	Help students to see and get response to questions, always available to student, effective to show lighting effects, depth of field and perspective control. 2- Use rich media resources with activity to enhance learning and engage the student

4.15. The teacher interview conclusions

It is clear that the photography lecturers are managing large classes in which it may be difficult to pay individual attention to students. Moreover, students' learning appears to suffer due to insufficient resources. However, the teachers in such large classes do not seem to use learning technology such as 'video', 'internet' and 'multimedia CD ROM', which could help in managing the lectures better and support the students' independent learning; this is possibly because of a lack of suitable resources. As a matter of fact, the teachers seem to rely on conventional media forms such as books and notes, diagrams and photo examples, for convenience.

The teacher interview results indicated that availability of cameras and high student numbers in class (between twenty-five and thirty students) was a key problem in teaching photography. Another difficulty faced by teachers was found to be access to different learning resources such as interactive websites, interactive CD-ROMs, conferences and trade exhibitions relating to teaching photography.

In the study, some initial differences were found between Bahrain and UK teachers in how useful they think advanced multimedia could be in teaching photography. It was found that teachers from Bahrain think that advanced multimedia could be useful in teaching photography but teacher UK-1, from De Montfort University, thought it might not be useful to use advanced multimedia in her class, except interactive CD-ROMs, because she felt that over-feeding a student’s mind with too many types of technology information makes their work weak and confused. She felt it is actually better to pick up an old fashioned photography book. However, she was the exception in not having much regard for advanced multimedia usage in photography teaching and learning.

Overall, the initial research results indicate that availability of cameras with accessories and high student numbers in class are the key problems in teaching photography. As already stated, the author proposes that these resources related problems may be partially alleviated by a virtual environment in which students take photographs through virtual cameras prior to using real cameras at a later stage.

Based on the findings from the literature review, student questionnaire results and interviews with photography teachers, possible subject areas for using advanced multimedia are exposure techniques, freeze and blur motion, achieving desired exposure and use of depth of field.

4.16. Chapter Summary

The author proposes that the existing problems identified could be addressed with new media technology and methods to support conventional teaching-learning methods. This is supported by the initial results obtained from students’ and teachers’ feedback. The author, in this context, proposes that for teaching-learning to be purposeful and effective for the benefit of the students, it needs to be based on a blend of face-to-face classroom-based lectures duly supplemented by e-learning resources using advanced interactive multimedia such as virtual cameras. Advanced Multimedia is more beneficial because it has richer media including more interactivity and vividness, and utilizes different learning experiences.

In the next chapter, the researcher will critically examine and test existing e-learning resources used in photography with students with the aim of developing design strategies for future e-learning developments with the use of interactive multimedia rich environments (advanced multimedia) in this area.

Chapter Five

Stage 2

Critical Review

5. Stage 2 Critical Review

5.1. Introduction

A Critical Review is an assessment and evaluation of the existing e-learning materials that are available. The aim of a critical review is to evaluate the strengths and weaknesses of the different resources already available to address the particular situation (Waddington, 2000).

5.2. Aims of the Critical review

In the previous chapters, current problems in teaching photography were identified and the use of an advanced multimedia e-learning resource was proposed as a possible solution. The purpose of the critical review was to evaluate existing e-learning materials with a particular focus on photography and the use of interactive multimedia rich environments. Following the initial review, these materials could then be further examined through a Student Survey in the next stage using the same criteria. This is because the critical review is quite subjective and hence, the student survey provides an added level of objectivity to the analysis. After clarifying the aim of the review and its major criteria, the next task was to formulate the questions for the review.

5.3. Methodology

Certain criteria were established to test the quality of the different approaches and means of various e-learning materials which were critically evaluated by the researcher and studied on the basis of the following factors, for which quantitative rating scales were adopted and applied to aid comparison. These factors were determined based on the work done by Lister (2005) and Bones (2003). The selection of factors was adopted from Laurillard (2002). The factors are:

- General design factors
- Pedagogical design factors
- Type of learning experience and multimedia used

- Effectiveness of multimedia components
- Overall rating

5.4. Design of the Questionnaire

A thorough study on questionnaire design was conducted to find out what type of questionnaire would be suitable for a critical review of e-learning material (Schrock, 2006; Fuccella and Pizzolato, 1998). It was found that well-defined goals are the best way to assure good questionnaire design. When the goals of a study can be expressed in a few clear and concise sentences, the design of the questionnaire becomes considerably easier. The questionnaire was developed to directly address the goals of the study (Stat Pac Inc., 2011). The goal of the questionnaire was to help the author to identify the strengths and weaknesses of existing e-learning resources with a particular focus on photography, and the use of interactive multimedia-rich environments. The evaluation questions were determined based on the work of Lister (2005) and Bones (2003).

5.5. Validity

The critical review research tool which was in the form of a questionnaire was presented to five external referees, who were faculty members from different institutions. The referees were asked to read each question and to comment on questionnaire items in terms of wording and content and to give their comments and suggestions for improving the scale. All members are listed in Appendix 5-1.

5.6. Selection of e-learning resources

In the process of selecting specific e-learning resources (via CD-ROM, DVD or Inter/Intra net) to be critically reviewed, the following criteria were used:

- Include resources that are commonly used in photography teaching.
- Include resources with major photography topics in these resources i.e. basic photography, concept of aperture, speed shutter, focal length,

lenses, image size, lighting techniques and depth of field. This is because the findings of the preliminary interview and questionnaire from the previous chapter indicate that these topics are difficult aspects for students, with depth of field being the most difficult for photography students.

- Include resources that combine both the simple and complex levels of interactivity in order to investigate the different learning experiences, based on low and high levels of interactivity and vividness.
- Include resources that use varieties of media and technology to present e-learning materials.
- Include resources that are public and accessible in order to investigate the effectiveness of different media technology
- Include resources that are rich with learning activities. According to Laurillard (2002) there are 5 types of learning experience.
- Include resources that provide continuous feedback - a resource which has a feedback feature is more effective and strengthens the pedagogical design experience.

5.6.1. Existing e-learning resources in photography

Bones (2003) conducted a limited critical review of e-learning resources for photography inclusive of websites, CD-ROMs and DVDs. By looking at the four websites, namely Photonet, Photo Interactive, Foto Info and Taking Great Pictures by Kodak, he was able to identify the strengths and weaknesses of these websites based on the criteria of: instructional content, instructional design, ease of use, motivation and technical aspects.

In this study, a more comprehensive review has been conducted using the following nine web-sites and CD ROMs (see Table 5-3 below) for learning photography. The review includes pedagogical design and different learning experiences based on Laurillard’s (2002) framework, in addition to the effectiveness of the multimedia component. This in effect looks at the level of enjoyment, engagement and effectiveness of learning. The author believes a more comprehensive review including these important factors needs to be considered because he proposes they are related to level of richness of multimedia as defined by the, level of interactivity and vividness. Therefore, this critical review serves to achieve the research goals by identifying the strengths and weaknesses of a particular resource and the associated causes.

5.6.2. Additional resources of e-learning materials in photography

In an attempt to compile more e-learning resources, the researcher identified some institutes and universities in UK, USA, Bahrain and UAE which offer photography courses. E-mails were sent out to the identified institutes and universities asking for the resources they used in order to compile a list of e-learning resources. Their reply is based on the most frequently used resources from different countries. In this exercise, many different sites were cited, and the resources chosen for review which were a mix of rich, intermediate and sometimes very low levels of multimedia for comparison.

The email enquiry details are presented in Table 5-1 below, together with the final outcomes. The first column identifies the country: UK, USA, Bahrain, UAE and Others as the reference countries. The next column gives the name of the institution where the researcher attempted to get feedback. This is followed by their responses to the researcher's email enquiry. The column 'No response' is marked for all those who did not respond to the email. In addition, the table shows institutes which are not using the e-learning resource along with those which are using them. The next column identifies e-learning resources referred to by the institutions. There were nine such e-learning resources identified as a result of this email enquiry through their frequent use by the institutions involved. Although one more e-learning resource was identified, it was not publicly available.

Table 5-1 E-learning supplementary tools in photography.

Responses received by author on the usage of e-learning materials in Photography as a supplementary tool in the UK, USA, Bahrain and UAE

Country	Name of Institute	No response	Responses		e-learning material used (CD-ROM, DVD or website)									
			Not Using Material	Using Material	1	2	3	4	5	6	7	8	9	NP
UK	De-Montfort University			√	√					√		√		
	Royal College of Art		√											
	Other UK Institutes*	√	√											
USA	College of DuPage		√											
	Rockport College		√											
	Northern Arizona University		√											
	Pennsylvania State University			√										√
	Other USA Institutes **	√												√
Bahrain	University of Bahrain			√	√	√	√		√	√				
	Delmon University			√	√				√					
UAE	Dubai Men's College			√				√			√			√
Others	Websites links and photography forums			√	√		√	√	√	√	√		√	√

1 To 9	Columns represents e-learning materials (CD-ROM, DVD and websites) used (Refer to Table 5-2)
NP	Not publicly and accessible website
Other	Links provided by academics in the Photography forums.
Other UK*	Bournemouth University, Swansea institute (University of Wales), Norwich School of Art and Design, University of Sunderland, Bradford College, University of Gloucestershire, UCE Birmingham.
Other USA**	UCLA, Lesley University, Herberger College's School of Art, Kansas State University, University of Florida, International Centre of Photography. Savannah College of Art and Design, USC, NYU, Arizona State University, Kansas State University, Rochester Institute of Technology, Kentucky State University, Louisiana State University, Northern Kentucky University, Northern Michigan University, Ohio State University, California State University Dominguez Hills.

5.6.3. Overall e-learning resources selected for critical review

As a result of collecting e-learning resources from the internet, from Bones' (2003) evaluation of existing e-learning resources, and additional e-learning resources from the e-mail enquiry, based on the selection criteria mentioned in section 5.6 above, the researcher was able to select the following list of nine e-learning resources for the purpose of conducting this critical review. The list is shown in Table 5-2 below.

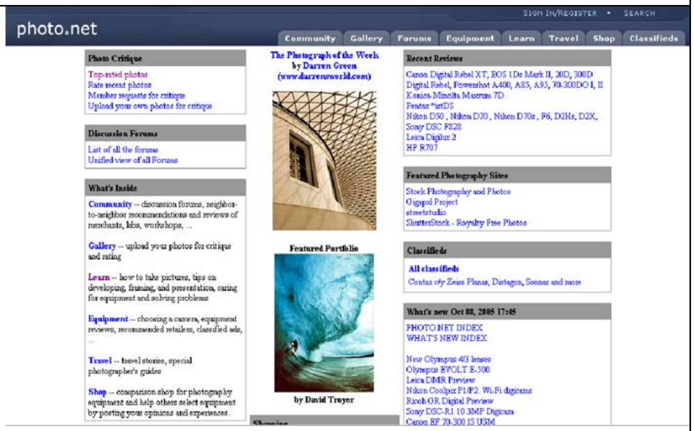
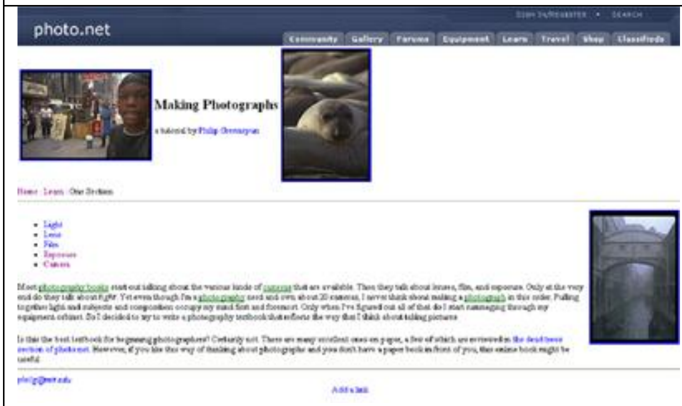
Table 5-2 Type of E-learning resources used for critical review.

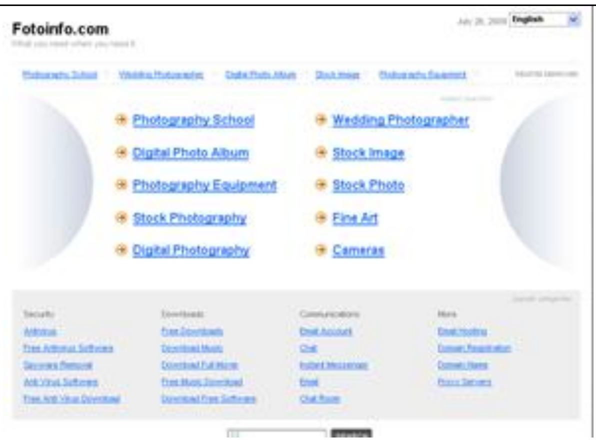
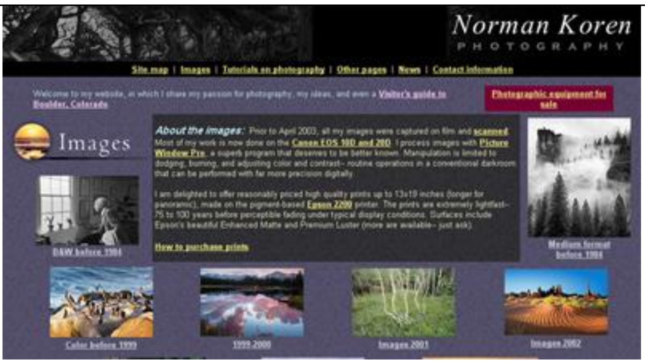
	Resources	E-learning Type	Level of Interactivity and Vividness of E-learning material	Nature of resource
1	Photonet	Website	Basic	General Basic photography learning
2	Foto Info	Website	Basic	General Basic photography learning
3	Norman Koren	Website	Basic	General Basic photography learning
4	Professional photography	CD-ROM	Basic- Intermediate	General photography learning
5	Photonhead	Website	Basic - Intermediate	General photography learning with camera simulation
6	Kodak	Website	Basic - Intermediate	General photography learning with some specialist aspects
7	Photo Interactive	Website	Basic - Intermediate	General photography learning
8	Virtual Studio	CD-ROM	Intermediate	Specialist in lighting techniques
9	Liquid Sculpture	Website	Intermediate	Specialist depth of field techniques

All the E-learning resources are presented as print screens in Table 5-3 below.

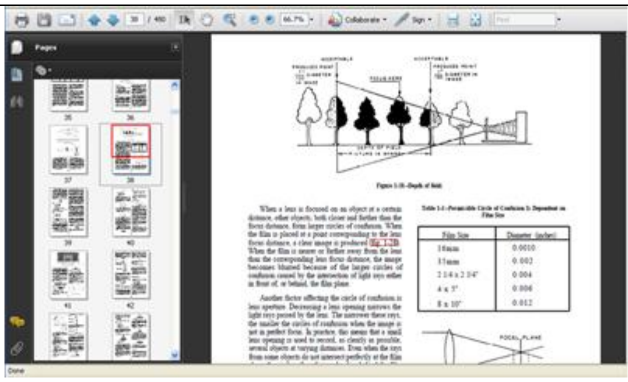
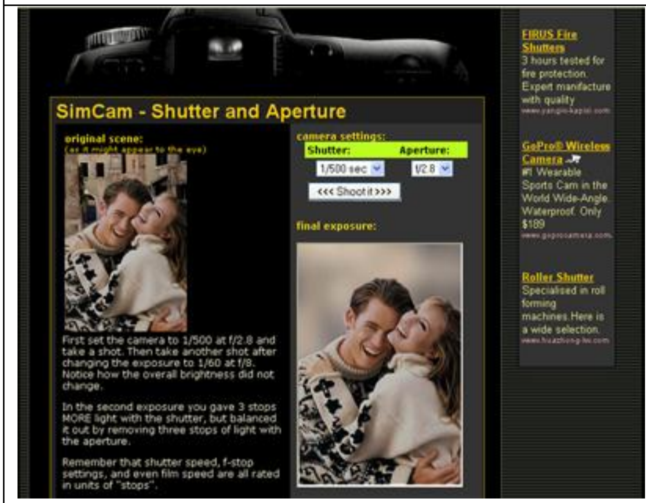
The comments in the left-hand column in Table 5-3 below is the description of the each E-learning resource developed as a general review by the researcher.

Table 5-3 Description and Print screens of e-learning resources.

Description of E-learning resources	Print screens of e-learning resources
1. Photo Net : http://www.photo.net/	
The largest community of photographers online that deals with both film and digital photography. Photo.net is an online community started in 1993, with hundreds of thousands of active members and many more casual viewers visiting daily. Photo Net has a great deal of useful information. However the website is cramped, with too many pictures and information and is quite overwhelming, The section on learning is boring and not very interactive, just written text, which is not motivating for those just starting to learn the art of photography.	 
2. Foto Info : http://www.fotoinfo.com	
Gives some basic tips and offers a large amount of information about photography. Foto-info is easy to navigate through and find what you are looking through. The initial page of Foto-info has no pictures, just a list of headings which you click on to take you to the relevant sites. This website has other	

<table>
<tr><td>websites contained within it, ranging from everything to do with weddings to learning aids and courses for those wanting to learn and understand photography.</td><td>
</td></tr>
<tr><td colspan="2">3. Norman Koren : http://www.normankoren.com/index.html#Tutorials</td></tr>
<tr><td>Tutorials on photography by Norman Koren cover all photography aspects and show a preference for static images and text.
This site has many pictures and text illustrating most aspects of photography but is not highly interactive and again suffers from being too busy. Learning photography from this website will be an arduous task.</td><td>


</td></tr>
<tr><td colspan="2">4- Professional photography training www.a2zcds.com</td></tr>
<tr><td>This consists of a CD-Rom with a PDF file containing good black and white text and images; it could be called an e-book.
Also a well laid out website advertising CD-ROMs. The website has good images and text arranged</td><td>
</td></tr>
</table>

in a thoughtful manner and there is a video clip at the side. There is a range of CD's available covering different topics and an informative description of each CD topic.	
5.Photonhead: http://www.photonhead.com/simcam	
"Learn photographic concepts with the SimCam camera simulator. Change the shutter and aperture and see the results in the browser" Good website that is not over complicated, beautifully laid out. Highly interactive – it has a simulated camera where you can change shutter speed and aperture and view the result instantly. Good learning tool for beginners and also has advanced tutorials to help increase knowledge and understanding of photographic techniques.	 

6. Kodak :

"Taking Great Pictures, using interactive camera simulators to practice some photography tips to improve your picture taking!"

The user can interact with a simulation camera by moving the red buttons from R and L to get a good view of the angle before taking a picture.

The user can also control the picture by moving the red button from L and R to change the light direction and see the shadow effect on the faces.

[NOTE: This print screen is now out-of-date and not all the activities mentioned here are currently available]

Highly interactive – has a simulated camera where you can change the light direction and view the result instantly. Also has good images, informative text and diagrams.

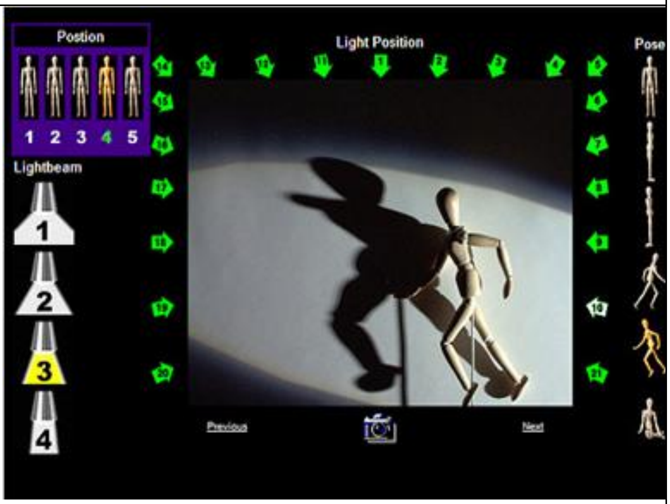
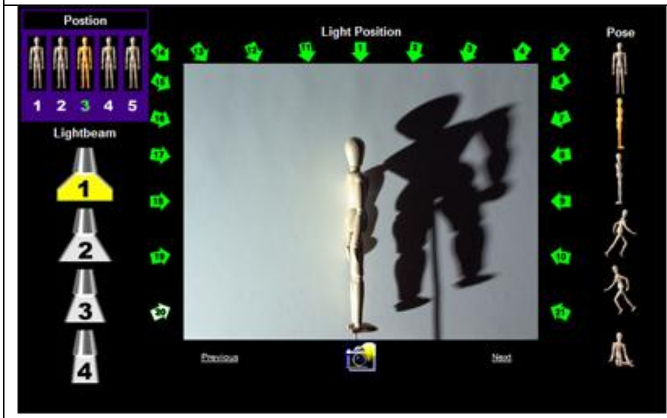
Good learning tool for aiding understanding of different aspects of photographic techniques.

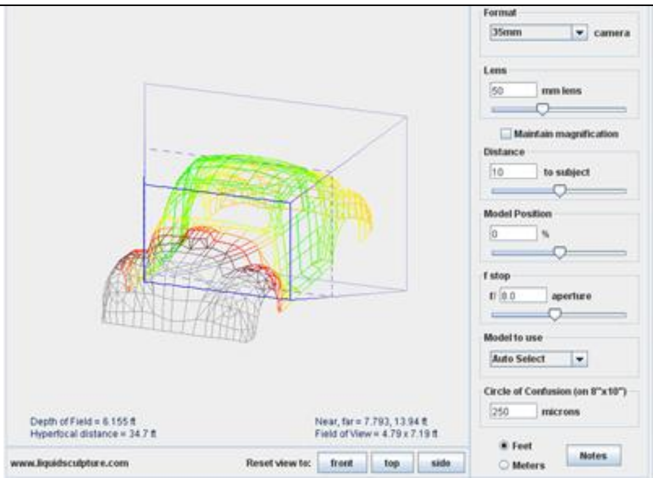
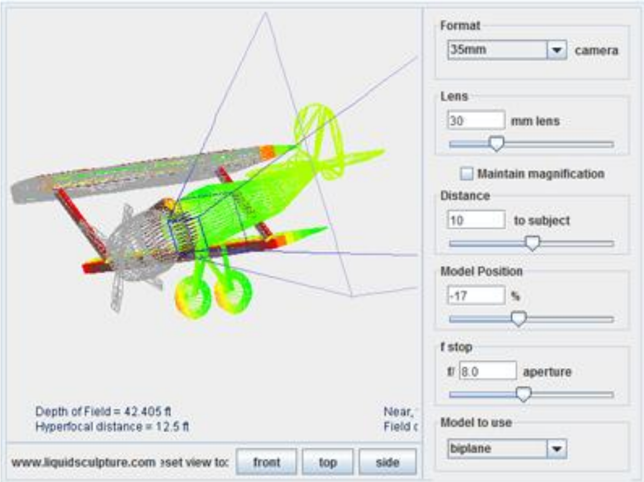
7. Photo Interactive : http://library.thinkquest.org/11355/html/index.htm

Demonstration showing how shutter speeds and F-stops affect the value of light in a scene.

These details are taken from the site: “This photography primer covers cameras, film, paper and printing, and lighting. Each section includes diagrams, examples, instructions, and a short quiz. In the ‘Virtual Photography’ section, you can adjust factors such as f-stop and shutter speed to see instantly how the photograph changes. The web site also contains a cross-referenced glossary, links to other sites, a gallery of student images, and a description of how digital photography was used to take pictures on Mars.”

This website covers cameras, film, paper and printing, and lighting. Very interactive and dynamic. There are diagrams, examples, instructions, and a short quiz. With the virtual camera simulation, you can adjust the f-stop and view results instantly. The web site also contains links to other sites, a gallery of student images, and a description of how digital photography was used to take pictures on Mars.

8. Virtual studio : CD-Rom Application.	
Virtual studio Lighting Techniques : Brown and Cruickshank (2003) utilize a 3D computer-generated model to explain the effects of directional lighting called 'The Virtual Studio' and highlight the benefit that this technique can offer. Despite the prevalence of certain technical defects, it allows the choice of different poses of a human reference figure in combination with the type of light source and direction and displays the resulting outcome. It is simple to use and the student is able to recognize the effects quickly, which aids in recollection during fieldwork. This model shows different poses of a 3D mannequin figure and the different effects lighting have on it. Students alter the lighting and poses, and view the results instantly. It is interactive and very easy to use and aids in the learning and understanding of the topic.	 

<table>
<tr><td colspan="2">9. Liquid Sculpture : <u>http://www.liquidsculpture.com/dof.htm</u></td></tr>
<tr><td rowspan="2">Depth of field simulator. This website allows you to simulate the depth of field by changing the settings on the lens part of the simulator. It is easy to use but assumes that the user has some knowledge of depth of field. However, the website is clear and concise and would be a good aid to learn and understand depth of field (if you already have some knowledge).
Another good feature about this is that it has different lenses for different makes, so you can simulate what depth of field would look like on a Nikon camera; for example. The images used are 3D mesh objects, which illustrate the point but are not really dynamic enough as an illustration, perhaps actual 3D models would have made this website more dynamic and more visually interesting.</td><td>
</td></tr>
<tr><td>
</td></tr>
</table>

This critical review was planned to critically evaluate these nine selected e-learning resources (websites, CD-Rom, DVD) for photography to identify different strengths and weaknesses and point out gaps and good practices in order to help in developing an improved design methodology and, ultimately, better e-learning resources.

The evaluation process was initially carried out by the researcher himself but later involved the end user, the students. The resources selected for subsequent evaluation and feedback by students are presented in chapter 6. The output of chapter five is the determination of five resources for further investigation. The five resources selected are based on the results of the 'critical review' of e-learning resources, in which the two best resources, the poorest resource and two resources considered average were reviewed. The findings of the critical review helped to establish a benchmark to enable a comparison between resources developed in a later stage with our design model and the most highly rated existing e-learning resources.

The next sections explain how each of the e-learning resources was evaluated by the researcher and studied on the basis of the factors highlighted. This is followed by the data analysis, findings from critical review and summary of the chapter.

5.7. The *c*riteria and *s*tages used for the critical review process

For ease of understanding*,* the researcher divided the critical review processes, which were based on Laurillard (2002), into five sets of criteria and stages, as follows:

1 General Design Factors
2 Pedagogical Design Factors
3 Type of learning experience and media used
3A Achieving learning outcome
3B Level of Motivation
4 Effectiveness of Multimedia Components.
5 Overall rating of the website.

The details of the criteria, the stages, and the guide forms used by the researcher to conduct the review are shown in Table **5-4** below.

Table 5-4 Criteria and Stages used for the critical review.

No.	Criterion/Stage	Appendices
1	General Design Factors	Appendix 5-2
2	Pedagogical Design Factors	Appendix 5-2
3	Type of learning experience and media used	Appendix 5-2

3A 3B	- Achieving learning outcome - Level of Motivation	Guide form 3A (Appendix 5-3) Guide form 3B (Appendix 5-4)
4	Effectiveness of Multimedia Components.	Appendix 5-2
5	Overall rating of the website.	Appendix 5-2

At this initial stage of the research, the researcher is of the opinion that the criteria and stages are designed to cover all the research questions. The details of the criteria will be discussed in depth in the following paragraphs of this chapter.

5.7.1. Stage 1 General Design Factors

The general design factors have reviewed seven items, as shown in Appendix 5-2 of this study. The researcher adopted the following seven items determined by Nielsen (1994) as general design factors.

1. Page organization/layout
2. Ease of navigation
3. Organization of information
4. Clarity of instructions
5. Ability to search and find the information
6. Ability to identify the site purpose of from the first page
7. Range of functions and information available

These design factors within the website were rated using a 5-point Likert scale. The rating codes used were as follows.

5 - Very Good, 4 – Good, 3 – Fair, 2 – Poor, 1 - Very Poor, N/A Not Applicable

5.7.2. Stage 2 Pedagogical Design Factors

The Pedagogical design criteria are based on Nielson's (1994) with some extensions adapted from Squires & Preece (1999).

The pedagogical design factors have fifteen items which are reviewed, as shown in Appendix 5-2 of this study.

2.1 Clarity of objectives (learning outcomes)

2.2 Extent to which the content reflects the objectives.

2.3 Extent to which learning activities relate to the objectives.

2.4 Quality of feedback provided on success in learning activities

2.5 The website's ability to motivate learner's attention

2.6 Provision of progressively more difficult tasks

2.7 Ability to deliver content in multi languages

2.8 Ability to interrupt application at any stage

2.9 Extent to which the website provides clear expectations of what the learner is required to do during the study

2.10 Appropriateness of multimedia components to the learning experience.

2.11 Effectiveness of sites in meeting learning objectives

2.12 Ability to work through topics step by step

2.13 Ability to retrace steps

2.14 Ability to work through topics in order determined by user

2.15 Provision of help and guidance on how to use the application

These pedagogical design factors within the websites were rated using a 5-point Likert scale based on the following rating codes:

5 - Very Good, 4 – Good, 3 – Fair, 2 – Poor, 1 - Very Poor, N/A Not Applicable

5.7.3. Stage 3 Type of Learning Experience and Multimedia Used

Five different learning experiences, based on Laurillard (2002), have been adopted to examine the applications. The learning experiences and multimedia used are:

2.1 Attending, apprehending

2.2 Investigating, exploring

2.3 Discussing, debating

2.4 Experimenting, practicing

2.5 Articulating, expressing

The details of the multimedia used are as shown in Appendix 5-2 of this study.

Using this as the basis of the review, the author used additional guide forms for rating the effectiveness of these learning experiences in terms of 'addressing the learning outcome' and 'level of motivation' associated with the particular multimedia used. Both the forms for learning outcome and level of motivation are presented below. These two guide forms were validated by the five external referees whose details are shown in Appendix 5-1.

5.7.3.1. Stage 3A - Achieving learning outcome

The 'Achieving learning outcome' guide form referred to in the 'Type of learning experience and media used' section above is presented as Appendix 5-3 of this study. The researcher evaluated 'Achieving learning outcome' for both *Attending, apprehending* and *Investigating, exploring* learning experiences, using this prescribed form as a guide.

In order to improve objectivity, this guide was presented and validated by a group of five experts at the University of Bahrain, as indicated in Appendix 5-1

There are 8 items reviewed at this stage of the study, to measure the Achieving learning outcome factor by expert whom validate this questionnaire guide and they are the following:

1- Facilitating the learning experience.

2- Enhancing learning.

3- Delivering methods according to content and target group.

4- Ensuring the positive role of learner

5- Developing learner attitude to word self study

6- Reinforcing the content objective

7- Showing awareness of the impact of learning style

8- Providing feedback

5.7.3.2. Stage 3B Level of Motivation

The ‘Level of Motivation’ form referred to in the ‘Type of learning experience and media used’ section above is presented as Appendix 5-4 of this study.
The same validation guide was used to measure the motivation factors, and this is the same as validating learning outcome and motivation, as discussed earlier. The form was validated by experts in the same way as the previous guide form (see Appendix 5-1).

The researcher evaluated level of Motivation for both *Attending, apprehending* and *Investigating, exploring* learning experiences using this form as a guide in Appendix 5-4.

There are five items reviewed at this stage to measure the Motivation factor by expert whom validate this questionnaire guide. The items are:

1- Level of attention
2- Interaction
3- Time of involvement
4- Number of media technology used in each resource.
5- Feedback

Figure 5.1 below shows the five learning experiences recognized in the literature review. However, only the first two learning experiences were found. The other three learning experiences of *Discussing, debating*; *Experimenting, practicing* and *Articulating, expressing* were not found and so there is no rating for them. As such, the researcher only discusses *Attending, apprehending* and *Investigating, exploring* as part of the critical review in this chapter. This is reflected diagrammatically in Figure 5.1 below, with the Kodak website given as an example, to show how the guide is implemented in Stage 3 of the critical review with regard to the type of learning experience and media used.

At this point, it is important to note that *Investigating and Exploring* has low level of interaction with few inputs, but *Experimenting and Practicing* has high level of interaction with many inputs. Due to this, all e-Learning resources do not reach the level of *Experimenting and Practicing*.

3	Type of learning experience and media used (Kodak website)																		
	Select the learning experience used in the e-learning material and the media used			Rate the media used with the following Rating from 5 = very effective to 1= ineffective															Comments
				Addressing learning outcome									Motivation						
				1	2	3	4	5	6	7	8		1	2	3	4	5		
	Learning Experience	Use	Multimedia Technology used	Facilitating the learning experience.	Enhance learning.	Delivering methods according to content and target group.	Ensuring the positive role of learner	Developing learner attitude to word self study	Reinforcing the content objective	Showing awareness of the impact of learning style	Providing feedback	Average rate	Level of attention	Interaction	Time of involvement	Number of media technology used	Feedback	Average rate	
3.1	Attending, apprehending	Yes	T, Ph, S, V	4	4	4	1	4	5	4	1	3.38	4	1	4	4	1	2.8	
3.2	Investigating, exploring	Yes	Sim.	4	4	4	4	4	4	4	5	4.125	4	4	3	4	4	3.8	
3.3	Discussing, debating	No	Not applicable									N/A						N/A	
3.4	Experimenting, Practicing	No	Not applicable									N/A						N/A	
3.5	Articulating, expressing	No	Not applicable									N/A						N/A	
T=Text , Ph=Photographic, S=Sound, V=Video, SIM=Simulation,																			

Figure 5.1 Guide form.

5.7.4. Stage 4 - Effectiveness of Multimedia Components

The effectiveness of Multimedia components was examined by the researcher. The components reviewed were:

4.1 Ease of use

4.2 Clarity of content

4.3 Level of Engagement

4.4 Level of Enjoyment and fun

4.5 Level of Learning

Each one of these four items is reviewed against the following six sub-items:

1. Text
2. Photographic
3. Illustrations

4. Sound
5. Animations
6. Simulations

The form has an additional column for comments.

The guide form used by the researcher to conduct the critical review is based on the form shown as Appendix 5-2 of this study.

5.7.5. Overall rating of the Website

This is the last stage of the critical review conducted by the researcher. In this stage the researcher conducted a review as to the Overall effectiveness of the web site as a learning aid of all the E-learning resource. This is done in relation to Q1 of the research question of this thesis. Two units were measured here: first, the use of advanced multimedia, such as video, animation and simulation, as a cognitive learning tool*; s*econd*,* the overall effectiveness of the application as a learning aid. The form has an additional column for comments.

5.8. Data analysis of the critical review

In this section the researcher presents the results which are drawn from the individual review conducted by the researcher in this study.

The researcher is a well qualified and experienced person to assess the materials evaluated. He is an expert in photography and in teaching photography for the last 22 years experience. Out of this he has 15 years of experience in evaluating learning materials, and 12 years of experience in evaluating interactive learning materials. The experience gained by the researcher is by way of practical on the job experience rather than by academic study. This study will very well compliment the existing expertise and experience.

5.8.1. General design factors

In compiling the results for general design factors, the highest mean value was scored by Kodak and Photonhead, which scored (3.70) each. This was followed by Photo Net which scored a mean of (3.10). Photo Interactive site was next with a mean of (3.00). Following this was Virtual studio with a mean score of (2.60) and Liquid Sculpture obtained a score of (2.40). Norman Koren had a mean score of (2.30), followed by Foto Info, which scored a mean of (1.90) and, lastly, Prof. Photography obtained the lowest mean of (1.60). The details are shown in Figure 5.2 below.

In relation to general design factors, it was found that the Kodak and Photonhead websites had the greatest potential to enhance learning motivation and the experience of users, due to the effective use of a range of functions and information, ease of navigation and clarity of instruction.

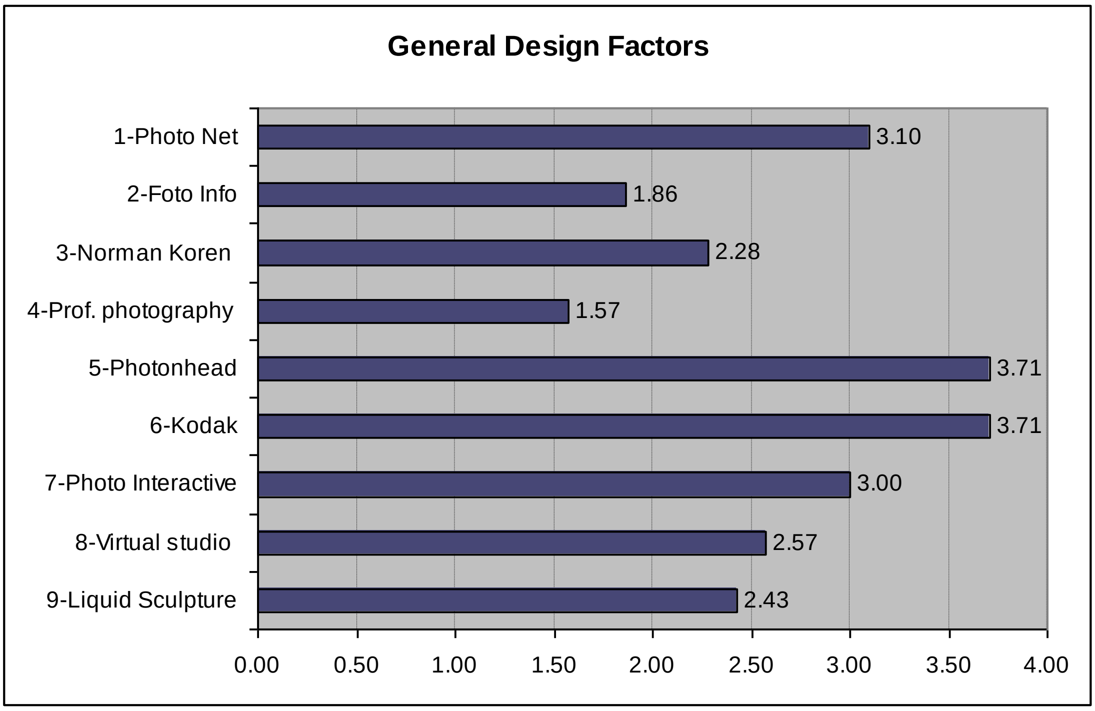


Figure 5.2 General design factors.

5.8.2. Pedagogical design factors

Kodak and Photonhead obtained the highest mean value of (3.90) in the pedagogical design factors. Virtual studio scored a close (3.80). Liquid Sculpture was next with a mean of (2.90). This was followed by Photo Interactive with a mean score of (2.40), with Norman Koren coming next with a mean of (1.90). Photo Net obtained a score of (1.90), and Foto Info a mean of (1.50). The lowest in the group was Prof. Photography with a mean of (1.10), as can be seen in Figure 5.3 below.

In terms of pedagogical design factors, Figure 5.3 indicates the appropriateness of multimedia components to the learning experience and high quality media rich content. Consequently, the learning activities of Kodak and Photonhead websites would help to achieve learning objectives by improving learning attention and engagement.

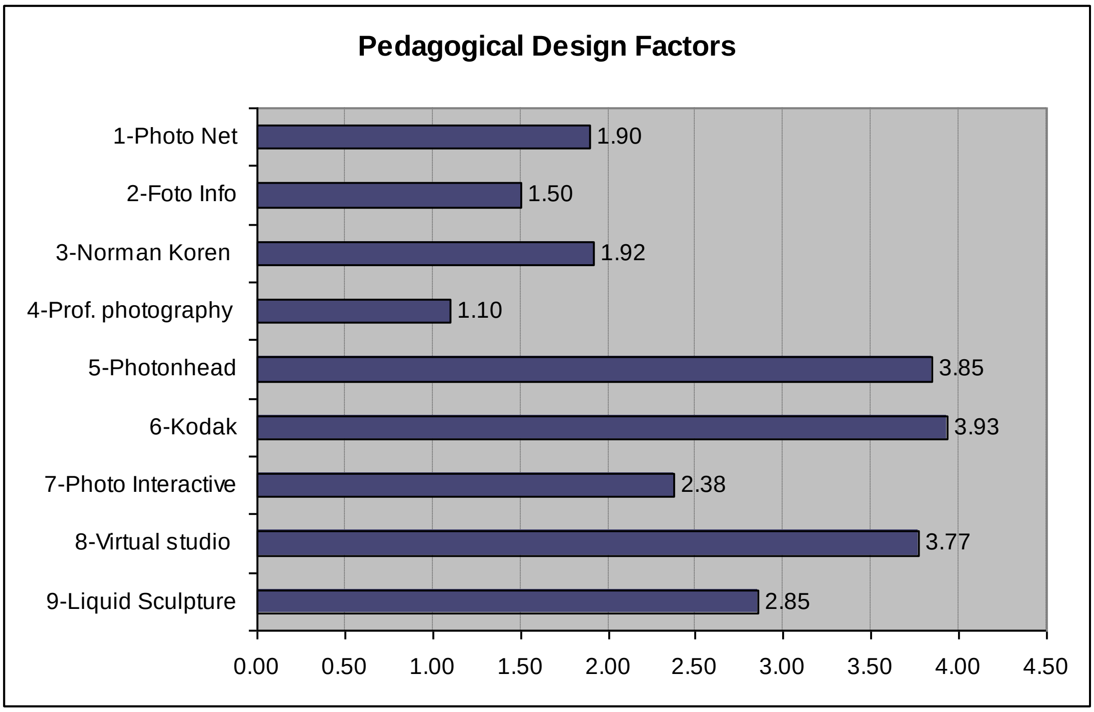


Figure 5.3 Pedagogical Design Factors.

5.8.3. Type of learning experience and multimedia used

Of the nine different e-learning resources, the researcher investigated five different learning experiences and multimedia used. However, the results only indicate two types of learning experiences and multimedia, with the other three not being applied in the nine e-learning resources.

All nine e-learning resources considered in this study engaged in the *attending and apprehending* learning experience. Not all the resources had the *investigating and exploring* learning experience in their resources. In Figure 5.4 and Figure 5.5 shown below, the value of (0.00) is a reflection of a learning experience which is 'Not Applicable' in the resources.

The resources which had *investigating and exploring* as part of their learning experience are Photo net, Photonhead, Kodak, Photo Interactive, Virtual studio and Liquid Sculpture.

This is an important finding as it indicates that the current resources do not use all the available types of learning experience.

5.8.3.1. Achieving learning outcome

With regard to 'achieving learning outcome', Photo Net, Foto Info, Norman Koren and Prof. Photography perform better in *Attending, apprehending* than in *Investigating, exploring*. On the other hand, Photonhead, Kodak, Photo Interactive, Virtual studio and Liquid Sculpture all perform better in *Investigating, exploring* compared to *Attending, apprehending* in achieving learning outcome, as shown in Figure 5.4 below.

In terms of the 'achieving learning outcome' factor, not only did Photonhead and Kodak accommodate learning of basic information through *attending and apprehending*, they also addressed more complex learning objectives using *exploration and investigation*, as shown in Figure 5.4 below.

Photonhead and Kodak accommodate the learning of basic information through *attending and apprehending* more than other e-learning resources, due to facilitating the learning experience and reinforcing the content objective. The more complex learning objectives using *exploration and investigation* are more applicable to Photonhead, where ‘Enhance learning’ and ‘Providing feedback’ performed better; whereas for Kodak only ‘Providing feedback’ is better than the performance value as compared to *attending and apprehending*.

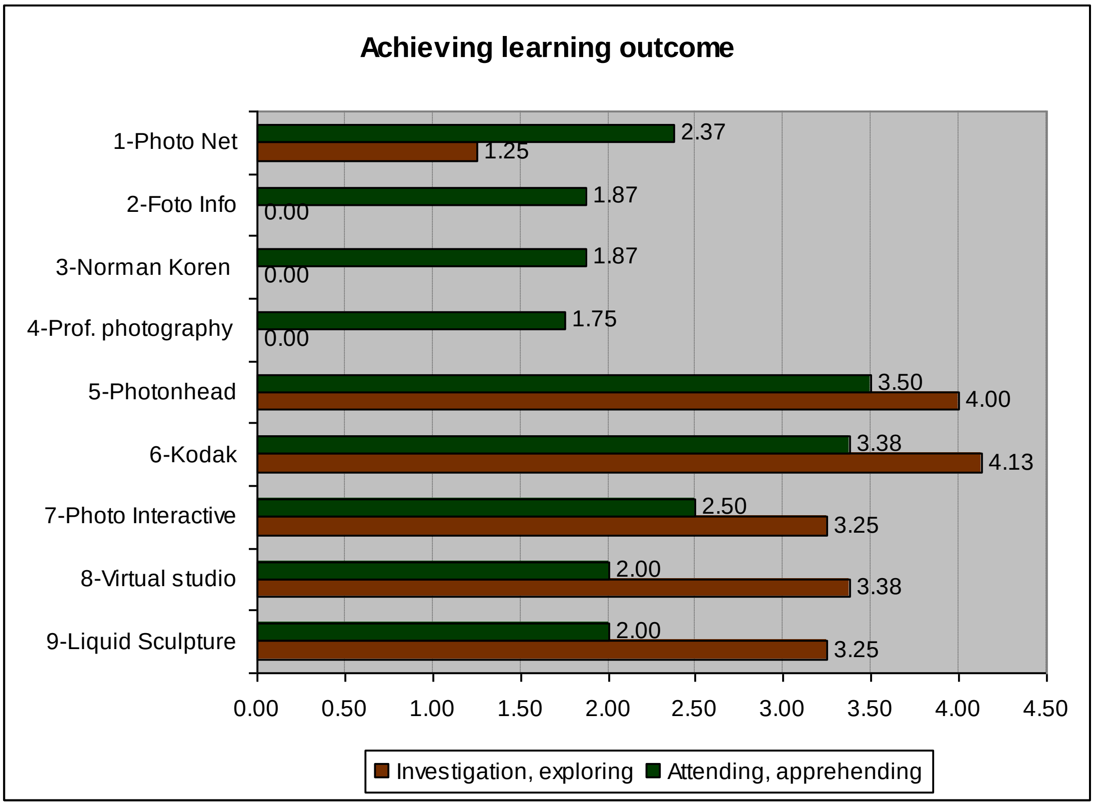


Figure 5.4 Achieving learning outcome.

5.8.3.2. Level of Motivation

In assessing level of motivation, Photo Net, Foto Info, Norman Koren and Prof. Photography perform better in *Attending, apprehending* than in *Investigating, exploring*. Conversely, Photonhead, Kodak, Photo Interactive, Virtual studio and Liquid Sculpture all perform better in *investigating, exploring* compared to *attending, apprehending* in terms of level of motivation, as shown in Figure 5.5 below.

In terms of the level of motivation factor, Kodak and Photonhead performed better in *investigating, exploring*' compared to *attending, apprehending*. Both Kodak and Photonhead achieve this through providing better interaction and feedback.

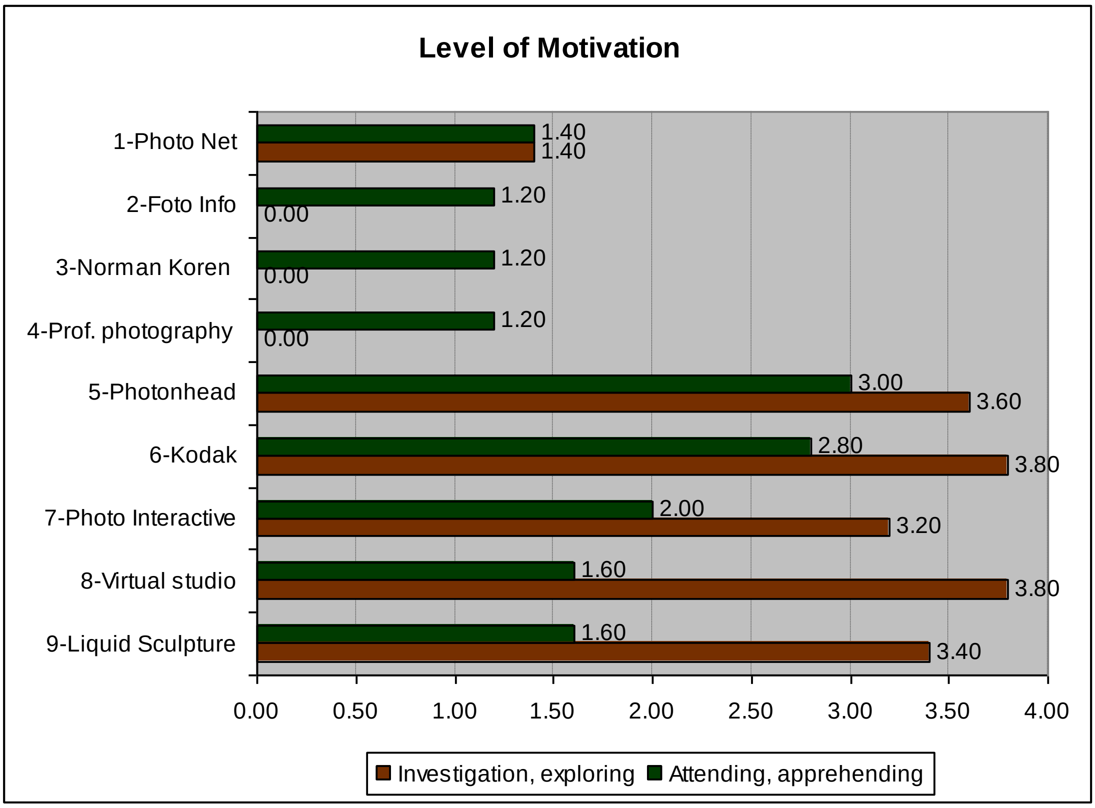


Figure 5.5 Level of Motivation.

5.8.4. Effectiveness of multimedia components

The researcher investigated the different multimedia content of the resources in relation to Ease of use, Clarity of content, Level of engagement, level of enjoyment and fun and level of learning. The different multimedia content of the applications are Text, Photographic Images, Illustrations, Sound, Animation and Simulations, as shown in the first column of Table 5-5 below which presents the results of the multimedia components in a tabular format.

For the Text component, Photo Net, Norman Koren, Photonhead and Kodak all scored the same mean of (3.00) for ease of use. Photonhead and Kodak scored the highest mean values for clarity of content, level of engagement, level of enjoyment and fun, and level of learning. The values are (3.00), (4.00), (3.00) and (4.00) respectively.

For the Photographic images component, Photonhead and Kodak scored the highest mean for ease of use, level of engagement, level of enjoyment and fun and level of learning, with a mean of (4.00) for each of the categories. However, the maximum mean, of (5.00), was scored by Kodak for clarity of content.

For the Illustrations component, Photonhead shared a common mean value of 4 for ease of use and clarity of content. Photonhead obtained a mean of (3.00) for level of engagement, level of enjoyment and fun, with Photo interactive obtaining the same score, (3.00), for level of learning.

For the Sound category, Kodak scored the highest mean for all the four levels of ease of use, clarity of content, level of engagement, level of enjoyment and fun and level of learning, with a common mean of (4.00) in all the categories.

For the Animation component, Photonhead scored the highest for all the four levels of ease of use, clarity of content, level of engagement, level of enjoyment and fun and level of learning with a mean of, (3.00), (3.00), (4.00) and (4.00) respectively.

For the Simulations component, Photonhead and Kodak scored (5.00) for both ease of use and Level of learning. Again, for level of engagement, level of enjoyment and fun, Photonhead and Kodak scored a mean of (4.00) while Kodak scored a mean of (5.00) for clarity of content.

Table 5-5 **Summary data for effectiveness of multimedia components.**

Multimedia content of the application	Ease of use		Clarity of content		Level of engagement		Level of enjoyment and fun		Level of learning	
Text	Photo Net Norman Koren Photonhead Kodak	3	Photonhead Kodak	4	Photonhead Kodak	3	Photonhead Kodak	3	Photonhead Kodak	4
Photographic Images	Photonhead Kodak	4	Kodak	5	Photonhead Kodak	4	Photonhead Kodak	4	Photonhead Kodak	4
Illustrations	Photonhead	4	Photonhead	4	Photonhead	3	Photonhead	3	Photo interactive	3
Sound	Kodak	4	Kodak	4	Kodak	4	Kodak	4	Kodak	4
Animation	Photonhead	3	Photonhead	3	Photonhead	4	Photonhead	4	Photonhead	4
Simulations	Photonhead Kodak	5	Kodak	5	Photonhead Kodak	4	Photonhead Kodak	4	Photonhead Kodak	5

A key observation from Table 5-5 is that the highest scores are associated with the use of "advanced multimedia" content, as shown in Table 5-6 below. Five of these components, including Text, Photographic images, Illustrations, Sound and Animation, are basic multimedia components, and the Simulations component is an advanced multimedia content.

In Ease of use, the basic multimedia components of Text, Photographic images, Illustrations, Sound and Animation scored an average of (3.60), while the advanced multimedia component obtained a score of (5.00).

In Clarity of content, the basic multimedia components of Text, Photographic images, Illustrations, Sound and Animation obtained an average score of (4.00), with the advanced multimedia component scoring (5.00).

For level of engagement, the basic multimedia content of Text, Photographic images, Illustrations, Sound and Animation scored an average of (3.60), while the advanced multimedia component scored (4.00).

For level of enjoyment and fun, the basic multimedia content of Text, Photographic images, Illustrations, Sound and Animation scored an average of (3.60), while the advanced multimedia component scored (4.00).

In Level of learning, the basic multimedia components obtained an average score of (3.80), while the advanced multimedia component scored (5.00).

Table 5-6 Multimedia and advanced multimedia average.

<table>
<tr><th>Level of media</th><th colspan="2">Multimedia content of the e-learning resources used</th><th>Ease of Use</th><th>Clarity of Content</th><th>Level of Engagement</th><th>Level of Enjoyment and Fun</th><th>Level of Learning</th></tr>
<tr><td rowspan="5">Basic Multimedia components</td><td>Text</td><td rowspan="5">Average</td><td rowspan="5">3.60</td><td rowspan="5">4.00</td><td rowspan="5">3.60</td><td rowspan="5">3.60</td><td rowspan="5">3.80</td></tr>
<tr><td>Photographic images</td></tr>
<tr><td>Illustrations</td></tr>
<tr><td>Sound</td></tr>
<tr><td>Animation</td></tr>
<tr><td>Advanced Multimedia component</td><td colspan="2">Simulations</td><td>5.00</td><td>5.00</td><td>4.00</td><td>4.00</td><td>5.00</td></tr>
</table>

5.8.5. Overall rating

Kodak and Photonhead were the best overall, with a mean of (4.00). Next were Liquid Sculpture, Virtual studio and Photo Interactive, each obtaining a mean of (3.00). Photo Net scored a mean of (2.50). This was followed by Professional Photography, Norman Koren and Foto Info, each scoring a mean of (2.00). The details are as shown in Figure 5.6 below.

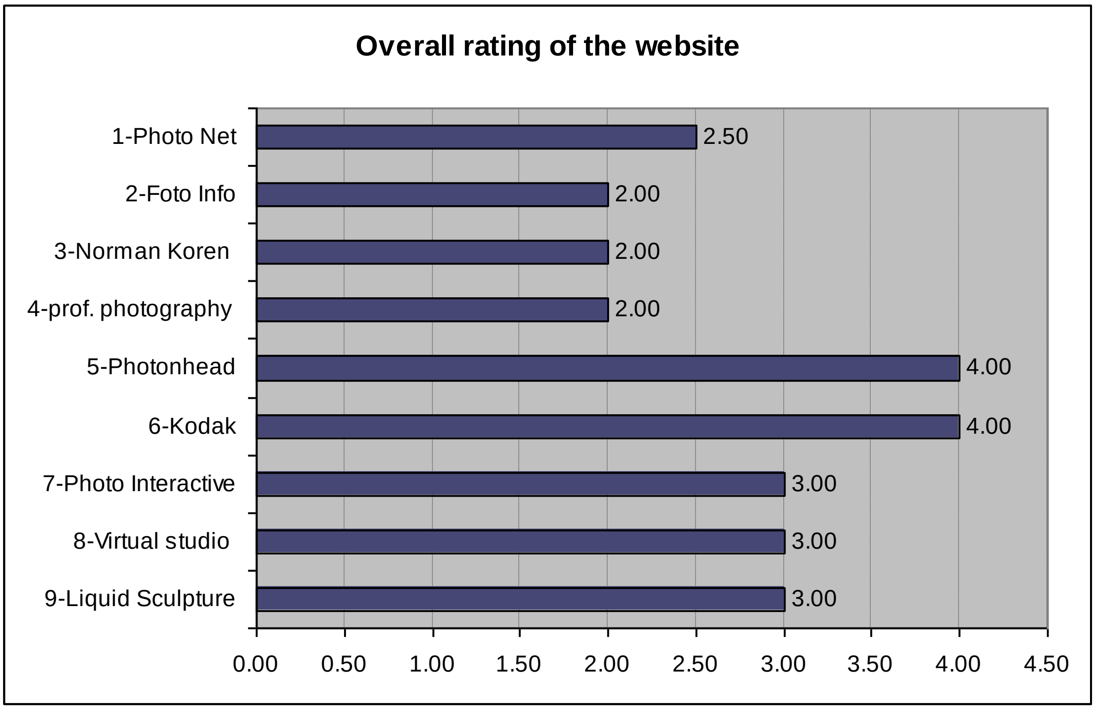


Figure 5.6 Overall rating of the website.

5.9. Findings from the Critical Review

From the critical review, it was found that the Kodak and Photonhead websites had the greatest potential to enhance learning motivation and the experience of users, due to the effective use of a range of functions and information, ease of navigation, clarity of instruction and effective performance feedback. Moreover, it was felt that the high quality media rich content in the learning activities in these websites would help to achieve learning objectives by improving learning attention and engagement, with the use of simulation, animation, photographic images and sound.

The critical review indicates the positive need for e-learning resources to solve photography teaching problems, such as lack of staff and equipment, raised by British and Bahraini teachers and students.

In contrast, it was felt that the Professional Photography training CD-ROM, Foto-Info and Norman Koren would fail to sufficiently motivate and engage the users to explore and learn due to poor page organization and layout, poor organization of information and the limited range of information available. Furthermore, the scores determined that these resources would fail to meet the learning objectives due to uninspiring media poor content, such as lengthy text and inadequate photographic images, a lack of clear learning objectives, and absence of feedback on the users' success in learning activities.

The Kodak and Photonhead websites were easier to use and provided appropriate well-organized content and feedback. They also used multimedia, such as camera simulation, animation, photography images and sound in order to generate interest and provide engagement and motivation. In addition, not only did they accommodate learning of basic information through *attending, apprehending*', they also addressed more complex learning objectives using *investigating, exploring*, which are required to understand the more complex topics such as depth of field and lighting techniques.

This critical review was originally carried out to discover the strengths and weaknesses of websites, and to embark on the best combination of media technology that may serve the purposes of photography teaching and alleviate its problems. However, the review has some limitations. These can be summarized as follows:

• Subjectivity: the researcher was the one who carried out this review and, thus, his judgment is perhaps questionable.
• Despite all efforts and measures taken, tools used in the review were not designed in line with accurate evaluation procedures.

Therefore, it seems logical to find other research and evaluative ways to secure objectivity. This leads us to the next step of this research field work: testing the technology option but, this time, with students. The researcher used triangulation method in conducting this study. Both the qualitative and quantitative methods were used. In this critical review chapter the researcher used qualitative method. In the next student feedback chapter the researcher used quantitative method in order to confirm the results of this critical review.

5.10. Chapter Summary

In this chapter, the researcher conducted an extensive critical review based on the five stages identified earlier in the chapter. Each one of the review stages was carried out and the results presented. Upon conducting an objective critical review of the e-learning resources currently used, it can be safely concluded that the Photonhead and Kodak resources were top in most of the different multimedia contents. These websites used different varieties of multimedia content, for instance Text, Photographic Images, Illustrations, Sound, Animation and Simulations as investigated in this study.

The factors examined in this critical review, including Ease of use, Clarity of content, Level of engagement, Level of Enjoyment and Fun and Level of learning have all contributed to effective learning and experiences in the learning process.

The next chapter will build on this critical review by testing its results in the field with students and tutors, in order to verify them in a more objective approach.

Chapter Six

Student feedback and observation of e-learning resources

6. Student feedback and observation of e-learning resources

6.1. Introduction

In this chapter the researcher set out to study whether the students' view of the selected e-learning resources would support the critical review conducted in the previous chapter. This would provide a more objective evaluation, and hopefully confirm the findings presented in Chapter 5.

In order to conduct the feedback and observation review, the researcher selected forty students from the University of Bahrain, all of whom had completed an introductory course in photography. This number comprises two groups of twenty students each who were available at the time of conducting the feedback. However, two students were not able to complete the feedback, bringing the total number of students who completed the feedback to thirty-eight. The student selection was carried out in Bahrain as the researcher designed the study in such a way, and logistically it would be difficult to do a similar exercise in the UK due to limited resources and funding.

The forty students selected from Bahrain have completed nine years of formal English education by the time they are admitted to the university to study photography degree course. With the nine years of formal English language education the students are generally able to understand the vocabulary related to their study.

For the purpose of this study the term E-learning resources refers to both web sites and CD ROMs, and the use of the word websites is inclusive of CD ROMs. The reason for selecting only five e-learning resources is explained in the following section.

6.2. Selection of E-learning resources

As mentioned above, the selection of e-learning resources is based on the results of the 'critical review' of the resources presented in the previous chapter. The two resources with the best ratings in that review (Kodak and Photonhead); the resource with the poorest rating (Norman Koren) and two other resources considered average (Virtual Studio and Liquid Sculpture) were chosen at this stage to determine whether the views of the students would support the results of the critical review.

Therefore, the e-learning resources selected to be studied further are as follows:

- Kodak website
  http://www.kodak.com/eknec/PageQuerier.jhtml?pq-path=38/39/6369&pq-locale=enGB
- Photonhead website
  http://www.photonhead.com/simcam
- Norman Koren website
  http://www.normankoren.com/index.html#Tutorials
- Virtual Studio CD-Rom
- Liquid Sculpture website
  http://www.liquidsculpture.com/dof.htm

All the nine initial learning resources, including the five selected here, were presented in the form of print screen illustrations in section 5.7.

6.3. Aims of the Student Feedback

The aims of this student feedback are:

- To evaluate the effectiveness of user testing of existing e-learning resources in photography with students;
- To confirm the results of the critical review;
- To examine the potential of media and technology rich learning resources to support learning in photography.

6.4. Participants

As explained in the introduction to this chapter, the participants in this feedback exercise were thirty-eight students. This section will explain the reasons for the choice of the number and nature of the participants.

The main methods for collecting information considered were:

- Face-to-face interviewing / questionnaire; and
- Direct informal observation.

At the end of the questionnaire, the students gave their comments which were initially made in Arabic. These comments were then translated into English by the researcher as part of the data processing.

It was decided that direct observation of the students, and the use of questionnaire completed by them while being observed by the researcher, were the most appropriate research methods for this type of study. This was because the assessor had to observe in person how the students interacted with each resource and what difficulties they faced while using it. This provided more complete data than a questionnaire alone. It also helped to provide quantitative and qualitative feedback on students' reactions to each resource,

6.5. Observation Form

The researcher used an informal observation form to record the activities of the students while they carried out the evaluation. A detailed study of different types of observation, based on Wallin (2001), was made to decide what type of observation would be most suitable for the study. The main aim of the observation was to find out whether the students engaged with the selected e-learning resources and whether they enjoyed using them by observing the following:

- ease of use and getting started with website / CD-Rom
- level of student interaction with the content
- level of engagement with learning activity
- length of time involvement

Standard Operating procedure (SOP)

The researcher conducted the observation in the computer laboratory with four groups of students. The first group was comprised of ten students, the second eleven, the third eight students and the fourth nine. The students attended one of the four sessions planned with the researcher at times allocated to each group, which they joined according to their own choice.

In order to aid the observation sessions, an informal observation format was used, with the researcher observing each one of the students individually. In each session, the students sat in one row with the researcher behind them, not only observing but also supporting them as all the selected resources are in English although the students have nine years of exposure to English from their studies, and they are familiar with the vocabulary used in the photography subject. When they started the exercises, the students had some difficulty but, as they became used to them, they seemed to find the exercises interesting and enjoyable.

The observation was assigned a value of 1 to 5 based on the tasks observed:

For level of student interaction with the content, the observation values were 1 for low and 5 for high.

For ease of use and getting started with website / CD-Rom, the researcher observed whether the task was carried out with ease or with difficulty. The range of observation values were 1 for difficult and 5 for easy;

For level of engagement with learning activity, the researcher valued the observation within the range of 1 for low and 5 for high;

To measure engagement, 'length of time' spent with e-learning resources was used because some resources have more learning activities than others depending on their simplicity and/or complexity for the student to think about and understand; thus, reflecting the student's degrees of attention, involvement, and interaction with these resources and activities. For length of time involvement, the researcher observed how long each student spent on each of the resources. The time varied from one student to another and from one resource to another. 1 was assigned for little time spent on the resources, and 5 for longer time spent. The researcher noted down the start and finish times, allowing the average time spent on each of the resources to be calculated for each student. Then the average time was assigned the values of 1 to 5. The results of the student observation are reported in Table 6-11 below.
The Informal Observation Form is presented as Appendix 6-1.

6.6. Student feedback rating scale

The students were asked to rate the selected websites using the following rating scale, as shown in Table 6-1 below.

Table 6-1 Feedback rating scale.

Scale	Description
1	Very Poor
2	Poor
3	Fair
4	Good
5	Very Good

6.7. Student Feedback Factors

Each of the students who took part in the observation session described above was also asked to fill in the ‘Student Feedback Questionnaire’ at the same time (Appendix 6-3). This questionnaire consisted of seven different factors, and each factor was divided into different criteria. Most of the factors and criteria used in the questionnaire were used in the critical review form, but in more detail and with more clarity. However, some factors and criteria were excluded from the ‘Student Feedback Questionnaire’ as they were not relevant to the role of the students as learners. The aim of the questionnaire was to build on the results obtained by the researcher from the results obtained earlier from the critical review, as well as to verify these results using a more objective approach. The main factors mentioned in the ‘Student Feedback questionnaire are as follows:

1. How the main page looks and functions
2. General design of the E-learning resources
3. Navigation of the E-learning resources
4. Learning from the E-learning resources
5. Multimedia content of the E-learning resources
6. Learning Activity
7. Overall rating of E-learning resources

Out of all these seven factors, six are common to all the E-learning resources and one single factor is unique to each of the E-learning resources. The factors 1, 2, 3, 4, 5 and 7 are used to assess all five selected web sites/CD-Rom. Factor 6 refers to each of the different activities assessed in each individual web site/CD-Rom. Both the common and unique factors are presented in Table 6-2 below, and the uniqueness of Factor 6 for each of the websites will be discussed in the respective section of this chapter.

Table 6-2 Common and unique factors of the e-learning resources.

No.	Factors	Status
1.	1, 2, 3, 4, 5 and 7	Common to all. These six factors are common to all and will be used to assess all five selected e-learning resources (web sites/ CD ROM)
2.	6	Unique to each e-learning resource. This one factor, learning activity, is different in all five e-learning resources.

6.7.1. How the main page looks and functions

The items assessed in this factor are:

- Ease of getting started
- Ease of navigation
- Range of functions and information available
- User instructions
- Page organization/layout

6.7.2. General design of the E-learning resources

The items assessed in this factor are:

- Ease of reading text
- Layout of screen
- Clarity of icons
- Use of text to present information
- Use of sound to present information.
- Use of video to present information.
- Use of illustration to present information
- Use of animation to present information.
- Use of simulation to present information.
- Use of color to present information.
- Use of headings and subheadings to organize the information
- Multimedia download speed

6.7.3. Navigation of the E-learning resources

The items assessed in this factor are:

- Ease of use of web site / CD ROM
- Clarity of where to go next
- Clarity of labeled links
- Ability to retrace your steps
- Organization of the web site / CD ROM
- Intuitiveness of interface
- Ease of finding information
- Ability to work through topics step-by-step
- Ability to jump straight to a chosen section.
- Help provided

6.7.4. Learning from the E-learning resources

The items assessed in this factor are:

- Interest level of content
- Feedback provided on success in learning activities
- Step-by-step guidance to learning activities
- Degree to which e-learning resources (web sites or CD ROM) helped you learn

6.7.5. Multimedia content of the E-learning resources

The items assessed in this factor are:

- Ease of use
- Clarity of content
- Level of learning
- Level of engagement
- Level of enjoyment and fun

6.7.6. Learning Activity

In this section, the researcher examines the student feedback on the e-learning activity on photography available in each of the e-learning resources (web sites and CD ROMs). The availability of a learning activity in the resources is an indication of rich media is being used, and the various resources have different learning activities. Some of the selected resources have an instant feedback function and others do not; one resource does not have a learning activity at all. The researcher based the format of the activities on the work of Susan Lister "An Action Research Project" (2005). The details of the learning activities are described in Table 6-3 below.

Table 6-3 Unique learning activities of the selected e-learning resources.

E-learning resources	Learning activity 1	Learning activity 2	Learning activity 3	Learning activity 4	Learning activity 5	Learning activity 6
Norman Koren	None	None	None	None	None	None
Photonhead	Shutter & Aperture	Film Speed	Camera Shake	None	None	None
Kodak	Locking the Focus	Using a Plain Backgrou nd	Moving It from the Middle	Knowing Your Flash's Range	Watching the Light	Troublesh ooting Your Pictures
Liquid Sculpture	Aperture	Lens focal length	Distance to subject	Film format	Changing the model	Easy to interact with model
Virtual Studio (Understandi ng the light)	Effect of the light on the model position	Effect of the light on the pose position	Effect of the type of light beam	Direction of the light position	Concept of shadow	None

6.7.7. Overall rating of E-learning resources

The items assessed in this factor are:

- I would use these e-learning resources to help with my studies.
- This is an excellent learning resource.
- The use of advanced multimedia is a very helpful learning tool
- I would still need help from staff to study this topic

6.7.8. Students' Comments

At the end of the students' feedback form, the researcher asked the following three open-ended questions for each e-learning resource:

- What are the major strengths of e-learning resources?
- What are the major weaknesses of e-learning resources?
- How can e-learning resources be improved?

The students made many comments in response to these questions, but the researcher chose to cite only those which seemed more important due to their high percentage of frequency in the students' answers. In this section, the researcher included only the comments which complimented student feedback with the researcher's observation and has left out other irrelevant comments.
The students' comments are listed in Appendix 6-3. Those that are repeated are numbered, which gives an insight into what the students were thinking while evaluating the e-learning resources. The main comments made by the students which support the arguments presented in the critical review are included here.

As no two student's comments are the same, the researcher interpreted those words of similar meaning. Upon assigning a common meaning, the frequency of each comment is taken as a group and calculated into a percentage of the total comments for each e-learning resource. The comments were initially made in Arabic, which was then translated into English by the researcher.

6.8. Analysis of the students' feedback

The researcher analyzed all seven factors identified earlier one by one. There are many items within each factor; therefore, the analysis is done with all the items in a factor. When conducting the analysis of all the items within a factor, the items are ordered from the highest mean value to the lowest mean value in order to enhance clarity and visibility in their presentation. Moreover, a

comparison of the results of this analysis with the critical review results presented in Chapter 5 can be seen in
Table 6-12 below.

6.8.1. Factor 1 - Main page looks and functions

In the results compiled for ‘main page looks and functions’, it can be seen that the Kodak and Photonhead websites have the highest average scores of (4.12) and (4.06), as shown in the student feedback results in Table 6-4 below.

The table shows that Photonhead has the highest rate of (4.50) for ease of getting started. Kodak has the highest rate of (4.35) for range of functions & information available, and (4.15) for user instructions. Photonhead and Kodak have equally high rates (4.15) in the ease of navigation category.
Norman Koren has the lowest average score of (3.12). It was particularly poor in terms of page organization / layout with a score of (2.40). This was confirmed by the students’ comments, where 33% of the students agreed that the weaknesses of the Norman Koren website in terms of page organization / layout were in the order of the headings and subheadings (See Appendix 6-1).

Table 6-4 Main page looks and functions.

Main page looks and functions	Norman Koren	Photonhead	Kodak	Liquid Sculpture	Virtual Studio
Ease of getting started	3.90	4.50	4.10	3.75	3.55
Ease of navigation	3.45	4.15	4.15	3.50	3.45
Range of functions and information available	3.00	3.80	4.35	3.20	3.20
User instructions	2.85	3.90	4.15	3.10	3.40
Page organization/layout	2.40	3.96	3.85	3.30	3.05
Average	3.12	4.06	4.12	3.37	3.33

The details of the feedback results from Table 6-4 are shown in a bar chart in Figure 6.1 below for easier identification.

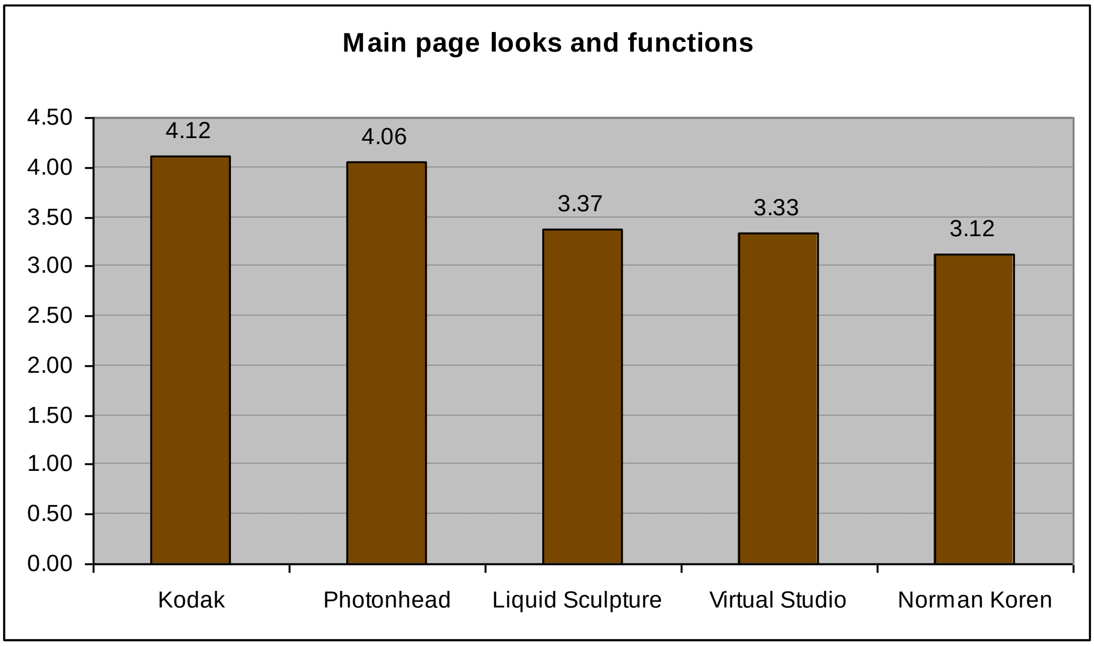


Figure 6.1 Main page looks and functions.

6.8.2. Factor 2 - General design of E-learning resources

Based on the information presented in Table 6-5 below, the student feedback results for general design of the website show that the Kodak and Photonhead websites obtained the highest average scores of (4.00) and (3.88), respectively. Table 6-5 shows that Photonhead has the highest rate (4.35) for use of text to present information, but the lowest rate, of (2.35), on use of illustration to present information. The categories where Kodak has the highest rate are use of sound to present information (4.20), and use of color to present information (4.50). This was supported by students' comments, where 42% of the students agreed that Kodak has an excellent use of multimedia components, such as sound, as can be seen in Appendix 6-3.

On the other hand, Norman Koren has the lowest average score of (2.93). It was particularly poor in terms of use of heading and subheadings to organize information (2.50) and for colour to present information (2.60). This was also drawn from the students' comments, where 33% of the students agreed that the weaknesses in the Norman Koren website was again in the order of the headings and subheadings, as shown in Appendix 6-2.

It should be mentioned that only Kodak provided sound no site used video, and animation was provided only in Photonhead.

Table 6-5 General design of the E-learning resources.

General design	Norman Koren	Photonhead	Kodak	Liquid Sculpture	Virtual Studio
Ease of reading text	3.25	4.20	4.00	4.30	4.15
Layout of screen	3.35	4.25	3.70	3.55	3.45
Clarity of icons	3.35	4.05	4.15	4.15	3.30
Use of text to present information	0.00	4.35	3.80	3.40	3.95
Use of sound to present information.	0.00	0.00	4.20	0.00	0.00
Use of video to present information.	0.00	0.00	0.00	0.00	0.00
Use of illustration to present information	0.00	2.35	3.65	3.15	3.70
Use of animation to present information.	0.00	0.00	0.00	0.00	0.00
Use of simulation to present information.	0.00	4.20	4.00	3.05	3.10
Use of colour to present information.	2.60	4.05	4.50	3.35	3.55
Use of headings and subheadings to organize the information	2.50	4.20	4.20	3.20	3.35
Multimedia download speed	2.55	3.30	3.75	3.15	3.95
Average	2.93	3.88	4.00	3.48	3.61

The results displayed in Table 6-5 above, and the discussions of the results as presented above, are captured graphically in a bar chart as Figure 6.2 below.

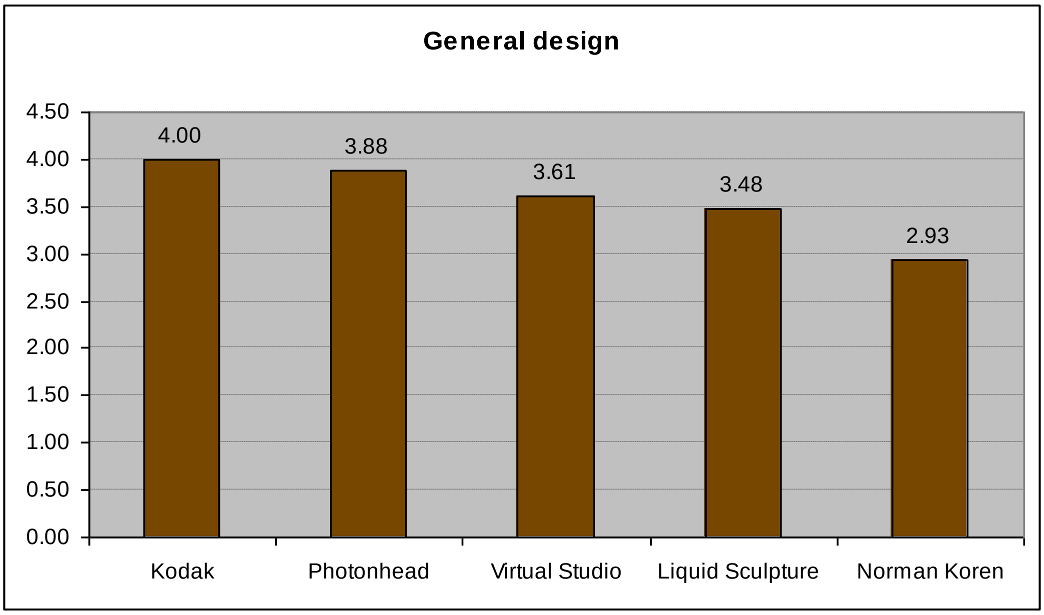


Figure 6.2 General design.

6.8.3. Factor 3 - Navigation of the E-learning resources

The student feedback results for navigation of the website/ CD ROM show that Kodak, Photonhead and Virtual Studio CD-Rom have the highest average scores of (3.81), (3.79) and (3.75) respectively. The details are presented in Table 6-6 below.

Table 6-6 Navigation of the E-learning resources.

Navigation of the Website/CD ROM	**Norman Koren**	**Photonhead**	**Kodak**	**Liquid Sculpture**	**Virtual Studio**
Ease of use of website	3.40	4.25	4.00	4.05	3.90
Clarity of where to go next	3.15	3.80	3.80	3.80	4.05
Clarity of labeled Links	3.05	3.70	4.05	3.80	3.75
Ability to retrace your steps	2.30	3.55	3.70	3.80	4.10
Organization of the website	2.05	3.95	4.00	3.85	3.70
Intuitiveness of interface	1.85	4.00	3.70	3.35	3.70
Ease of finding information	2.45	4.30	3.75	3.25	3.85
Ability to work through topics step-by-step	2.15	3.95	3.55	3.50	4.15
Ability to jump straight to a chosen section.	2.55	3.95	4.15	3.70	3.70
Help provided	2.10	2.40	3.40	2.40	2.60
Average	2.51	3.79	3.81	3.55	3.75

As can be seen from the table, Photonhead has the highest rate (4.25) for ease of use of website, and for ease of finding information (4.30). However, Kodak has the highest rate (4.15) for ability to jump straight to chosen section. Virtual studio has the highest rate (4.15) for ability to work through topics step-by-step.

The lowest average scores (2.50) were given to Norman Koren. It was particularly poor in terms of ability to retrace your steps (2.30), for organization of the website (2.05), for intuitiveness of interface (1.85), for ease of finding information (2.45), for ability to work through topic step-by-step (2.15), for ability to jump straight to a chosen section (2.55), and for help provided (2.1).

The discussion of the results presented above, together with the details of the results shown in Table 6-6 , is summarized in a bar chart in Figure 6.3 below.

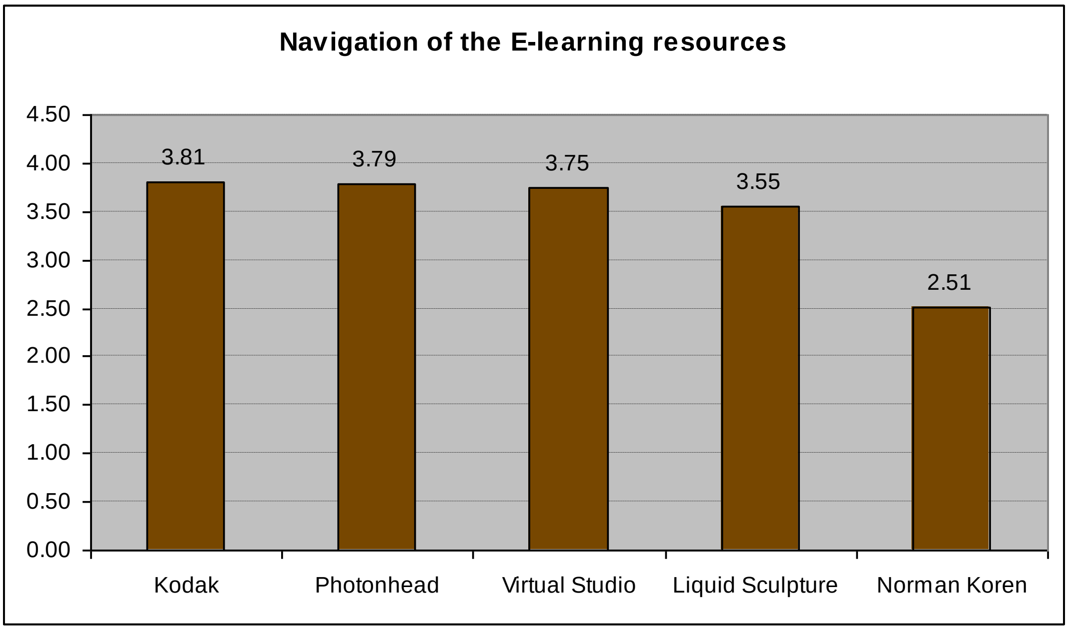


Figure 6.3 Navigation of the E-learning resources.

6.8.4. Factor 4 - Learning from the E-learning resources

The student feedback results for learning from the web site shows that the Kodak website is the most successful e-learning resource, because the results indicate that the website has the highest rating in all categories, as well as the average rating of (4.21) as a learning resource within the web site. This is further confirmed by students' comments in that 51% of the students agreed that they learnt about some difficult aspects of photography from the Kodak website in a useful and attractive way. Furthermore, 62% of the students agreed that the interaction provided on the Kodak website through the virtual camera gives the learner a feeling of being present at that event when they are taking the picture (See Appendix 6.1).

The second most successful website was Photonhead, with a mean value of (3.85). The students' comments on how to improve Photonhead point to a suggestion to "increase the interactive learning activities", with 22% of the respondents mentioning this. Another comment from the students is a need for "Increase of use of an interactive multimedia such as simulation, VR Camera" with 23% of the comments, as reflected in Appendix 6-1 of this study.

Virtual Studio was third with a mean value of (3.40), with 33% of the students commenting on the “need to give the virtual studio more reality by using real pictures”.

Norman Koren had the lowest average score of (1.60) because it was excluded from feedback as there is no learning activity provided on the website. Details of the student feedback are presented in Table 6-7 below.

Table 6-7 Learning from the E-learning resources.

Learning from the E-learning resources	Norman Koren	Photon head	Kodak	Liquid Sculpture	Virtual Studio
Interest level of content	2.80	4.00	4.10	3.65	3.65
Feedback provided on success in learning activities	0.15	3.75	4.75	2.40	3.30
Step-by-step guidance to learning activities	1.60	3.50	3.80	2.25	2.8
Degree to which website helped you learn	1.85	4.15	4.20	3.00	3.85
Average	1.60	3.85	4.21	2.83	3.40

As can be seen from the table, Kodak obtained the highest rating in all four categories of learning from the e-learning resources: interest level of content (4.10); (3.75) for feedback provided on success in learning activities; for step-by-step guidance to learning activities (3.50); and (4.15) for degree to which website helped student learn. These ratings are also supported by the students' comments in that 42% of the students agreed that Kodak has a high level of interaction and feedback with the content. In addition, 54% of the students agreed that the virtual environment of the Photonhead learning activity gives the user a feeling of reality (See Appendix 6-1).

Norman Koren had the lowest average score of (1.60), and was particularly poor in terms of feedback provided on success in learning activities (0.15), and step-by-step guidance to learning activities (1.60). This was also supported by students' comments, where 41% of the students agreed that the Norman Koren website did not contain sufficient learning activities and 33% of the students agreed on the lack of interaction and feedback on this website (See Appendix 6-1).

Liquid Sculpture also scored badly with feedback provided on success in learning activities being (2.40), and guidance to learning activities rating only (2.25). This was supported by students' comments, where 35% of the students suggested improving the Liquid Sculpture website, by using real pictures rather than relying on wire frame objects (polygon) which offer less vividness.

The details discussed above, together with the results shown in Table 6-7 above, are presented in Figure 6.4 below.

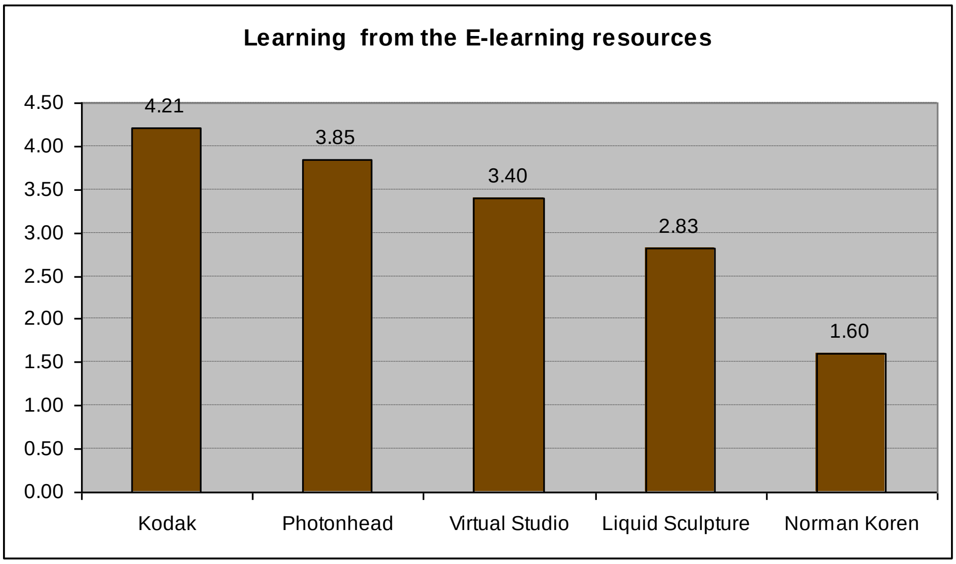


Figure 6.4 Learning from the E-learning website.

6.8.5. Factor 5 - Multimedia content rating of E-learning resources

The researcher examined the different multimedia content of the resources investigated in this study including Text, Photographic Images, Illustrations, Sound, Animation and Simulations. These contents were examined against Ease of use, Clarity of content, Level of learning, Level of engagement and Level of enjoyment and fun

Table 6-8 below shows the relationship between Ease of Use and Clarity of Content for each type of multimedia content, as well as each the e-learning resources rating. The table shows the highest score for each criterion. In addition, the researcher presents the value of each of the multimedia components against the advanced multimedia (Simulation). Advanced multimedia was defined and discussed in Chapter 2.

Table 6-8 Ease of use and clarity of content of Multimedia

Multimedia content of the e-learning resources	Ease of use		Clarity of content	
Text	Photonhead	4.25	Photonhead	4.00
Photographic Images	Photonhead	4.30	Photonhead	4.20
Illustrations	Photonhead	3.65	Virtual studio	3.90
Sound	Kodak	4.00	Kodak	3.60
Animation	Photonhead	4.20	Photonhead	4
Simulation	Photonhead	4.85	Photonhead	4.65

Five of these components - Text, Photographic images, Illustrations, Sound, and Animation - are basic multimedia components and Simulation is an advanced multimedia.

A key observation in Table 6-8 above is that the highest scores are associated with the use of "advanced multimedia" content. Therefore, with regard to basic multimedia and the level of ease of use, Text, Photographic images, Illustrations, Sound and Animation all had a clearly lower score than advanced multimedia (simulation) which had a score of (4.85). In terms of the level of clarity of content, the basic multimedia, inclusive of Text, Photographic images, Illustrations, Sound and Animation, faired worse than the advanced multimedia (simulation) which had a score of (4.65).

A concluding remark with regard to advanced multimedia is that it has a higher mean value in both ease of use and also clarity of content.

The researcher evaluated the Level of learning, Level of engagement and Level of enjoyment and fun which are related to the research hypotheses of this study. Table 6-9 below presents the result for each of the multimedia components separately, as well as the relationship of each of them to each type of multimedia content and their e-learning resource rating.

For text, Kodak scored the highest mean value for Level of learning, Level of engagement and Level of enjoyment and fun, the values are (3.80), (3.75) and (3.65) respectively.

For Photographic images, Kodak obtained the highest mean for Level of learning and level of engagement, with (3.70) and (4.00) respectively; Photonhead scored the highest mean for Level of enjoyment and fun with (3.75).

For Illustrations, Virtual studio obtained a score of (3.45) for Level of learning, and Photonhead had a high mean of (3.70) for level of engagement, Photonhead and Liquid Sculpture shared a common mean value of (3.75) for Level of enjoyment and fun.

For the Sound category, Kodak scored the highest mean for all three categories -Level of learning, level of engagement and Level of enjoyment and fun - with a score of (3.60), (3.75) and (3.60) respectively.

For Animation, Photonhead scored (4.00), (3.75) and (3.75) in Level of learning and level of engagement and Level of enjoyment and fun respectively. It is important to note that only Photonhead had animation in its e-learning resource. For Simulations, Photonhead scored (4.45) for Level of learning, (4.60) for level of engagement, Kodak scored (4.50) in Level of enjoyment and fun.

Table 6-9 Multimedia content rating of the E-learning resources

Multimedia content of the resources	Level of Learning		Level of engagement		Level of enjoyment and fun	
Text	Kodak	3.80	Kodak	3.75	Kodak	3.65
Photographic images	Kodak	3.70	Kodak	4.00	Photonhead	3.75
Illustrations	Virtual studio	3.45	Photonhead	3.70	Photonhead & Liquid Sculpture	3.75
Sound	Kodak	3.60	Kodak	3.75	Kodak	3.60
Animation	Photonhead	4.00	Photonhead	3.75	Photonhead	3.75
Simulations	Photonhead	4.45	Photonhead	4.60	Kodak	4.50

A key observation from Table 6-9 is that the highest scores are associated with the use of “advanced multimedia (simulations)”. Therefore, for Level of learning, the basic multimedia components - Text, Photographic images, Illustrations, Sound and Animation – performed lower than the advanced multimedia which scored (4.45). In Level of engagement, the score for the basic multimedia components was also lower than the advanced multimedia component, which was (4.60). Regarding the Level of enjoyment and fun of the basic multimedia components, a similar result was observed in that the advanced multimedia component obtained a higher mean of (4.50).

6.8.6. Factor 6 - Learning activity

One of the interests of the researcher is to examine the different learning activities in each of the resources by the student, as shown in Table 6-3 above. Each of the resources is of a different type and has a varying number of learning activities, except for one which does not have any learning activities. Each of the resources will be discussed one by one.

Kodak Website:

The Kodak website ran a tutorial on interactive camera simulators, and there were six items covered in the site, which were:

- Locking the Focus
- Using a Plain Background
- Moving It from the Middle
- Knowing Your Flash's Range
- Watching the Light
- Troubleshooting Your Pictures

The scores for these items were as follows: Watching the light obtained a mean of (4.50); Knowing Your Flash's Range and Using a Plain Background had a mean of (4.35) each; Moving It from the Middle scored a mean of (4.30); Troubleshooting your pictures obtained a mean of (4.20) and, finally, Locking the Focus obtained a mean of (4.15). All these amounted to an overall average of (4.31), as shown in Figure 6.5 below.

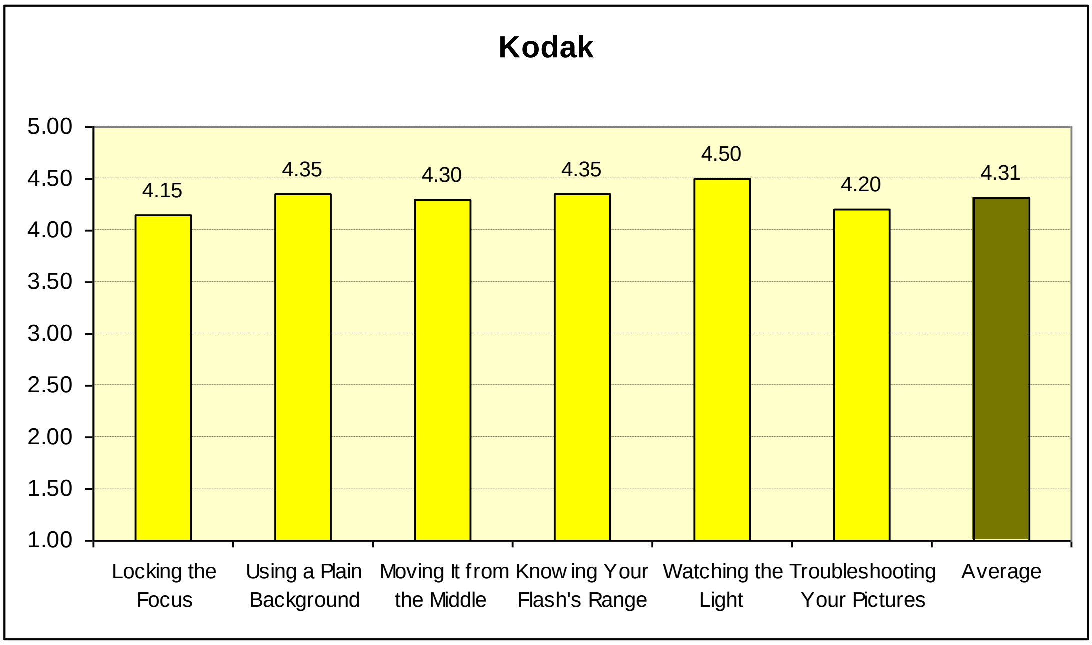


Figure 6.5 **Kodak.**

Photonhead website:

Photonhead provides an Interactive camera simulation tutorial on the website, covering three items, namely Shutter and Aperture, Film Speed, and Camera Shake. Shutter and Aperture obtained a mean score of (4.40), while Film Speed scored a mean of (3.90) and Camera Shake scored (4.20). The average for the site was (4.17), as reflected in Table 6-7 below.

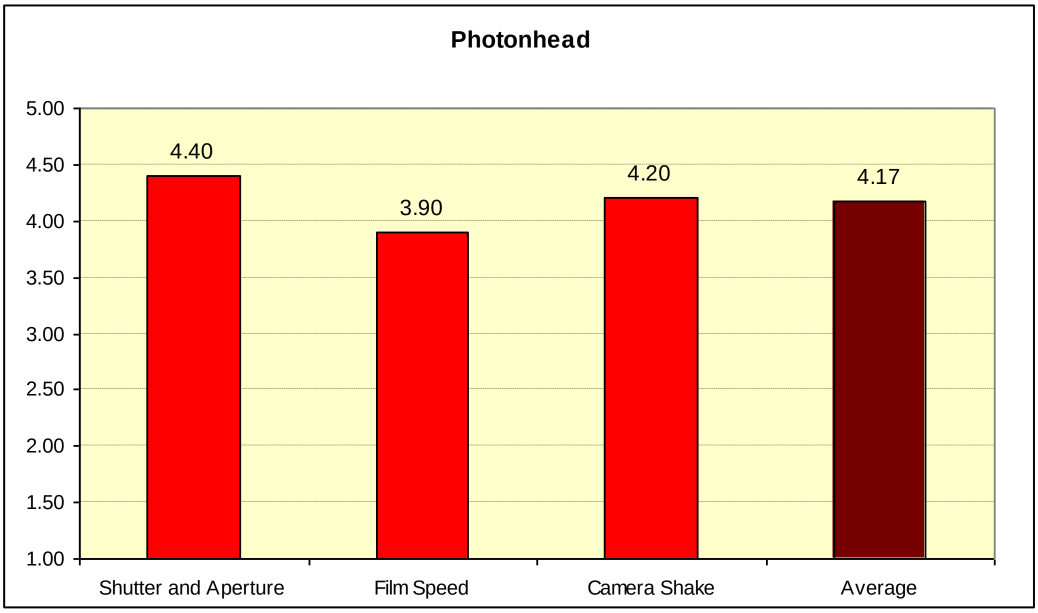


Figure 6.6 **Photonhead.**

Virtual studio CD-Rom:

The Virtual Studio site runs a 'Practice lighting techniques tutorial', with five different items covered, namely:

- Understanding the effect of the light on the model position
- Understanding the effect of the light on the pose position
- Understanding the effect of the type of light beam
- Understanding the direction of the light position
- Understanding concept of shadow

Understanding the effect of the light on the model position and Understanding the effect of the type of light beam obtained a mean of (4.20), while Understanding the direction of the light position scored a mean of (4.15). Next was Understanding concept of shadow, which obtained a mean of (4.10). The item of Understanding the effect of the light on the pose position obtained the lowest mean of (3.85). The average of all these items adds up to (4.10), and the results are shown in Figure 6.7 below.

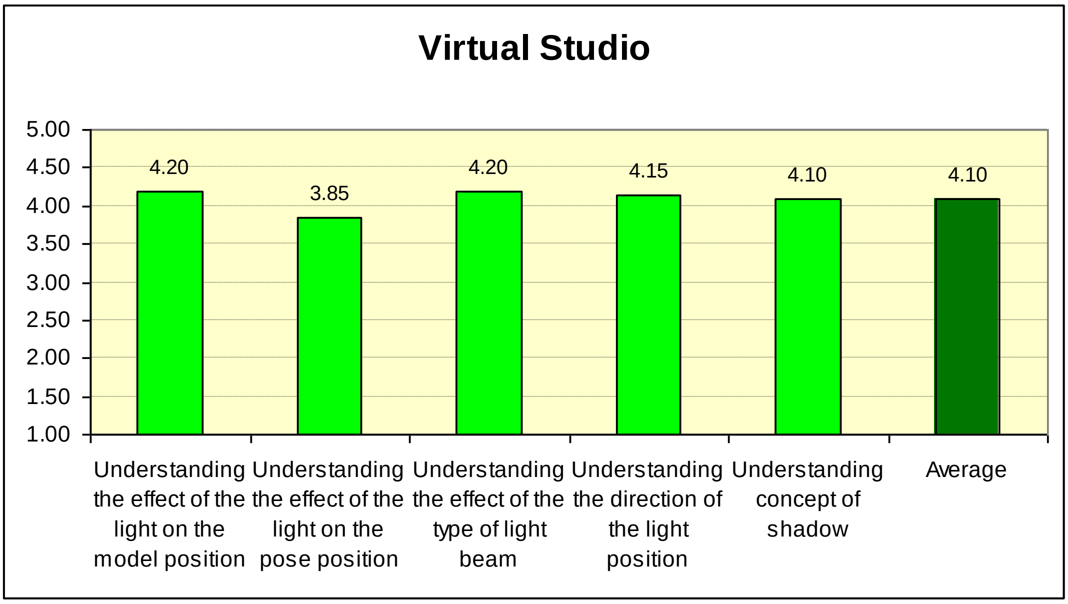


Figure 6.7 Virtual Studio.

Liquid Sculpture Web site:

The Liquid Sculpture site provided a tutorial on ‘Examine the depth of field’, covering the following items:

- Aperture
- Lens focal length
- Distance to subject
- Film format
- Changing the model
- Easy to interact with model

Lens focal length obtained a mean of (3.70), followed by Aperture with a mean of (3.55). Distance to subject item scored a mean of (3.50), while changing the model obtained (3.55). Next was Easy to interact with model with a mean score of (3.10), and the lowest mean was for Film format at (2.95). All these scores accumulated to an average of (3.39), and the details are as shown in Figure 6.8 below.

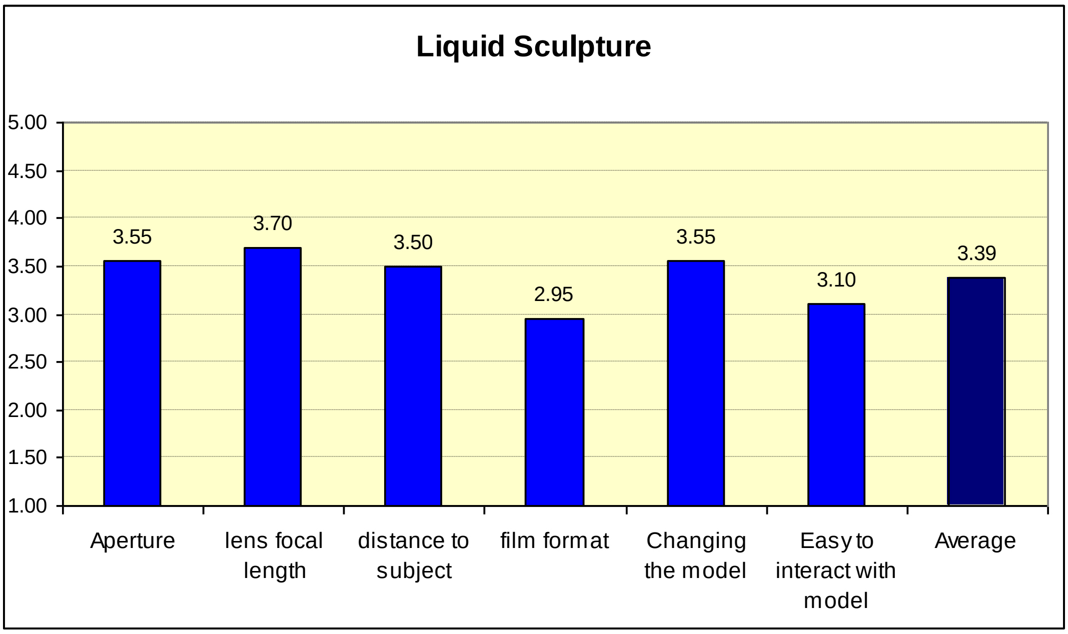


Figure 6.8 Liquid Sculpture.

Norman Koren Website:

No tutorial activity is available on this web site.

Overall Interactive learning activity

In assessing the overall interactive activities of the E-learning resources investigated, the researcher compiled the scores from the student feedback. Based on this feedback, Kodak obtained the highest mean of (4.31), followed by Photonhead with (4.17). Next was Virtual Studio with (4.10), while Liquid Sculpture scored a mean of (3.39). It is of note that Norman Koren was excluded from this analysis as there was no active tutorial lesson on the Norman Koren website. The details are as shown in Figure 6.9 below.

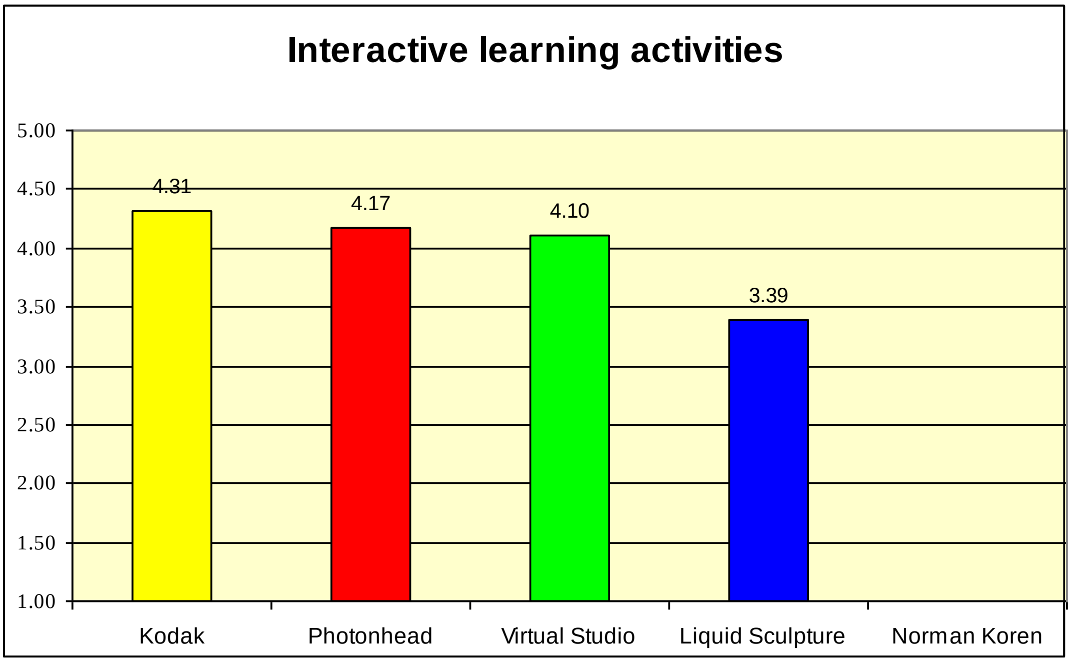


Figure 6.9 Overall Interactive learning activities.

There are different numbers and types of learning activities in the five e-learning resources. Figure 6-12 shows that Kodak has obtained the highest rating since it has several learning activities and tasks. In addition, each activity is supported by instant feedback and sound. On the other hand, the figure shows that there was a slight difference in the ratings between Virtual Studio (4.10) and Photonhead (4.17). In fact, Virtual Studio has only one interactive learning activity with several tasks, while Photonhead has three activities; however, neither e-learning resource was supported by any feedback or sound.

The lowest rating among the resources studied was for Liquid Sculpture which obtained (3.39). This could perhaps due to the reason that the user of this website needs prior knowledge on depth of field in order to be involved and be able to interact with the contents in the resource. Moreover, the task for this site's activity presented students with a high level of complication, and it has no vividness.

The discussion presented above confirms that the Kodak website is the most successful e-learning resource. The individual activity with the highest score, of (4.50), was watching the light in this activity; the students enjoy the effect of light on the subject as, with the mouse, they change the lighting effect between different times (from morning to noon, evening and so on). In this way, the students can see the full effect of lighting, giving good experience of light on the image or picture.

6.8.7. Factor 7 - Overall Rating of E-learning resources

Kodak had the highest rating in most items and this includes the following comments and respective ratings: "I would use this website to help with my studies'' (4.25); "this is an excellent learning resource" (4.30); "the use of advanced multimedia is a very helpful learning resource" (4.35). Moreover, the rating for "I would still need help from staff to learn this topic" is the lowest at (2.40), thus indicating that the students could learn this topic without assistance. Furthermore, it is a useful learning resource and a very helpful learning tool for using advanced multimedia, as can be seen in Table 6-10 below.

This conclusion was also drawn from students' comments, where 55% of them agreed that using the Kodak website was "Engaging with interactive learning activity", and 53% of the students commented the same for Photonhead.

The students' comments further enlighten the fact that the "Interaction with the virtual camera gives the learner a feeling that they are present at that event when they are taking the picture", 62% agreeing with this for Kodak and 42% for Photonhead.

On the other hand, **Norman Koren** had the lowest score in most items. "I would use this website to help with my studies" obtained a score of (1.70), and "This is an excellent learning resource" scored (1.90). "The use of advanced multimedia is a very helpful learning tool" scored (0.00) for the reason that the website was poor in using advanced multimedia as a learning tool, as well as being more static with no interactive learning activities or instant feedback available. This is reflected in the score obtained by the item "I would still need help from staff to learn this topic", the highest rate of (3.75) for this website. This shows that students still need the help of staff in learning the topic, as can be seen in Table 6-10 below. The students' comments also emphasised the weaknesses of the learning resources, where students agreed that there was a "Limitation of usage of rich multimedia" for Norman Koren, with 21% of the responses for this website and 19% for Liquid Sculpture. A further 37% of the comments for Norman Koren went to "It does not contain sufficient learning activities", with an additional 33% of comments indicating a "Lack of interaction and feedback" for the same website.

Table 6-10 Overall rating of E-learning resources.

Overall Rating of E-learning resources	Norman Koren	Photonhead	Kodak	Liquid Sculpture	Virtual Studio
I would use this website to help with my studies.	1.70	4.15	4.25	3.25	3.90
This is an excellent learning resource.	1.90	4.00	4.30	3.15	3.95
The use of advanced multimedia is a very helpful learning tool	0.00	3.95	4.35	3.25	3.90
I would still need help from staff to learn this topic	3.70	3.15	2.40	3.75	3.05

6.9. Student Observation Results

The researcher observed four different types of activity carried out by the students, namely Ease of use and getting started with website / CD-Rom, Level of student Interaction with the content, Level of engaging with learning activity and Length of time involvement in the resource.

The researcher conducted an informal observation only and the results are presented in Table 6-11 below.

- Ease of use and getting started with website / CD-Rom

As can be seen from Table 6-15, Kodak scored the highest mean of (4.20), which indicates that the site was easy to use or get started with. Photonhead obtained a mean of (4.00), followed by Norman Koren with a mean of (3.80), and Virtual Studio with a mean of (3.20). Liquid Sculpture obtained the lowest score in this task of (2.80), indicating that this resource was not so easy to use or get started with.

- Level of student interaction with the content

Kodak and Virtual Studio both scored the highest mean of (3.75), indicating the highest level of student interaction with these two resources. Photonhead was very close behind with a mean of (3.70). Liquid Sculpture scored a mean of (3.20) while Norman Koren scored the lowest mean of (2.75), indicating the low level of student interaction with the content in this resource. These scores are well supported by the students' comments in that 47% of the comments pointed to "Interaction with learning activity of the website through an attractive way" for Kodak, and 42% commenting that Kodak has "Good interaction and feedback with the content".

- Level of engaging with learning activity

Kodak again scored the highest mean of (4.70), which indicates a high level of engagement with the learning activity. Photonhead scored a mean of (4.35) while Virtual Studio obtained a mean of (4.15). Liquid Sculpture's score of (3.20) was the lowest, while Norman Koren did not offer any learning activity to measure. This is again confirmed by 55% of the students' comments agreeing that, with the Kodak website, they are "Engaging with interactive learning activity" and 53% saying the same for Photonhead.

- Length of time involvement in the resource

On average, each student is observed to have spent some forty-one minutes with the Kodak resources. Photonhead is observed to have kept the students occupied with its resources for an average of thirty-five minutes, while students spent an average of twenty-one minutes with the Virtual Studio resource. For Liquid Sculpture, the average time that students spent was fifteen minutes, and for the Norman Koren resource it was nine minutes. On average each student spent approximately two hours with all the resources.

The students' comments have indirectly confirmed these observations as the tendency is for students to spend more time on average on the Kodak and Photonhead resources as these are "engaging with interactive learning", with comments indicating 55% and 53% respectively. Consequently, this indicates that less time is spent on the resources with less engagement with the learning activity.

Another relevant comment from the students which is related to length of time is that "Interaction with the virtual camera gives the learner a feeling that they are present at that event when they are taking the picture" with Kodak obtaining 62% of the comments in this respect, and Photonhead 42%. This translates naturally to a longer time spent on resources with higher levels of interaction.
Overall, the greatest numbers of comments were made about the Kodak and Photonhead websites.

Table 6-11 Observation results.

The task	Kodak	Photonhead	Virtual Studio	Liquid Sculpture	Norman Korean
Ease of use and getting started with website / CD-Rom	**5** Ease ←	**4**	**3**	**2**	→ **1** Difficult
	4.2	4	3.2	2.8	3.8
Level of student interaction with the content	**5** High ←	**4**	**3**	**2**	→ **1** Low
	3.75	3.70	3.75	3.2	2.75
Level of engaging with learning activity	**5** High ←	**4**	**3**	**2**	→ **1** Low
	4.70	4.35	4.15	3.2	0
Length of time involvement	60 Minutes ←				→ 5 Minutes
	41 minutes	35 minutes	21 minutes	15 minutes	9 minutes

6.10. Summary of Student Feedback on E-learning resources

The overall findings from the student feedback confirm the findings of the earlier critical review chapter. There is also a clear indication that the advanced multimedia obtains higher results compared to the basic multimedia components in terms of Level of learning, level of engagement, and Level of enjoyment and fun (see section chapter one for definitions). This is further evidence to support the formulation of the three hypotheses as follows:

Hypothesis 1

Ho: Advanced multimedia based learning applications do not give a higher level of learning when compared to traditional approaches.

Ha: Advanced multimedia based learning applications give a higher level of learning when compared to traditional approaches.

Hypothesis 2

Ho: Advanced multimedia based learning applications do not give a higher level of engagement when compared to traditional approaches.

Ha: Advanced multimedia based learning applications give a higher level of engagement when compared to traditional approaches.

Hypothesis 3

Ho: Advanced multimedia based learning applications do not give higher level of enjoyment when compared to traditional approaches.

Ha: Advanced multimedia based learning applications give higher level of enjoyment when compared to traditional approaches.

The student feedback (which is a quantitative study) is very important not only because the students are the main beneficiaries of this study but also because their feedback provides a higher level of objectivity while the critical review (which is a qualitative study) takes into consideration only the personal judgments of the researcher. Both the methods used evolve into a more desirable triangulation approach.

6.10.1. Kodak

The Kodak site was rated the best website due to the ‘usefulness of this resource to their studies’ and its high level of engagement. It was rated as an excellent learning resource and its use of interactive multimedia was felt to be very helpful though the resource still required some supplementary help from staff to learn the topic. Students commented favorably that the interaction with a virtual camera seemed like taking real pictures and the resources also provided good use of sound, interactivity and feedback.

Main page looks and functions was one of the factors on which Kodak obtained the highest score of (4.12) and, in General design of E-learning, Kodak has the highest mean of (4.00). Navigation of the E-learning resources also saw Kodak securing the highest mean of (3.81). Learning from the E-learning resources saw Kodak scoring the highest mean of (4.21) with all the other resources scoring lower than Kodak. In Multimedia content rating of the E-learning resources, Kodak again scored the highest in two contents, namely text and sound in all the categories - Level of enjoyment and fun, Level of learning and Level of engagement. For simulations in the advanced multimedia content, Kodak again scored the highest mean value for level of enjoyment. In interactive learning activity Kodak again had the highest mean of (4.31). Therefore, in terms of overall rating, Kodak obtained the highest mean for all the items studied.

6.10.2. Photonhead

Although Photonhead is good with regard to teaching some difficult technical aspects with the help of virtual cameras, this website did not adequately use all multimedia components such as sound effects, as can be seen with Kodak. Neither did the site provide sufficient feedback to make the learning very useful. However, this was the only resource which provided animation for the students.

Photonhead was a close second to Kodak in the Main page looks and functions with a mean of (4.06). In General design of E-learning, it again came closely behind Kodak with a mean of (3.88). Likewise, in Navigation of the E-learning resources, Photonhead secured a mean just below that of Kodak, with a value of (3.79). Learning from the E-learning resources saw Photonhead scoring high but just short of Kodak with a mean of (3.85). In Multimedia content rating of the E-learning resources, Photonhead obtained full marks for animation in all three categories of Level of enjoyment and fun, Level of learning, and Level of engagement. In the photographic images content, Photonhead obtained the highest value in Level of enjoyment and fun and, for illustrations, this website also scored the highest mean value for Level of enjoyment and fun, and Level of engagement.

For simulations in the advanced multimedia content, Photonhead scored the highest mean value in Level of learning and Level of engagement and, in interactive learning activity; Photonhead was very close to Kodak with a mean of (4.17). The overall rating of Photonhead was just below that of Kodak, with a mean of (4.03).

6.10.3. Virtual Studio

Virtual Studio also facilitated interaction with a virtual camera, but failed to fully aid learning due to a lack of interaction and feedback. It also lacked certain features, such as using only one colored light and providing little control.

6.10.4. Liquid Sculpture

The weakness of the Liquid Sculpture website was attributed to the limited information it provided and the difficulties of interaction with the content.

6.10.5. Norman Koren

The Norman Koren website was rated the worst due to its ineffectiveness in helping with studies and being a poor ‘learning resource’, due to lack of interaction and feedback and failure to use a full range of multimedia.

These results support the findings of the critical review, which rated Kodak the best resource particularly due to the ‘helpfulness of its interactive learning simulation activities’. On the contrary, Liquid Sculpture failed to help in learning for all its activities, due to the complexity in presentation and explanations, using only wire-frame examples. Norman Koren had no learning activities at all.

Table 6-9 presented above clearly indicates that simulation, which is the richest form of multimedia interactivity and vividness, as used in both the Kodak and Photonhead resources, provides more enjoyment, engagement and helpfulness to learning when compared to the other media. The implications of a rich multimedia are that it facilitates learning and understanding of the difficult aspects of photography.

6.11. A comparison between the student feedback and critical review

In comparing the results of the 'Student Feedback Questionnaire' with the results of the "critical review" in relation to General Design, pedagogical design and learning from E-learning resources, the rating shows that Kodak and Photonhead websites have obtained the highest rate in both studies. This is reflected in

Table 6-12 below. The results show that the student feedback supports the findings of the earlier critical review.

Table 6-12 Critical review and student feedback results comparison.

Factor	Critical Review results		Student feedback results	
General Design	Kodak	3.7	Kodak	4.00
	Photonhead	3.7	Photonhead	3.88
Pedagogical Design and learning from the resources	Kodak	3.93	Kodak	4.21
	Photonhead	3.85	Photonhead	3.85

The results of both the critical review and student feedback clearly show that Kodak and Photonhead obtained the highest scores. In fact, Kodak scored highest in almost all the aspects studied. In terms of general design factors, Kodak was the best, closely followed by Photonhead, the same results are repeated for both Kodak and Photonhead in Pedagogical Design factor, and this is also the case with Learning from the E-learning resources.

In an attempt to gain a better understanding of the study outcomes, the researcher compared the results of the student feedback with the critical review in terms of multimedia content of the E-learning resources. The results are presented in Figure 6.10 below.

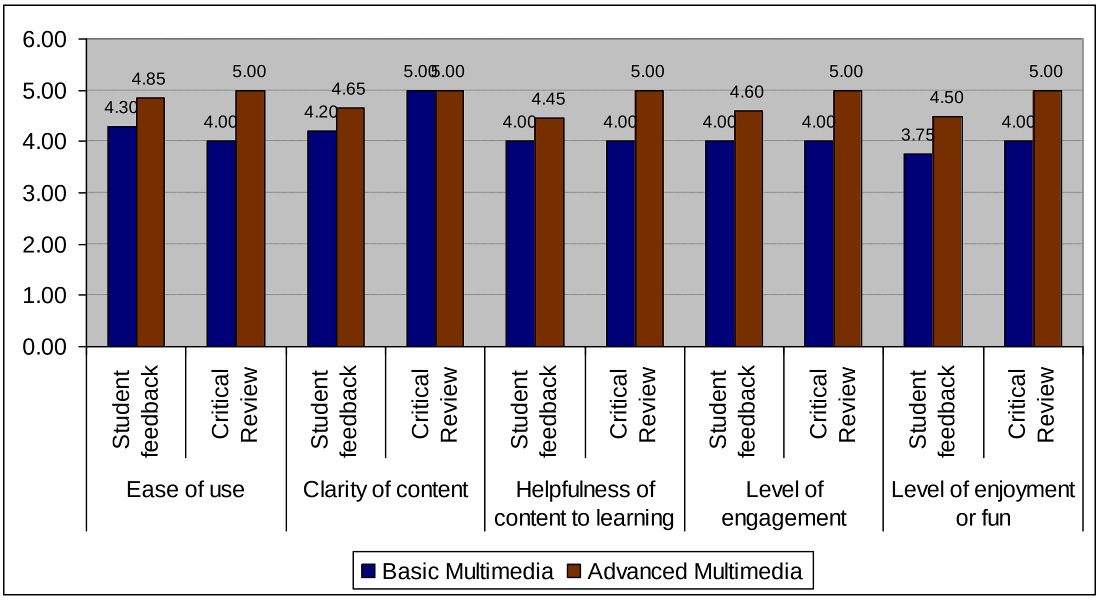


Figure 6.10 Student feedback and critical review comparison

The results shown in Figure 6.10 are discussed below:

Ease of use:

Advanced multimedia (simulation) had a higher result with a mean of (4.85) in student feedback and (5.00) in critical review. The basic multimedia component obtained a mean of (4.30) and (4.00) in the student feedback and critical review respectively.

Clarity of content:

Advanced multimedia (simulation) had a higher result in both the student feedback and critical review, with a mean of (4.65) and (5.00) respectively. The basic multimedia component scored a mean of (4.20) and (5.00) respectively in the student feedback and in the critical review.

Level of learning:

A comparison between the student feedback and critical review results show that advanced multimedia (simulation) obtained a higher mean value in both sets of results, with (4.45) and (5.00) in student feedback and critical review respectively. Similarly, the basic multimedia components scored lower in both the critical review and student feedback, with (4.00) and (4.00) respectively.

Level of engagement:

Advanced multimedia (simulation) also obtained a higher mean value in both the critical review and student feedback, with (5.00) and (4.60) respectively. In the same way, the basic multimedia components scored low in the critical review and student feedback, at (4.00) in both.

Level of enjoyment and fun:

In this category advanced multimedia (simulation) again obtained a higher mean value in both the critical review and student feedback, of (5.00) and (4.50) respectively. Accordingly, the basic multimedia component obtained lower scores, of (3.75) and (4.00) respectively, in both the student feedback and critical review.

These student feedback results support the initial findings of the critical review, in that there is a higher response mean value in the advanced multimedia compared to the basic multimedia components. This is true in relation to the criteria of multimedia content of the e-learning resources (ease of use, clarity of content, Level of learning, level of engagement and Level of enjoyment and fun), and shows that advanced multimedia is better than basic multimedia. The results presented and discussed above show that the student feedback supports the findings of the earlier critical review.

6.12. Chapter Summary

It may be concluded from this chapter that the Kodak site was felt to be the most useful and engaging learning aid by the students and this indicates not only that its use of multimedia, especially simulation (virtual camera), animation, photographic images and sound, possibly generates more interest but that it also enables some topics to be explained more clearly. It allowed learning through ‘exploration and investigation’, in addition to ‘attending and apprehending’, providing a greater choice of, and more effective, learning experiences. This would seem to confirm the findings of the earlier critical review. Moreover, the success of the Photonhead and Kodak resources together suggest that, for' Interactive Multimedia' to be effective, it requires clear learning objectives, appropriate learning activities and 'feedback', which encourage and motivate students to learn. These more effective websites use a range of learning styles such as 'attending and apprehending' and 'investigating' and 'exploring', supported by a variety of multimedia components, such as text, images, photographs, animation and simulation, the latter being particularly effective in this case. 'Ease of use', 'clarity of content', 'level of fun or engagement', 'appropriateness of content to learning' and 'download speed' all contribute to a more effective learning experience. Further research will include developing a design model based on these findings for creating interactive multimedia in Photography education and testing the model using a prototype featuring depth of field, which was earlier identified as a key difficulty in photography education. This is discussed in the next chapter(s).

Chapter Seven

Development of a Design Model

7. Development of a Design Model

7.1. Introduction

This chapter describes the development of a design model for using advanced multimedia in education in preparation for its subsequent use and testing through the development of a prototype in photography lessons to be discussed in the next chapter.

7.2. Instructional System Design Process

In order to design the proposed model of this research, the literature in particular (Davidson-Shivers, 2006) shows that an instructional system design (ISD) process should be followed as it helps to cover the proposed design requirements. Instructional system design is a process which consists of broadly determining the current state of learner understanding, defining the end goal of instruction, and creating some media-based "intervention” to assist in the transition. It involves the practice of arranging media content (for example: text, images, audio, animation and video) to help teachers to efficiently and effectively play their role in supporting student learning. It focuses on outcomes while properly accounting for a multi-variable context that can be predictive, although researchers acknowledge that, given the variability’s of human capacities, a guarantee of reliable learning outcomes is not totally possible (Dabbagh, 2002).

The aim of ISD is to make instruction effective, efficient, appealing and cost-effective. Thus, the instructional designer uses a variety of interactive media to improve learning and address learning objective. Traditional face-to-face teaching methods can be enhanced, or supported, by innovative e-learning methods. The instructional designer is the expert in finding the "right " technology to support "good” classroom pedagogy (Beetham & Sharpe, 2007) as it is crucial to know when to use a wide range of instructional strategies, as well as passive and interactive media.

The ISD process is usually represented in the form of models or mnemonics to summarize its components and procedures. In fact, there are hundreds of ISD models documented in the literature; however, none are specifically for photography. The following section discusses one of these models selected to achieve the objectives of this research, and that is the ASSURE model. This model is a linear ISD model which is fairly easy to understand and apply. The rationale for selecting this model is explained in detail in section 7.3.1 below.

7.3. ASSURE Model

Heinich et al. (2002) state that, in order to use media technologies effectively, a systematic plan for their use is necessary. They suggest utilizing a generic ISD model named the ASSURE model as a framework. It involves six major steps in an instructional planning process, shown in Table 7-1 below.

Table 7-1 ASSURE Model

A	Analyze Learner
S	State Objectives
S	Select Methods, Media, and Materials
U	Utilize Methods, Media, and Materials
R	Require Learner Participation
E	Evaluate and Revise

Source: Heinich et al. (2002)

Since this study was based mainly on developed version of ASSURE model, the major steps of this model need to be clearly presented. Below is a brief explanation of these six steps.

1. Analyze Learners

In order to select the best media and technology for the delivery of instructional content, it is essential to identify and analyze the audience. While it is impossible to take into consideration every characteristic of each learner, general characteristics, specific entry components (what the learner might already know about the content to be presented), and learning styles are key characteristics to consider at the onset of planning.

2. State Objectives

Stating clear and specific objectives is important both for establishing learner expectations as well as setting the criteria for what media and technology will be suitable for the particular course. The instructor may develop the instructional objectives, or they may be taken from the supporting course materials . Establishing objectives is also necessary for accurate evaluation of learner achievement in the course.

3. Select Methods, Media, and Materials

Only after the instructor has analyzed the learners (for ability, preparation, and learning style) and has articulated the objectives for the course is it possible to select the methods and media/technology that are appropriate for the particular teaching and learning environment. The first step establishes where the learner is, and the second step provides the destination desired by the instructor. The selection and subsequent use of the appropriate media and technology will facilitate the learners' progress.

4. Utilize Media and Materials

After the methods, media, and materials have been selected, they must be properly implemented in the teaching and learning environment . The following "5 Ps" describe this process :

- ❑ Preview the instructional materials before using them,
- ❑ Prepare the materials (properly sequencing them, for example),

- Prepare the environment so that both instructor and learners will be able to use the materials without difficulty,
- Prepare the learners so that they are ready to learn, and
- Provide the learning experience through presentation, discussion, and collaborative exercises .

5. Require Learner Participation

Active learner participation in the education process enhances student outcomes and increases the likelihood of a successful and satisfactory learner experience. The instructor is encouraged to provide ample opportunities for learners to manipulate and otherwise interact with instructional materials (computer-presented materials facilitates this), practice skills relevant to the stated objectives, and provide as well as obtain feedback regarding their learning experience.

6. Evaluate and Revise

In the final step, it is important for the instructor to evaluate the actual effectiveness of the instruction. The evaluative process may take place in a variety of formal or informal ways including group discussion, exit interviews, distribution and collection of assessment instruments, and so on. Gathering data regarding instructional effectiveness will provide a basis for subsequent revisions to the course itself. It closes the loop from planning to execution and back to planning again (Heinich et al., 2002).

In summary, this model can be described as a procedural framework for planning and delivering instruction that integrates technology and media into the teaching process. Moreover, it constitutes a systematic approach to writing lesson plans that helps teachers organize instructional procedures, make an authentic assessment of students learning, and it can be used by all presenters.

7.4. Rationale for Using ASSURE Model

As part of the development and research process, several models were considered (see section 2.6.2). Upon careful consideration, the researcher based the selection of the ASSURE model as the most appropriate model, and subsequently adapted it, for the following reasons:

First, it shows in details how the instructional process can be implemented at the classroom level while integrating media and technology in teaching and learning. According to this model, the instructional process is systematically started by analyzing students' characteristics, learning styles and content. In line with this analysis, objectives are behaviorally stated and determined. This model can be then developed to incorporate lessons in a way that suits this research objective. Then, the lesson is supported with teaching methods and strategies, followed by participation and activities, ending with the last step: "Evaluation". Thus, the ASSURE model is a versatile ISD model necessary for adaptation to the requirements of this research and the achievement of its aims.

Second, the linearity of this model makes it simple and direct to implement parts of the field work in the classroom. These parts are related to delivering instruction to both the control and experimental groups using the same plans and approaches.

Third, this model by its nature helps to link and integrate all instructional components to serve the achievement of pre-determined research and instructional goals. This can specifically be exemplified by the sub-system of producing the technological tools in the research prototype and using them to deliver the content, participation, and evaluation.

Fourth, the ASSURE model, through its last step of evaluation, reflects back on the research components resulting in their improvement. This is important for the final development of the prototype.

Fifth, it includes a separate step (step 3) on 'media and technology selection" which allows this research to develop and adapt this step to meet the research aim of using technological tools that better serve the needs of the lesson and the students.

Sixth, it puts great emphasis on the importance of active student engagement in their learning process.

However, chapter 2 shows that the ASSURE model has some limitations. It is a generic model that supports basic and traditional types of media rather than supporting the use of advanced and rich media technologies with which this research is primarily concerned. In addition, the simple linear design of the ASSURE model does not usually reflect the complexity of the instructional process. Moreover, it does not leave room for knowledge and conceptual sequencing and mapping. Furthermore, the ASSURE model has a structural shortcoming from an ID perspective, as it does not include specific entries for task and thinking styles.

To sum up, the ASSURE model has its strengths and weaknesses. However, this researcher will attempt to develop the model through utilizing the strengths and overcoming the weaknesses. ASSURE is a very general model that is designed to be used as a guide for various types of technological teaching tools, including the many forms of computer programs discussed in section 2.6.2.3 of this study. On the other hand, the proposed model is specifically expected to deal with technologically more advanced and rich media, students' different knowledge experiences, learning styles, and task and thinking styles. It is also more applicable to a photography learning scenario than other models. Above all, the improved ASSURE model should represent a systematic framework towards achieving the instructional aim and help the researcher to design and implement the prototype.

The following section discusses the stages of the ASSURE model development.

7.5. Developing and Improving the ASSURE Model

In step 3 of the ASSURE model (media and technology selection), the need arises to select the appropriate forms of media technology to provide a suitable student learning experience. This means taking into consideration the specific problems encountered by teachers and students when teaching and learning in the context of the specific subject, which is photography in this research. However, as already stated, the existing ASSURE model provides insufficient guidance on matching the appropriate media and learning styles (see the following section 2.6.2.3 for more details). Therefore, the development process of the ASSURE model focuses on this third step of media and technology selection, as shown in Figure 7.1. The following section describes this development process.

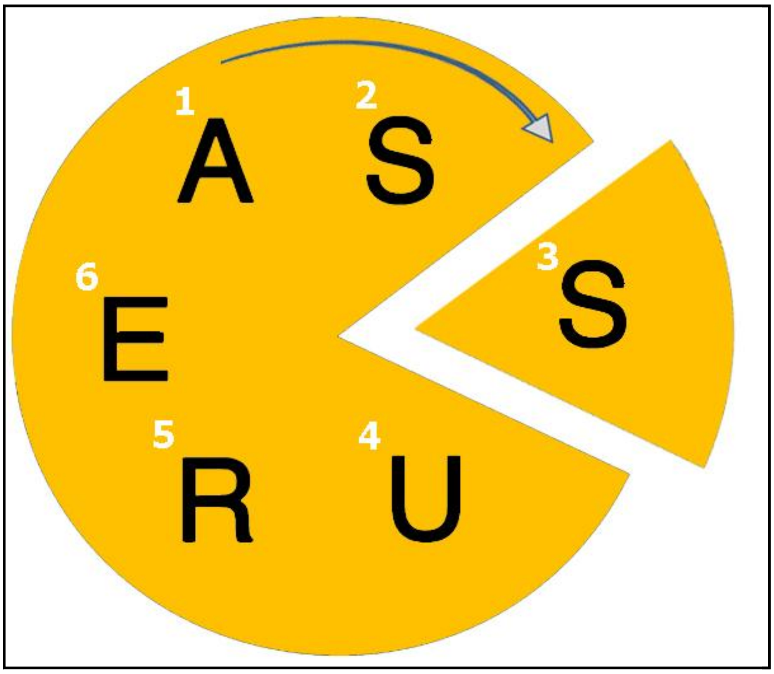


Figure 7.1 Focus on step 3 of ASSURE model.

7.5.1. Laurillard's Conversational Framework

Laurillard (2002) puts forward a model that addresses this particular research need for media and technology selection, called the Conversational Framework. Laurillard's Conversational Framework is a simplified conceptual framework for describing different aspects of the learning process or activities, and it was discussed in detail in section 2.6.2.4. Table 7-2 summarizes this framework.

Table 7-2 Laurillard's conversational framework.

Learning experience	Media Technologies	Media forms
Attending, apprehending	Print, TV, video, DVD	Narrative
Investigating, exploring	Library, CD, DVD, Web resources	Interactive
Discussing, debating	Seminar, online conference	Communicative
Experimenting, practicing	Laboratory, field trip, simulation	Adaptive
Articulating, expressing	Essay, product, animation, model	Productive

Source: Laurillard (2002).

In this framework, Laurillard stresses the learning experience rather than the method of assessing learning outcome. Based on literary and practical evidence, as mentioned in sections 2.6.2.4 and 2.6.2.5, it was found that using this framework is extremely important in its ability to match the selection of media (Step 3 in the ASSURE Model) with learning experiences. The critical review, student survey and observation results (see chapters 3, 4, and 5) show that using a variety of learning experiences including 'attending and apprehending' and 'investigating and exploring', supported by a range of media components, such as text, images, photographs, animation, and simulation, can provide effective e-learning resources where 'ease of use', 'clarity of content', 'level of fun and engagement', 'appropriateness of content to learning' all contribute to an effective learning experience.

According to Laurillard's Conversational Framework (as discussed and explained in section 2.5.3.4), students need to use specific media technologies and forms to complete their learning experiences. Even though this is an improvement on step 3 of the ASSURE model, it still fails to differentiate between similar media in terms of advantages and disadvantages and does not include the most up-to-date media technologies.

Moreover, this research has demonstrated that students are unlikely to be interested in learning unless it provides them with engagement or motivation. It is also likely that if they only experience learning through ‘attending and apprehending’, it may be insufficient to achieve more complex learning objectives such as those related to depth of field in photography education. The earlier findings discussed in chapter 6 section 6.12 indicate that the use of richer multimedia, i.e. animation, video, and simulation, can possibly generate more interest in the learning materials as well as explaining some visually complex topics more clearly. They also allow learning through ‘investigating and exploring’, which may be more effective for learning complex topics; the latter possibly being accomplished through multimedia- based simulations or the use of a virtual camera in photography education.

The above-mentioned shortcoming of Laurillard's conversational framework, can only be overcome by finding another classification model which is able to provide a suitable framework for the teacher to select the appropriate media technology from basic media (text, images) to advanced media (interactive websites, simulative, VR). Based on the literature definition mentioned in section 2.5.1, the best classification model to adopt for this purpose is that of Steuer (1993). The following section shows the steps to adapt this model as part of the development process to improve both the ASSURE model and the conversational framework.

7.5.2. Steuer's Classification model

It is proposed that Laurillard’s conversational framework can be further developed by the work of Steuer (1993) to differentiate the different types of multimedia and embrace the concept of advanced multimedia by focusing on vividness and interactivity. Figure 7.2 shows this classification model, which was discussed in section 2.5.1.

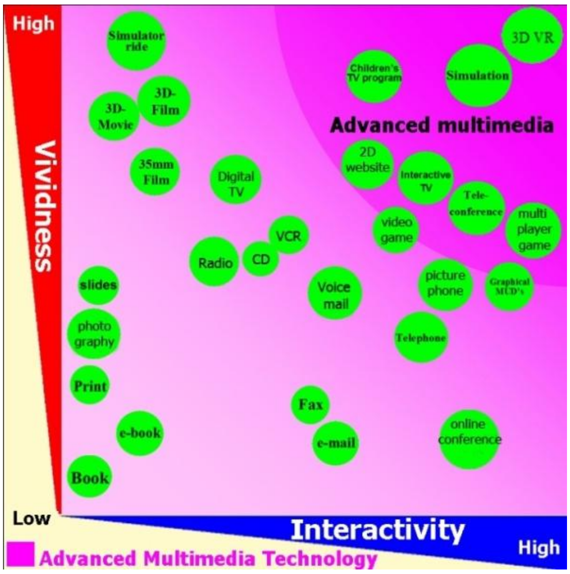


Figure 7.2 Media technologies classified by vividness and interactivity

Source: Modified from Steuer's Classification Model (1993).

Figure 7.2 above shows how Steuer (1993) classified a wide range of media technologies in terms of vividness and interactivity. 'Advanced Multimedia' can be defined as combination of a rich interactive medium, which provides high levels of interactivity and vividness. It uses advanced media hardware and software tools including Simulation and 3D Virtual Reality (Albayat, 2011).

Steuer argues that the more vivid and the more interactive a particular environment is, the greater the sense of presence evoked by that environment (1993). Furthermore and very importantly, research findings from this study, presented in sections 5.9 and 6.12 of chapters 5 and 6 respectively, and those drawn from Albayat (2007b) indicate that the more interactive the media the more engaging, fun and useful it is for the student, and the more likely they are to learn. This idea is central to the development of a model for using advanced multimedia in photography education as it suggests that, depending on the learning experience required to achieve a learning outcome, the specific choice of media should be determined by either the level of interactivity; the preference being, in terms of effectiveness, for the level of interactivity to be as high as possible. Previous studies showed that by increasing the vividness and interactivity of a user interface, the sense of engagement during interaction increased (Rozendaal et al. 2007b).

7.5.3. A Modified Version of ASSURE Model

The researcher, therefore, proposes a new design model for using Advanced Multimedia in Photography Education (AMPE). Hereafter, it is referred to as AMPE based on the existing ASSURE Model (see section 2.6.2.3 for the details of this model). The proposed AMPE model addresses teaching challenges after careful evaluation of the problems encountered by the teachers and students in photography education. The developments and improvements to the ASSURE model are explained in the following sections .

7.5.3.1. Step 1: Analyze Learner

According to ASSURE model, the instructor should determine the general and individual characteristics of students in terms of: age, study level, gender, culture, learning skills, background, and previous knowledge. In AMPE, these characteristics were also taken into consideration. Furthermore the following modifications were taken into consideration:

General characteristics are:

- ❑ Appropriate use of advanced multimedia technology, i.e. this technology, should for example be acceptable for the students' socio-cultural code, adaptable to their learning skills, and manageable by their own physical and mental ability.
- ❑ Analysis of the subject content with the focus of using advanced multimedia in delivering this content, which requires a treatment and sequencing of concepts, definitions, and ideas starting with simple and real use experiences ending with abstract and more difficult ones. This idea of progression from simple and real use experiences to abstract and more difficult ones is elaborated on in 8.8.2.

Entry Competencies:

- ❑ Do the learners have the knowledge base required to enter the lesson?
- ❑ Do they have the entry competencies and technical vocabulary for this lesson?
- ❑ Have they already mastered the skills you are planning to teach?
- ❑ Do they have biases or misconceptions about the subject?

Learning Styles:

- ❑ Describe the learning style preferences of the individual members of the class (e.g., auditory, visual, tactile/kinesthetic). Then determine the information processing habits of the learners. This category includes a broad range of variables related to how individuals tend to approach the cognitive processing of information. Finally, determine the motivational and physiological factors of the learners. Consider things such as anxiety, degree of structure, achievement motivation, social motivation, cautiousness, and competitiveness.

7.5.3.2. Step 2: State Objectives

In AMPE, objectives should be stated with the following modifications in mind:

- ❑ Objectives should be stated behaviorally considering the nature of advanced multimedia required to achieve the learning outcomes.
- ❑ This advanced multimedia should be specified as a condition to support the achievement of the learning objectives in relation to the learning experiences and knowledge to be acquired.

7.5.3.3. Step 3: Select Methods, Media, and Materials

The instructor should select the most appropriate methods and media relevant to achievement of his/her course objectives. In AMPE, the following modifications are applied:

- ❑ Both the selection of methods and media should consider the requirements of advanced multimedia in this improved ASSURE model.

- To achieve this, the researcher has identified that currently there is not sufficient guidance to select the appropriate methods, media and materials particularly in terms of advanced multimedia.
- To overcome this shortcoming, Laurillard's conversational framework (see section 7.5.1 above) is adapted as a framework to select methods, media and materials.
- The selection of methods, media and materials has three stages: Stage 3A, Stage 3B and Stage 3C.
- First, this adaptation process was conducted by creating a sub-system to select the most appropriate multimedia technologies and their methods in terms of learning experience and related media forms.
- Figure 7.3 shows Step 3 in its initial development stage (Stage 3A and Stage 3B).

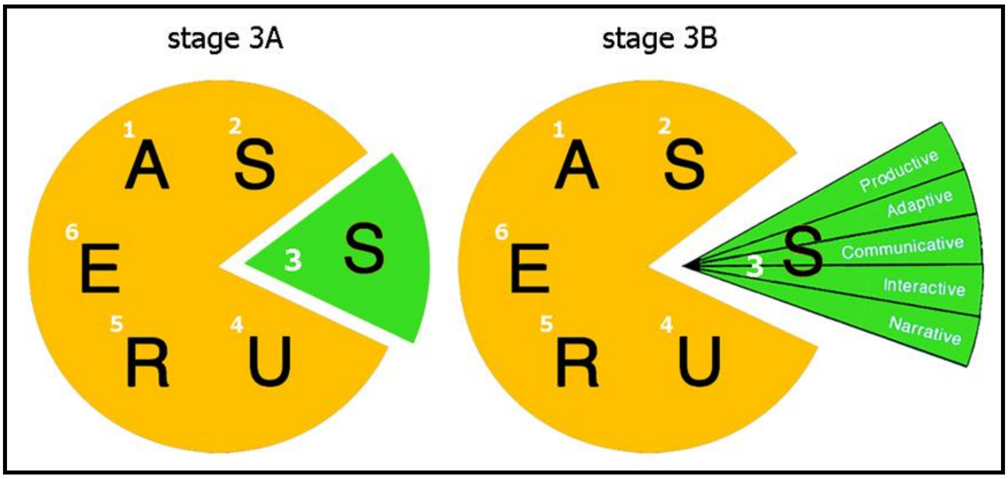


Figure 7.3 Development of the ASSURE Model - Stage 3A to Stage 3B
Source: Albayat (2011)

- Second, the choice of the media forms based on Laurillard's conversational framework is even more refined with reference to the media levels of vividness and interactivity, as defined by the classification model of Steuer (1993) (see section 7.5.2 above). This is also in line with the findings from the critical review, student survey and observation of this PhD research, which indicate that the higher the level of vividness and interactivity, the greater the potential effectiveness of the learning materials produced.

- Figure 7.4 shows Step 3 in the development of the ASSURE model (Stage 3C).

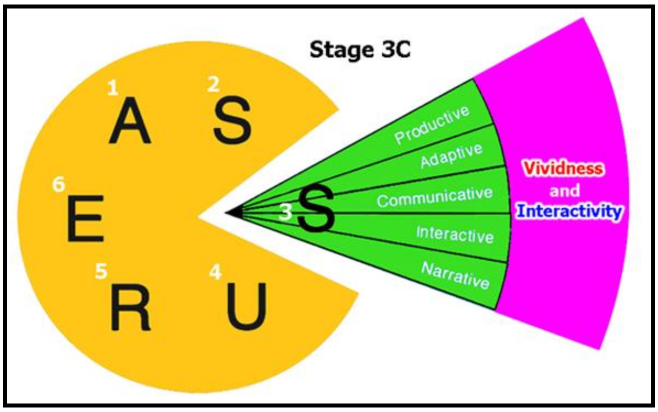


Figure 7.4 Development of the ASSURE Model - Stage 3C
Source: Albayat (2011).

- The third and final stage of the adaptation process of Step 3 of the ASSURE model is the combination of Stages 3A, 3B and 3C incorporating advanced multimedia and methods, as is shown in Figure 7.4. This combination is an important addition to the ASSURE model resulting in a framework for advanced multimedia and methods selection, which suits the needs of research objectives and field work specifically in teaching photography using advanced multimedia. It is important to mention that Laurillard's Communicative media, which allows for online discussion and debate, was excluded from the adaptation process as it is beyond the scope of this research, which only focuses on offline and face-to-face based provision.

By combining Stages 3A, 3B and 3C, as shown in Figure 7.4 above, the following are the main components of the resulting framework shown in Figure 7.5 below:

1- Column 1 is modified from Laurillard's Conversational Framework (2002); this column represents different learning levels, starting with ‘Restate concepts and ideas’ in Row (A) and ending with ‘Assess students (formative and summative)’ in Row (D) in Figure 7.5.

2- Columns 2 and 3 are taken directly from Laurillard's conversational framework to reflect different learning experience and media forms.

3- Column 4 is an adapted version of Laurillard's Media technology, taking into consideration developments of advanced multimedia and their suitability for specific learning experiences. It also indicates a preference for advanced multimedia technology based on the findings of this research.

4- Column 5 is adapted from the categories defined by Steuer (1993), and classifications which match what is seen in Figure 7.2 in relation to the media technology in terms of the level of interaction, vividness and appropriateness for each type of learning experience. Again it indicates a preference for advanced multimedia (in terms of the highest appropriate levels of interactivity and vividness) based on the findings of this research.

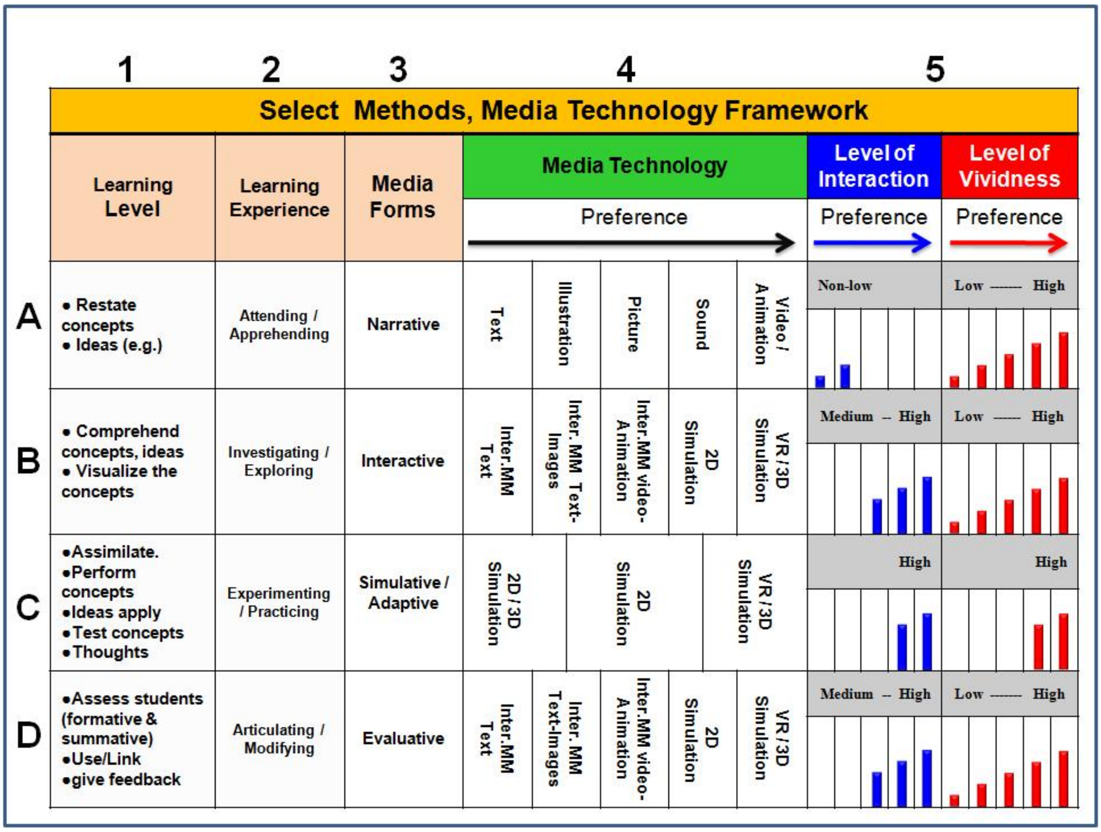


Figure 7.5 Advanced Multimedia and Methods Selection Framework.

7.5.3.3.1. Explanation of this framework in Practice

The framework shown in Figure 7.5 above is, therefore, designed to be a framework for the teacher to select the most appropriate methods and media technology for the learning experience needed to achieve specific learning outcomes. The key point here is that, based on the findings of the student survey in particular, the preference indicated is to select (where possible) the media technology with the highest levels of interaction and vividness to maximize effectiveness.

This framework can be used as follows:

- Once the teacher has chosen a particular learning outcome, the required learning level for their students and particular situation needs to be selected. If introducing the area of practice, then ‘restate concept, ideas’ might be suitable; if the students have already looked briefly at the subject, a more in-depth approach might be needed, so it would be better to move to a more complex level of learning, from A to B to C or D (see Figure 7.5).
- After the learning level has been selected, the teacher moves along the row to see the type of learning experience and media form recommended; then further along to the required type of media technology; and finally they are led to the appropriate levels of interaction implied by the available choices in that row.
- If the teacher goes all along the row, for example along Row A, and then realizes that the level of interaction is not sufficient, then they would need to start again by looking along the next row. In this way, the teacher will be supported by the framework in choosing the most suitable learning experience, media forms, media technology, by following the relevant row or learning level.

7.5.3.3.2. Some examples of how the framework works

Example 1: Referring to Row ‘A’ in Figure 7-5, for ‘Restate concept, ideas’ as a learning level, the teacher should select:

> ‘Attending and Apprehending’ as the learning experience;
>
> ‘Narrative’ as the media form, and;
>
> ‘Text’, ‘Illustration’, ‘Picture’, ‘Sound’, ‘Video/animation’ as the media technology, with preferences for the highest level of interaction.
>
> For example, looking at photographs taken using different shutter speeds enables the students to discuss the different effects on a range of subjects, as can be seen in Figure 7.7 and Figure 7.8.

Example 2: For ‘Attending and Apprehending’ learning experiences, the media forms proposed would be primarily linear in the/their narrative and, in terms of increasing levels of interaction: ‘Text’, ‘Illustration’,’ Images’, ‘Sound’, and ‘Video/Animation’.

However, for ‘Investigating and Exploring’ learning experience, the media form used would need to be more interactive and, in terms of increasing levels of interaction, ‘Interactive Text’, ‘Interactive Text and Image’, ‘Interactive Video/Animation’, ‘2D simulation’ and ‘3D simulation/VR'.

The research has shown that simulated 3D virtual environments are the most interactive technologies. This is obvious from Steuer's Classification Model figure 7-2 (see p. 228) where one can see that high level of interactivity leads to the media type such as 3d simulation.

An example to show apprehending would be a group activity where students are asked to think of situations where they would use a slow shutter speed and a high shutter speed to create contrasting and interesting visual effects. This can be achieved through looking at interactive computer-based questions, dragging and dropping shutter speed values onto photographs.

Example 3: The teacher chooses a particular learning outcome for a session with his students:

"On completion of this learning activity you will be able to: **Understand the relationship between the shutter speed and what you see in a photograph**".

It is possible to achieve this learning outcome at each of the learning levels with each of the four different **media forms** – 'Narrative', 'Interactive', 'Simulation' or 'Evaluative'.

- **Narrative:**

Describing to the students the range of shutter speeds and their mathematical relationship - how different shutter speeds affect what is captured, from high speed thousandths of a second e.g.1/4000th through to long exposures e.g. ½ second or longer, using examples from the early use of photography through to modern examples e.g. covering work by Eadweard Muybridge (1830-1904), Étienne-Jules Marey (1830-1904) and Harold Edgerton (1903 –1990).

- **Interactive**:

Rolling over a sequence of a number of different subjects, for example a fountain or waterfall. This interactive piece would show a list of shutter speeds from very short exposures, e.g.1/4000th of a second, through each shutter speed to 2 seconds or longer together with their corresponding photograph. When students roll over the shutter speeds, they see the different photographs that match that speed alongside. Figure 7.6 below shows the interactive multimedia (2D simulation) to demonstrate the effect of changing shutter speed.

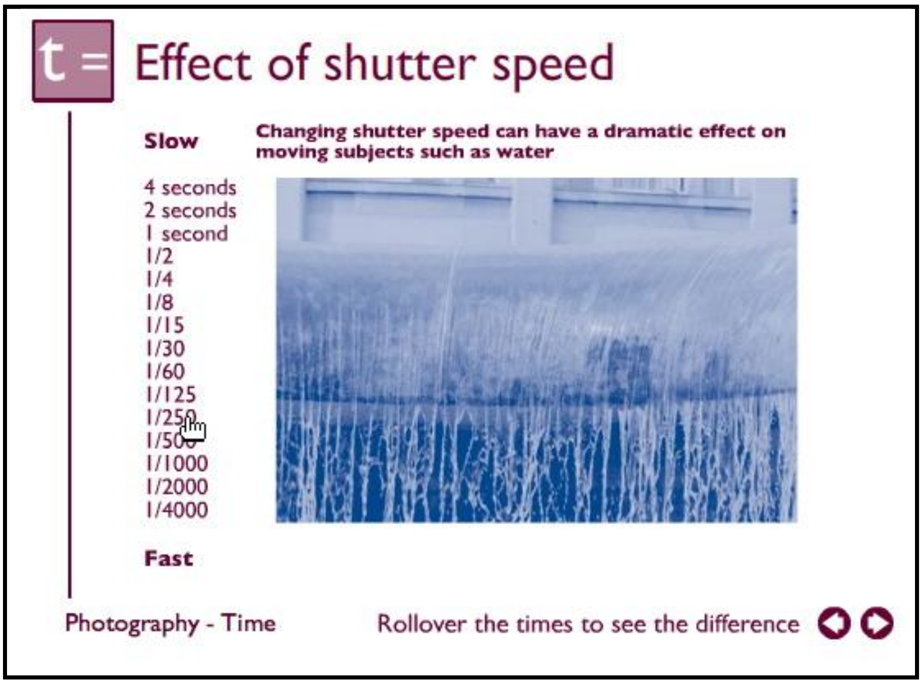


Figure 7.6 Effect of shutter speed.

Source: Bryson (2008).

- **Simulation**

On screen students would have the virtual camera with controls to alter the shutter speed. Alongside the camera, on the same screen, is a short video of an event. The students are asked to view this first, then set their virtual camera's shutter speed to capture which kind of photograph they want. On firing the virtual shutter, they will see the image they have captured on the camera's viewer. They can then try different shutter speeds (see Figure 7.7 and Figure 7.8 below) to try to get the effect they want, simulating the real world situation of having a model repeat a movement for a photographer to capture what s/he wants as a photograph. Through trying this virtually, with a number of different scenarios in the videos, students can better develop an understanding of the impact of their choice of shutter speed on the final photograph.

This camera simulator allows students to practice by altering and observing the effect of different shutter speeds on the photograph's motion blur or lack of motion blur.

Figure 7.7 Low shutter speed 1/40

Figure 7.8 High shutter speed /2000

- **Evaluation:**

Questions are given to assess students' understanding using multiple- choice questions and drag-and-drop questions. Then, problem-based questions are used. For example: "What kind of photograph would you achieve if you photographed a cyclist riding through a stream with an exposure of ½ a second?"

More details on the use of the framework are described in chapter 8. However, it should be noted that the final choice of media technology can also be influenced by the physical and human resources available; for instance, a 3D simulation is not feasible (even if it is desirable) if there are no suitable computers to deliver it or the specialist staff to develop it. To this end, the third step of ASSURE was adapted to the developed AMPE model.

7.5.3.4. Step 4: Utilize Methods, Media, and Materials

The researcher focuses on E-learning in utilizing Methods, Media, and Materials using advanced multimedia technology. After the selection of the appropriate media form and the possible media technology and methods, the instructor should use and identify the physical resources available and/or required. In AMPE, these may include a TV set, video, multimedia projector, PCs, Printers, scanners, and software; in addition to staff, assistant moderators, and specialist staff in accordance with staff-student ratio.

The instructor should implement the 5 Ps (see section 7.3) to ensure an efficient lesson delivery using advanced multimedia.

7.5.3.5. Step 5: Require Learner Participation

In AMPE, the instructor should encourage his/her students to participate interactively using the advanced multimedia (interactivity and vividness) tools e.g. simulation and VR through interaction with instructional materials to acquire practical skills relevant to the stated objectives and learning experiences and provide them with feedback.

7.5.3.6. Step 6: Evaluate and Revise

In AMPE, the instructor needs to evaluate the actual effectiveness of the instruction through using advanced multimedia (interactivity and vividness) tools. The researcher evaluates the e-learning resources through the students' feedback. The evaluation process can take place on three levels:

- The students can be interactively evaluated using different means of testing tools, such as achievement tests in photography.
- The media technology and resources, such as enriched games, simulations and VR, can be evaluated using data-gathering tools
- The whole six-step AMPE system may be evaluated for its effectiveness using data-gathering tools.

7.6. Proposed Model for Using Advanced Multimedia

In summary, the following Figure 7.9 shows how the proposed design model for using Advanced Multimedia in Photography Education (AMPE) has been finally adapted from the ASSURE model in preparation for in-field testing by the creation of a prototype specifically designed for a photography course.

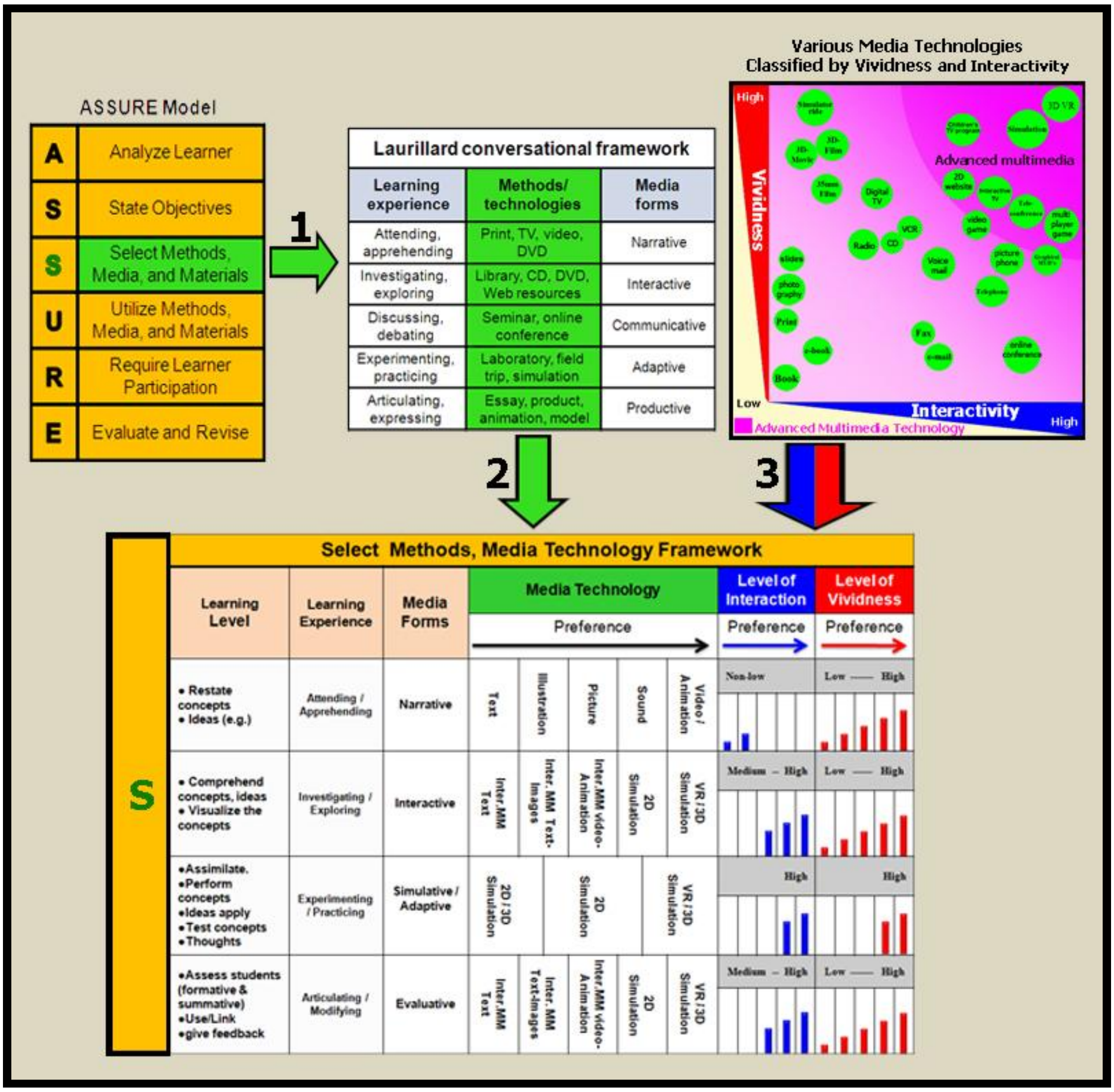


Figure 7.9 **Advanced Multimedia in Photography Education (AMPE).**
Source: Albayat (2011).

Figure 7.9 shows Advanced Multimedia in Photography Education (AMPE) as finally derived, developed, and produced from the ASSURE model. The ASSURE model was first found to be the best instructional design model that fits the research objectives, and its field work in photography. All steps were revised and modified in light of this adaptation. Step 3 of the original ASSURE model (indicated as no. 1 in Figure 7.9) was given more attention as it affects the media technology selection which is an important focus of the purposes of this research. The first stage of this particular modification (indicated as no. 2 in

Figure 7.9) signifies the need to incorporate Laurillard's conversational framework, supported by Steuer's amended classification model (indicated as no. 3 in Figure 7.9), to reflect the relationship between the media form selection and the learning experience/outcomes in photography lessons. As a result of this amalgamation, a multimedia and method selection framework was concluded for use in photography education.

7.7. The Proposed Model's Unique Features

The AMPE model has several key features to support the use of advanced multimedia in education and higher level learning. These are as follows:

1. It is a model specifically for photography education. It enables the instructor to obtain immediate and continuous feedback through its systematic approach supported with hands-on experience, field trips, and practical photography sessions.
2. It is a model that relates choice of media to the learning outcomes and associated learning experience to achieve those outcomes.
3. It is a model that that also relates choice of media to available physical and human resources. Learning will be based on the most appropriate selection of advanced multimedia in the form of presentations, virtual tours, simulations, and interactive inquiry and feedback.
4. It is a model that embraces and clearly defines basic to advanced multimedia technology.
5. It is a model that recognizes the importance of using the most vivid and interactive media possible to ensure learning effectiveness, engagement and fun.
6. It paves the way for structuring a prototype in photography education for the field work of this research and other applications.
7. It serves to bridge the gap in literature, which lacks any pedagogical models to teach practical courses (such as photography) emphasizing the use of advanced multimedia. It blends components from ASSURE

and the conversational framework with special focus on methods, resources and media selection.

8. It combines a number of features from individual models leading to a more rigorous developmental process.
9. It is a model that relates choice of media to the learning outcomes and associated learning experience to achieve those outcomes.

7.8. Chapter Summary

The development of the design model to use advanced multimedia in photography education is explained above, using a step-by-step approach. This model provides a framework for designing, implementing, and evaluating an e-learning resource in photography. The development of an e-learning resource for depth of field using this design model and its subsequent testing will be fully discussed in the next chapter.

Chapter Eight

Design of the Prototype

8. Design of the Prototype

8.1. Introduction

This chapter discusses the design of a prototype using the proposed design model discussed in the previous chapter. This prototype will subsequently be evaluated in order to determine the effectiveness of the model. The sections below describe and discuss the details of this design and the ways in which the prototype was implemented and evaluated.

8.2. Photography Lesson

Photography was originally selected as the research topic because the author is specialized in this subject with a long experience of teaching in this field. From the student survey and teachers' interview results presented in chapter 4, it was clear that Depth of Field' (DOF) is one the main topics that photography students and teachers have difficulty with, from both a technical and creative perspective. It is a demanding concept in terms of understanding and visualization, and there is an associated shortage of both physical and staff resources to meet the necessary teaching requirements. It was, therefore, chosen as a suitable topic for the development of the prototype.

A prototype can be defined as "A preproduction model developed to evaluate the feasibility of new ideas, materials, technology, and design techniques as part of new product development" (Dictionary of Business and Management, 2009). It allows designers or developers to examine different alternatives, test theories and confirm performance prior to the mass production of the product, thus eliminating any unexpected problems before final stages of production.
The advantages of prototyping can be considered as being the following:

- It is a planned approach
- It reduces future costs of failure relating to mass production

- It reduces development time
- It motivates the researcher to think on a broader scale
- It facilitates implementation as users know what to expect
- It results in higher user satisfaction

However, these can be considered the disadvantages of prototyping:

- It may become difficult to manage
- It may lead to insufficient analysis
- It may sometimes lead to incomplete documentation

In this study, the researcher will develop a functional e-learning prototype using advanced multimedia for Photography education for the topic of Depth of Field.

In order to test the validity and effectiveness of the proposed design process model, the design processes are applied according to the adapted ASSURE model to develop an advanced multimedia e-learning prototype resource for teaching the concepts of Depth of Field in Bahrain, the home country of the author. Sections 8.2.1 through 8.2.6 below provide a detailed account of the prototype construction, design, implementation, and evaluation of the design. The procedures of developing and producing the prototype are shown in detail at the end of this chapter, in section 8.3.

8.2.1. Stage 1 - Analyse Learners

In this first step of the prototype development, Bahraini students were analysed for their general and individual characteristics in terms of the following profile. This profile is generated from the University of Bahrain registry of students, which identified those registered for photography courses.

❑ General and Individual Characteristics of Students

- Age: between 19 and 22.
- Study level: Undergraduate 2005-2009 - 2nd year
- Gender: 90 % female, 10% male.
- Number of students: 100 (25 per group)
- Learning skills: Open-minded with an appreciation that they need to know more to take good photographs.
- Background: Secondary School with one year preparatory programme at University of Bahrain (UB), or Royal University in Bahrain (RUB).
- Cultural factors: Economically backward, very little knowledge of handling equipment, not confident in handling a camera.
- Previous knowledge: Basic understanding of photography (aperture / focal number, focal length of the lens, size of the picture and focusing) through using a camera.
- Technological skills: Able to use a web browser and interactive applications; and already familiar with using multimedia applications since they are majoring in educational technology.

❑ Content analyses

With regard to the content (concepts, definitions, ideas and skills), the following analysis was conducted based on the needs of the learners from the general syllabus proforma of both the UB and RUB. These are general standard syllabuses applied in photography courses.

- Knowledge of the concept of depth of field, formula and processes.
- Basic knowledge of aperture, focal length of the lens, and focusing.
- Understanding of the concept of depth of field.
- Application of this knowledge and understanding in concrete situations
- Development of skills in taking photographs using the range of possibilities that depth of field offers by combining lens selection, aperture choice and subject distance to communicate visually, for example portrait with background out-of-focus.

- In terms of **human resources availability**, there are two skilled specialist members of staff in technical computing located one at UB, and one at RUB to assist the lecturer in the class. There are also two multimedia designers allocated to help the development of the prototype.

- There was **sufficient budget**, in terms of the infrastructure available for the researcher to complete this design and prototype. For some administrative expenses, the researcher used his own personal resources, amounting to approximately seven hundred GBP.

Key issues that needed to be considered were as follows:

1. High number of students per teacher as the staff-student ratio was generally at 1:75
2. Individual attention not currently possible
3. Lack of camera resources to teach particular topics in photography.

- The **aim of the learning resource** was to address these issues and support and develop learners' understanding and the use of depth of field in their photographic work.

- **Learning outcomes** 1, 2 and 3 are knowledge and skill oriented, and require field work. New e-learning resources are required to support the traditional teaching methods in order to achieve learning outcomes 1, 2 and 3. The proposed learning resources will consist of advanced multimedia which will attempt to overcome the problems mentioned above by:

1. Providing more individual attention
2. Providing a virtual camera alternative to address the lack of camera resources to teach the particular topic of Depth of Field (DOF) in photography.

3. Considering the implications of advanced multimedia, facilitating learning and understanding of the demanding aspects of photography.

There is also a need to give students the opportunity to experiment independently with a virtual camera before using a real one, particularly those who are not confident and have difficulty accessing and using real cameras due to the limited numbers of cameras available. Moreover, as only film cameras are available, instant results can be obtained from a virtual camera and money can be saved on film, film processing and printing during experimentation. Steps followed in the design process of the prototype for the e-learning resources are explained and discussed below in section 8.2.3.1, in Stage 3, and presented in a storyboard flowchart in section 8.2.3.3.

8.2.2. Stage 2 - State Learning Objectives (learning outcome)

It was determined from the learner needs and syllabus that, on completion of this advanced multimedia learning experience, students will be able to:

1. Demonstrate the ability to define depth of field, name three influences upon it, and recognise examples of its use.
2. Demonstrate an understanding of how the individual elements affect depth of field in a photograph, that is:
   A) Aperture,
   B) Focal length of a lens
   C) Camera-to-subject distance.
3. Apply the knowledge gained from understanding how the individual elements affect a photograph by combining these elements, that is:
   - Aperture + focal length lens,
   - Aperture + camera-to-subject distance,
   - Focal length of a lens + camera-to-subject distance,
   - Aperture + focal length of a lens + camera-to-subject distance
   - Demonstrate their skills in taking photographs using depth of field.

In light of the experiential evidence and personal observation, it seems that the progression from defining/illustrating to exploring is reasonable approach where simple (explanatory with less interactivity) learning materials are suited to learning outcome 1 with the material getting more complex (interactive and vivid) as we progress form learning outcome 2 to 3.

8.2.3. Stage 3 - Select Methods, Media, and Materials

The most suitable teaching and learning experience methods for learning resources were determined to be narrative, interactive, simulative and evaluative, given the learning objectives identified in the previous stages. The determination of the above is based on the design model in Chapter 7 (Figure 7.5).

The next section will show how the design process of prototype model was planned, developed, and produced. The testing stage of the prototype and the design model on which it is based is discussed in the next chapter.

8.2.3.1. Design Process of the Prototype Model

Storyboards are used primarily in film making to design individual shots before actual filming. They are also common in comic strip, animation, TV commercials, and multimedia design, but can be used for many other sorts of projects. Whereas a flowchart focuses on the structure and interactivity of a system, a storyboard or "content flowchart" allows far more detailed illustration of the contents of each screen or element. The storyboard should contain a sketch of the visual aspect of the screen, information which will be presented, descriptions of animations, interactions (for example dialogue boxes), sounds, and any other media (LeLoup and Ponterio, 2003). Here a linear storyboard type is used which is suitable for the lesson objective and prototypes. The next stage is to draw a design process for the prototype (Depth of Field -DOF) based on the structure of the student linear journey navigation flow chart as shown in

** To **ensure mastery of learning, students cannot proceed to LO-2 unless the students answer all the questions correctly i.e. they have to retake only parts of L.O-1 that they have got wrong.**

Figure 8.1. Screenshots for the prototype in the initial design process model (storyboard) and final screen shots will show how the design process of the proposed design model is implemented for each learning outcome. This will be discussed briefly in this section, but the screen shots from the prototype will be fully presented in section 8.3.

Therefore, both the design process of the prototype and the prototype flowcharts will be discussed simultaneously so that it is easy to understand how the planning and production stages utilise the design process model proposed by this research. The lesson plan utilised in the design process of the prototype is again used here to highlight learning outcomes and build the prototype.

The design process of the prototype starts from a low level learning experience, building to a high level i.e. from Narrative->Interactive->Simulative->Evaluative.

- Achievement of learning outcome 1 is supported by narrative and evaluative methods, which provide an explanation of the basic concepts of DOF, followed by formative evaluation, through multiple choice questions, to test the understanding of the basic concept and its uses.
- Achievement of learning outcome 2 is supported by narrative, interactive and evaluative methods, which provide an explanation of DOF in relation to aperture, focal length of a lens and camera-to-subject distance, and then reinforce this by demonstrating the various concepts interactively. This is followed by multiple choice questions to test the understanding of these concepts.
- Achievement of learning outcome 3 is supported by narrative, simulative and evaluative methods, which provide an explanation of the relationship when combining the above concepts (aperture, focal length of a lens and camera-to-subject distance), and the opportunity to practically apply this knowledge using a simulation and formative evaluation to test the practical understanding of these concepts.

The most suitable combination of multimedia for the learning resource(s) was also determined according to this model's criteria. They were: text, photographs, illustrations, and simulation/application. A combination of text, photographs, charts, illustration and 2D simulated camera actions (changes in aperture, focal length and distance) were used together with formative and summative assessments. Table 8-1, below, summarises the contents of Table 8-2 through to 8-11, which detail the Learning Outcomes and the respective Design Process and Rationale of Pedagogy and Media used in each.

Table 8-1 Rationale of Pedagogy and Media used for each LO

Learning Outcome 1	Table 8-2	Design process of prototype (DOF)	Table 8-3	Rationale of Pedagogy / Media used.
Learning Outcome 2A	Table 8-4	Design process of prototype (DOF)	Table 8-5	Rationale of Pedagogy / Media used.
Learning Outcome 2B	Table 8-6	Design process of prototype (DOF)	Table 8-7	Rationale of Pedagogy / Media used.
Learning Outcome 2C	Table 8-8	Design process of prototype (DOF)	Table 8-9	Rationale of Pedagogy / Media used
Learning Outcome 3	Table 8-10	Design process of prototype (DOF)	Table 8-11	Rationale of Pedagogy / Media used.

Learning outcome 1: Demonstrate an understanding of the concept of DOF and its uses.

- Achievement of Learning Outcome 1 (narrative) is supported by text, illustration, and picture.
- The choice of media used here will have low interactivity and low to medium vividness.
- Assessment of Learning Outcome 1 (evaluative) is through interaction (Text-Image).
- The choice of media used here will have medium interactivity and low to medium vividness.

These are summarized in Table 8-2 - Design process of prototype (DOF), and Table 8-3 - Rationale of Pedagogy / Media used for learning outcome 1.

In order to demonstrate the concept of depth of field, and assess its understanding, colour pictures are used showing depth of field and shallow depth of field. Text is also used in addition to the pictures to explain the concept, definition and uses of depth of field. The diagrammatic images also explain the area of depth of field. The reason for using photography pictures rather than other media, such as video or animation, is simply due to their image quality, availability and low production cost. The basic interactivity allows navigation of content and response to multiple choice questions. This is shown in more detail with reference to the Design Process of Prototype and Rationale of Pedagogy / Media used in the following tables, Table 8-2 to Table 8-11 for all learning outcomes.

Table 8-2 Learning Outcome 1.

<table>
<tr><th colspan="2">Design process of prototype (Depth of Field) using advanced multimedia</th></tr>
<tr><td colspan="2">For Rationale of Pedagogy / Media used for Learning Outcome 1, please refer to Table 8-3.</td></tr>
<tr><td colspan="2">Learning outcome 1: Demonstrate the ability to define depth of field, name three influences upon it, and recognise examples of its use.
Media forms: Narrative</td></tr>
<tr><td>Page 1 Learning experience (Attending, apprehending)</td><td>Media Technology</td></tr>
<tr><td>Depth of Field
In order to produce professional photography which has high technical as well as aesthetic qualities, and which follows the basic concepts of composition, one must have a grasp of some basic elements, among which is depth of field.

When a lens is focused on an object, there is some distance in front of the object, and some behind which will also be acceptably sharp. This zone of sharpness which includes the subject is called the depth of field (Davis, 1972).</td><td>Text
Picture</td></tr>
</table>

Page 2 | **Media Technology**

What is Depth of Field (DOF)?

The amount of distance between the nearest and farthest objects that appear in acceptably sharp focus in a photograph; the zone of sharpest focus in front of, behind, and around the subject, when the lens is focused on a specific subject

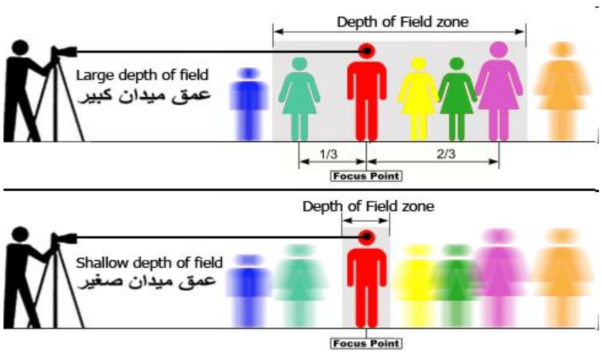


Illustration of DOF, showing large depth of field and shallow depth of field.

Text
Illustration

<table>
<tr><td>Page 3</td><td>Media Technology</td></tr>
<tr><td>

The amount of depth of field:

Choosing the amount of depth of field is key in photography. When shooting a landscape, for example, you want as much of the photograph as possible to be in sharp focus, so a large depth of field is required, as illustrated in Photo1. In other situations, such as taking a portrait, a shallower area of sharp focus will separate your subject from distracting backgrounds, as illustrated in Photo 2.

Photo 1 Photo 2

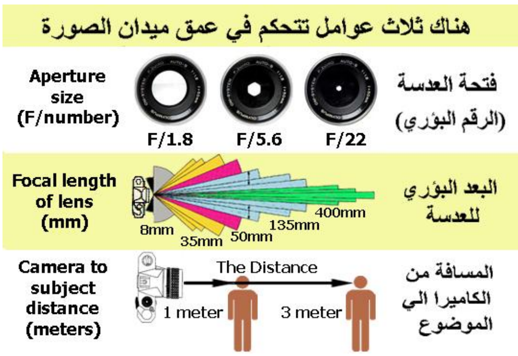
(Photo 1: Photograph with extended depth of field, from near to far in sharp focus).

(Photo 2: Photograph with shallow depth of field, where only the main subject is in focus).

</td><td>Text
Picture</td></tr>
<tr><td>Page 4</td><td>Media Technology</td></tr>
<tr><td>

Factors that affect depth of field:

There are three factors which control the depth of field in a photograph:



Each of these factors will be covered in the rest of this lesson with the help of examples and interactive demonstrations for you to try out

</td><td>Text
Illustration</td></tr>
</table>

Learning outcome1: Understanding of the concept of depth of field and its uses. **Media forms: Formative Evaluation**	
Page 5	**Media Technology**
Answer questions about : The concept of depth of field and its uses to confirm achievement of Learning Outcome. **Q1-Depth of field refers to:** A- The distance between the subject and the background. B- The distance between the camera and the subject. C- The amount of front to back sharpness in a photograph. D- Mentioned on A and B.	Interactive Text
Page 6	**Media Technology**
Q2-Depth of Field allows you to control: A- The amount of light that reaches your film or digital media. B- The ISO speed. C-The amount of sharpness in your finished picture. D-Your lens selection.	Interactive Text
Page 7	**Media Technology**
Q3- Which of these 4 images has the largest depth of field? 	Interactive Text/ Images

Table 8-3 Learning Outcome 1 Rationale of Pedagogy / Media used.

Rationale of Pedagogy / Media used		
This section corresponds to the Table 8-2 Design process of prototype		
Learning outcome 1: Demonstrate an understanding of the concept of depth of field and its uses. **Media Form used: Narrative**		
Page	**Pedagogy 1:**	One coloured picture is used to demonstrate the concept of the depth of field by showing the foreground/background sharpness of picture

1	**Media use 1:**	Text, in addition to picture, is used to explain the concept and the definition of the depth of field. The reason for using only text and pictures rather than other media is that they are more appropriate for the subject matter and easy to produce. There is no perceivable pedagogic advantage to using richer media or interactivity for this particular learning outcome. Throughout this study, the AMPE model is used to guide the choice of media used. Text and images are sufficiently good here to explain the depth of field without resorting to rich multimedia as can be seen in the picture, and all details are explained in the following Learning Outcome.
Page 2	**Pedagogy 2:**	To visualize the concept of the depth of field, in detail and from a different perspective, two coloured Illustrations are used. The first illustrates large depth of field and the second illustrates shallow depth of field.
	Media use 2	Text, in addition to the two illustrations, is used to explain the area of depth of field. The reason for using only text and illustrations rather than other media is that they are more appropriate for the subject matter and easy to produce. There is no perceivable pedagogic advantage to using richer media or interactivity for this particular learning outcome.
Page 3	**Pedagogy 3**	To demonstrate the concept of the depth of field in real pictures, two coloured pictures are used to distinguish between large/shallow depths of field.
	Media use 3	Text is used in addition to the two pictures to explain the area of depth of field in each picture. The reason for using only text and pictures rather than other media is they are appropriate for the subject matter and easy to produce. There is no perceivable pedagogic advantage to using richer media or interactivity for this particular learning outcome.
Page 4	**Pedagogy 4**	To relate previous knowledge with current as the student has already studied three factors by mentioning their effect on the DOF. This also prepares the student for the next unit.
	Media use 4	Three illustrations are used to quickly and briefly remind the student of the theoretical /pictorial basics of the three factors and their effect, in order to build on previous knowledge.

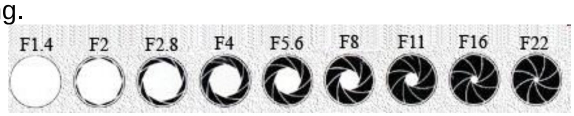
		Illustrations are used as choices. These should work effectively to explain and prepare the students for the next Learning Outcome i.e. LO2A - the aperture size, LO2B – the focal length of the lens and LO2C - camera to subject distance.
Learning outcome 1: Demonstrate an understanding of the concept of depth of field and its uses. **Media Form used: Formative Evaluation**		
Page 6,7,8	**Pedagogy 5**	*Multiple Choice Questions to measure the understanding and application of depth of field with the help of text and image to ensure the complete achievement of L.O-1 and prepare the student for the next concept. ** To ensure mastery of learning, students cannot proceed to LO-2 unless they answer all the questions correctly i.e. they have to retake only parts of L.O-1 that they have got wrong.
	Media use 5	Interactive text/images are used because the text enables the student to theoretically understand the concept of the subject while the images enable the student to apply their knowledge to differentiate between pictures and to identify the best picture with largest/smallest depth of field. The AMPE model is used to guide the choice of media used in this entire study. Text and images are used as a choice because the still picture is a "persistent" medium, allowing a learner to study the message at length (Kemp,1985).

Learning outcome 2A: Demonstrate an understanding of how the individual elements (Aperture) affect depth of field in a photograph.

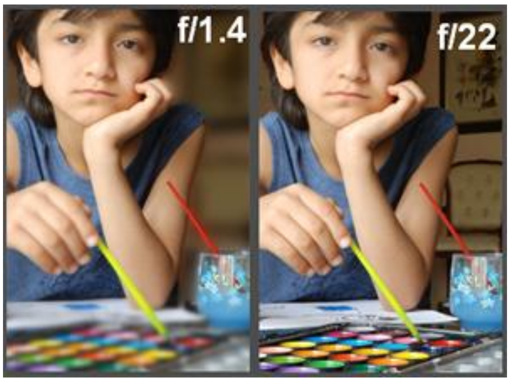
- Achievement of Learning Outcome 2A (narrative) is supported by text, illustration and picture.
- The choice of media used here will have low interactivity and low to medium vividness.
- Achievement of Learning Outcome 2A (interactive) is supported by 2D Simulation.
- The choice of media used here will have medium interactivity and medium vividness.

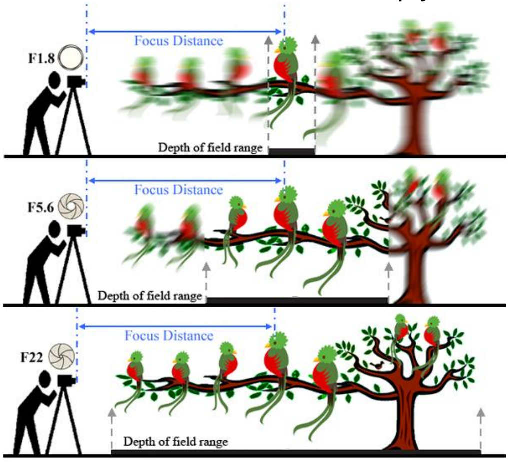
- Assessment of Learning Outcome 2A (evaluative) is achieved by interactive Multimedia (Text-Image).
- The choice of media used here will have medium interactivity and low to medium vividness.
- Illustration of f-number and associated aperture size and its affect on DOF is achieved with the help of text and pictures. Audio, video and animation etc. is not required; however, to reinforce the concept, the student can interactively investigate and visualize the concept and how individual elements affect DOF (Aperture) by changing a sliding bar aperture using 2D simulation. A 3D simulation is considered too costly and not necessary as it would provide no significant advantage, as detailed in Table 8-4 Design process of prototype (DOF) and Table 8-5 Rationale of Pedagogy / Media used for Learning Outcome 2A.

Table 8-4 Learning Outcome 2A.

<table>
<tr><td colspan="2">Design process of prototype (Depth of Field) using advanced Multimedia</td></tr>
<tr><td colspan="2">For Rationale of Pedagogy / Media used for the Learning Outcome 2A please refer to Table 8-5.</td></tr>
<tr><td colspan="2">Learning Outcome 2A: To demonstrate an understanding of how the individual element (Aperture) affects the depth of field in photography.
Media forms: Narrative</td></tr>
<tr><td>Page 1 Learning experience (Attending, apprehending)</td><td>Media Technology</td></tr>
<tr><td>1- Aperture (F/Stop)*
These different aperture sizes are called f-numbers (the "f/" stands for focal ratio). Aperture size actually grows in diameter the lower the f-number. For example, f1.4 is a very large opening, whereas f/22 is a very small opening.


A larger aperture (smaller f-number, e.g. f/1.4) has a shallow depth of field. Anything behind or in front of the main focus point will appear blurred. A smaller aperture (larger f-number, e.g. f/22) has a greater depth of field. Objects within a certain range behind or in front of the main focus point will also appear sharp.
*This part is meant to recall the previous lesson and prepare the student for the current lesson</td><td>Text/
Illustration</td></tr>
</table>

<table>
<tr><td>Page 2</td><td>Media Technology</td></tr>
<tr><td>The relationship between aperture and depth of field is clear when you look at the effect of different f/numbers. Look closely at the differences in the photograph below


A small aperture like f/22 gives a large depth of field resulting in more overall sharpness.
A large aperture like f/1.4 gives a shallow depth of field resulting in a blurry foreground and background.</td><td>Text/
Picture</td></tr>
<tr><td>Page 3</td><td>Media Technology</td></tr>
<tr><td>How does aperture affect depth of field (DOF)?
Let's take a look at an illustration that will help you visualize this :


The difference in the three illustrations is the aperture size:
1- The first illustration is captured with f/1.4 (Largest opening aperture) reducing the DOF.
2- The second illustration is taken with f/5.6 giving an average DOF
3- The third illustration is taken with f/22 (smaller opening aperture) increases the DOF.</td><td>Text/
Illustration</td></tr>
<tr><td colspan="2">Learning Outcome 2A: To demonstrate an understanding of how the individual element (Aperture) affects the depth of field in photography.

Media forms: Interactive</td></tr>
<tr><td>Page 4</td><td>Media Technology</td></tr>
</table>

Camera simulator Further reinforcement is provided by allowing the student to practice and investigate the virtual effect on images of changing the scroll bar of apertures.  The application: demonstrates the concept of depth of field virtually. To reinforce this understanding, the application demonstrates the following: changing the virtual aperture (f/16, f/11, f/8, f/5.6, f/4, f/2.8 and f/1.8) by using the sliding bar of the virtual camera shows the students about the effects on the picture.	2D Simulation
Learning Outcome 2A: To demonstrate an understanding of how the individual element (Aperture) affects the depth of field in photography. **Media forms: Formative Evaluation**	
Page 5	**Media Technology**
Answer questions about changes in aperture to test your understanding of depth of field and confirm achievement of LO2A. Q1- The photograph above was taken with an aperture of f/11. If I changed this to f/5.6, what effect would this have on the depth of field?  A- Increases the depth of field. B- Decreases the depth of field. C- No effect on the depth of field D- Changes picture size.	Interactive Text/ Images

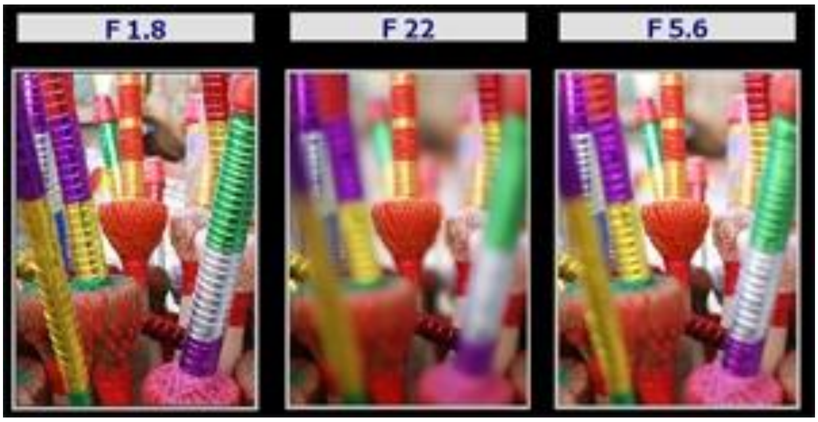
Page 6	**Media Technology**
Q2- Drag and drop the related (F-stop) to the right picture. 	Interactive Text/ Images
Page 7	**Media Technology**
Q3- Drag and drop the related aperture lens to the correct picture 	Interactive Text/ Images

Table 8-5 Learning Outcome 2A Rationale of Pedagogy / Media used.

Rationale of Pedagogy / Media used		
This section corresponds to Table 8-4 Design process of prototype		
Learning Outcome 2A: To demonstrate an understanding of how the individual element (Aperture) affects the depth of field in photography. **Media Form used: Narrative**		
	Pedagogy 1:	To explain how the aperture affects depth of field in a photograph.

Page 1	**Media use 1:**	Illustration is used to demonstrate the f-number and aperture size vs DOF to enable the student to visualize the relationship between the two. Explanation of these concepts is done through text and illustration to demonstrate the increases and decreases of the depth of field by reducing and increasing the aperture diameter (f-number). In this preliminary stage, simple and basic concepts such as f-number and aperture size require text and illustration rather than audio, video and animation etc. because the motion picture is a “transient” medium, requiring learners to grasp the message as each concept or piece of information in the video and animation is being presented (Kemp, 1985). Using the AMPE model as a guide for choice of media used, text and illustration are chosen as the suitable media used at this stage. Taken with other factors, as a whole this is expected to work effectively.
Page 2	**Pedagogy 2:**	Comparison is used to demonstrate the relationship between aperture/f-number in depth of field
	Media use 2:	Two versions of the same picture are used to enable the student to compare between their sharpness as each version has its own f-number in relation to its aperture size. Pictures are chosen as the best choice of media at this stage and should work effectively if managed well with other factors because the pictures are sufficiently clear to highlight the depth of field differences between the two pictures, and how the focal number affects the depth of field.
Page 3	**Pedagogy 3:**	To visualize, in detail and from different perspectives, how changing the aperture increases and decreases the depth of field in each illustration.
	Media use	Illustration is used to allow the student to visualize the

<table>
<tr><td></td><td>3:</td><td>subject from different perspectives and to show the effectiveness of depth of field from different stages: shallow, medium and large. There is no perceivable pedagogic advantage to using audio, richer media or interactivity for this particular learning outcome because its financial cost is high and instructional return is minimal.
Illustration is the choice of media which is expected to work effectively if combined with production skills and time availability.</td></tr>
<tr><td colspan="3">Learning Outcome 2A: To demonstrate an understanding of how the individual element (Aperture) affects the depth of field in photography.
Media Form used: Interactive</td></tr>
<tr><td rowspan="2">Page 4</td><td>Pedagogy 4:</td><td>To investigate and visualize the concept of how aperture effects DOF</td></tr>
<tr><td>Media use 4</td><td>2D simulation is used to investigate and visualize how aperture affects DOF by changing the focal number/ aperture using a sliding bar on the virtual camera, allowing the students to change the f-numbers and investigate the effect. This also gives them some virtual experience in using the camera in a real situation and in adjusting its aperture to obtain the desired effect.
The level of interactivity and media richness is close to high as different types of pictures are of high quality and vividness, and show much detail. Changing the sliding bar also produces sound effects to give the impression that the student is using a real camera. There is no perceivable pedagogic advantage to using 3D Simulation/VR for this particular learning outcome because the 2D simulation used is low in cost and achieves the predetermined instructional objectives. 2D media technology can also be supported with existing production skills and matches time availability.
Throughout this study, the AMPE model is used to guide the choice of media used. *The media used for Learning</td></tr>
</table>

		Outcome 2A is equally applicable to Learning Outcome 2B (media use 3) and 2C (media use 3).
Learning Outcome 2A: Understanding how the individual element (Aperture) affects the depth of field in photography. **Media form used: Formative Evaluation**		
Page 5,6,7	**Pedagogy 5**	Multiple Choice and drag/drop question types to measure the students' understanding of how aperture affects depth of field in order to ensure their achievement of LO-2A
	Media use 5	1. Interactive multimedia is used. Text enables the student to show whether they understand the theoretical concept of the subject. Images enable the student to apply their knowledge to differentiate between pictures. Sound is used to reinforce student responses. 2. To double check students' understanding of f-stop numbers, and their relationship to the aperture size, two sets of images with drag/drop technique are used to match the correct f-number with its relevant picture in the first situation; and the right aperture size with its relevant picture in the second situation. 3. Taking all this into account, interactive multimedia is used due to expertise, production skills, funding and time availability. * This media choice is equally applicable to Learning Outcome 2B (media use 4) and 2C (media use 4).

Learning Outcome 2B: Demonstrate an understanding of how the individual elements (Focal length of a lens) affect depth of field in a photograph.

- Achievement of Learning Outcome 2B (narrative) is supported by text, illustration and picture.
- The choice of media used here will have low interactivity and low to medium vividness.
- Achievement of Learning Outcome 2B (interactive) is supported by 2D Simulation.

- The choice of media used here will have medium interactivity and medium vividness.
- Assessment of Learning Outcome 2B (evaluative) is supported by interactive Multimedia (Text-Image).
- The choice of media used here will have medium interactivity and low to medium vividness.
- Illustration of focal length of lens versus DOF with the help of pictures. Explanation of these concepts could be done through text, pictures and illustration as this requires more explanation only on the different focal length of lens and does not require audio, video or animation etc. Moreover, 3D is costly and not necessary for this as practice and investigation is done with only the help of the scroll bar. Investigation and visualization of the concept of how individual elements (focal length of lens) affect DOF is done by changing the sliding bar focal length of lens using 2D simulation, as summarized in Table 8-6 Design process of prototype (DOF) and Table 8-7 Rationale of Pedagogy / Media used.

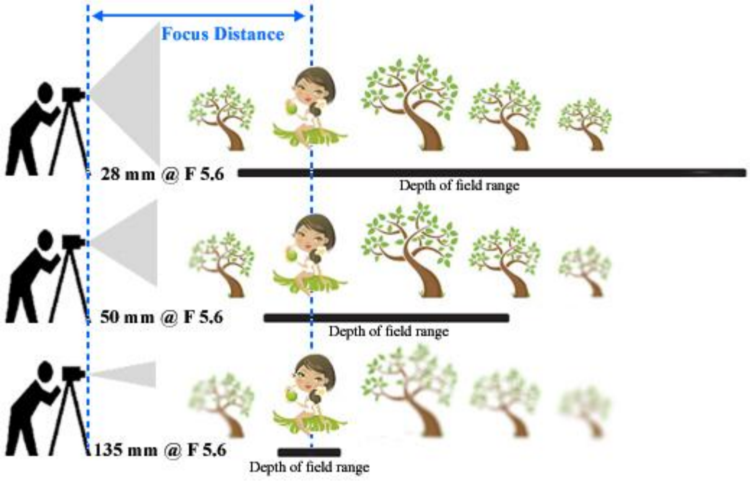
Table 8-6 Learning Outcome 2B.

Design process of prototype (Depth of Field) using advanced Multimedia	
For Rationale of Pedagogy / Media used for the Learning Outcome 2B please refer to Table 8-7.	
Learning outcome2B: To demonstrate an understanding of how the individual element (focal length lens) affects the depth of field in photography. **Media forms: Narrative**	
Page 1 Learning experience (Attending, apprehending)	**Media Technology**
Focal length of the lens: The second factor that affects the depth of field of photography is the focal length of the lens you are using. The shorter the lens focal length, the greater the depth of field for a given aperture. In other words, a wide-angle lens provides more depth of field at f/5.6 than a normal lens, and a normal lens provides more depth of field at f/5.6 than a telephoto lens.	Text, Pictures

<table>
<tr><td>


Image A: 105 mm Using a longer lens decreases the depth of field

Image B: 35 mm Using a wider angle lens increases the depth of field.
</td><td></td></tr>
<tr><td>Page 2</td><td>Media Technology</td></tr>
<tr><td>
How does the focal length of the lens affect depth of field (DOF)?



The difference between the three illustrations above is the focal length of the lens:

1-The first illustration with 28mm short focal length (wide-angle lens) increases the DOF.

2- The second illustration with 50mm focal length (normal lens) gives average DOF

3-The third illustration with 135mm focal length (telephoto lens) reduces the DOF
</td><td>Text,
Illustration</td></tr>
</table>

<table>
<tr><td colspan="2">Learning Outcome 2B: To demonstrate an understanding of how the individual element (focal length lens) affects the depth of field in photography.

Media forms: Interactive</td></tr>
<tr><td>Page 3</td><td>Media Technology</td></tr>
<tr><td>Camera simulator
Further reinforcement is provided by allowing the student to practice and investigate the effect of changing focal length of the lens virtually on images. The application: demonstrates the concept of depth of field virtually.
To reinforce this understanding, the application :</td><td>2D Simulation</td></tr>
<tr><td>

demonstrates the following:
Changing the virtual focal length lens (28mm, 50mm and 70mm) shows the students about the effects on the picture.</td><td></td></tr>
</table>

Learning Outcome2B: To demonstrate an understanding of how the individual element (focal length lens) affects the depth of field in photography. **Media forms: Formative Evaluation**	
Page 4	**Media Technology**
Answer questions about changes in focal length lens to test your understanding of depth of field and confirm achievement of LO-2B. Q1-The photograph above was taken with a telephoto lens. If I changed to a wider angle lens, what effect would this have on the depth of field?  A - Increase the depth of field. B - Decrease the depth of field C - No effect on the depth of field. D -Change picture size.	Interactive Text/ Images
Page 5	**Media Technology**
Q2- The following images have been taken from different focal lengths of the lens - some have been cropped to eliminate perspective. Consider the image shown, and drag and drop the related focal length of the lens to the correct picture: 	Interactive Text/ Images

Page 6	Media Technology
Q3- Drag and drop the related focal length of the lens to the correct picture: 	Interactive Text/ Images

Table 8-7 Learning Outcome 2B Rationale of Pedagogy / Media used.

<table>
<tr><th colspan="3">Rationale of Pedagogy / Media used</th></tr>
<tr><th colspan="3">This section corresponds to Table 8-6 Design process of prototype</th></tr>
<tr><td colspan="3">Learning Outcome 2B: To demonstrate an understanding of how the individual element (focal length lens) affects the depth of field in photography.
Media Form used: Narrative</td></tr>
<tr><td rowspan="2">Page 1</td><td>Pedagogy 1:</td><td>To explain how the individual element (focal length of lens) affects depth of field in a photograph.
Comparison is used to demonstrate the relationship between focal length of lens and depth of field.</td></tr>
<tr><td>Media use 1:</td><td>Two versions of the same picture are used to enable the student to compare between their sharpness, as each version has its own focal length of lens in relation to lens view and sharpness. These two pictures here are the only choice possible.</td></tr>
</table>

Page 2	**Pedagogy 2:**	To visualize, in detail and from different perspectives, how changing the focal length of lens increases and decreases the depth of field in each illustration.
	Media use 2:	Illustration is used to allow the student to visualize the subject from different perspectives and to show the effectiveness of depth of field from different stages: shallow, medium and large. There is no perceivable pedagogic advantage to using audio, richer media or interactivity for this particular learning outcome because its financial cost is high and additional instructional return is minimal. Illustration is used as it is considered suitable for this learning outcome.
Learning Outcome 2B: To demonstrate an understanding of how the individual element (focal length lens) affects the depth of field in photography. **Media Form used: Interactive**		
Page 3	**Pedagogy 3:**	To investigate and visualize the concept of how the focal length of lens affects DOF
	Media use 3:	2D simulation is used to investigate and visualize how focal length of lens affects DOF by changing the focal length of lens / lens view using a sliding bar on the virtual camera. This bar enables students to change the focal length of lens and investigate the effect. This also gives them some virtual experience of using the camera in a real situation and adjusting its focal length number to obtain the desired effect. The level of interactivity and media richness is close to high, as different types of pictures are of high quality and vividness, and much detail. Also, changing the sliding bar produces sound effects to give an impression that the student is using a real camera. There is no perceivable pedagogic advantage to using 3D Simulation/VR for this particular learning outcome because the 2D simulation used is low in cost and achieves the predetermined instructional objectives.

Learning Outcome 2B: Understanding how the individual element (focal length lens) affects the depth of field in photography. **Media Form used: Formative Evaluation**		
Page 4,5,6	**Pedagogy 4:**	Multiple Choice and drag/drop question types to measure students' understanding of how focal length of lens affects depth of field in order to ensure their achievement of LO-2B
	Media use 4:	1. Interactive multimedia is used: Text enables students to theoretically understand the concept of the subject. Images enable students to apply their knowledge to differentiate between pictures. Sound is used to reinforce students' responses. 2. To double check students' understanding of how focal length of lens affects interims of focal length of lens number and the DOF range size, two sets of images with drag/drop technique are used to match between the right **focal length of lens view** with its relevant picture in the first situation; and between the right **focal length of lens number** and its relevant picture in the second situation.

Learning Outcome 2C: Demonstrate an understanding of how the individual elements (camera-to-subject distance) affect depth of field in a photograph.

- Achievement of Learning Outcome 2C (narrative) is supported by text, illustration and picture.
- The choice of media used here will have low interactivity and low to medium vividness.
- Achievement of Learning Outcome 2C (interactive) is supported by 2D Simulation.
- The choice of media used here will have medium interactivity and medium vividness.

- Assessment of Learning Outcome 2C (evaluative) is supported by interactive multimedia (Text-Image).
- The choice of media used here will have medium interactivity and low to medium vividness.

- Illustration of camera-to-subject distance vs DOF with the help of pictures. Explanation of these concepts could be done through text, pictures and illustration as it only requires more explanation on the different camera-to-subject distance, and does not requires audio, video and animation etc. Moreover, 3D is costly and not necessary for this concept, which can be practiced and investigated with the help of a scroll bar. The investigation and visualization of the concept of how individual elements affects DOF (camera-to-subject distance) is done by changing the sliding bar indicating camera-to-subject distance using 2D simulation, as summarized in Table 8-8 Design Process of Prototype (DOF) and Table 8-9 Rationale of Pedagogy / Media used.

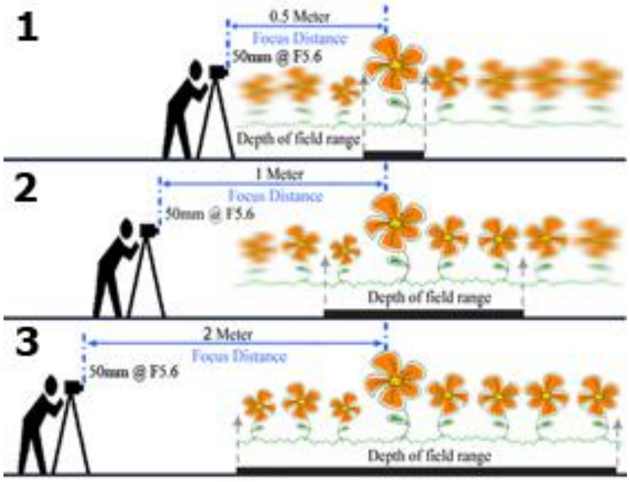
Table 8-8 Learning Outcome 2C.

<table>
<tr><th colspan="2">Design process of prototype (Depth of Field) using advanced Multimedia</th></tr>
<tr><td colspan="2">For Rationale of Pedagogy / Media used for the Learning Outcome 2C please refer to Table 8-9.</td></tr>
<tr><td colspan="2">Learning Outcome 2C: To demonstrate an understanding of how the individual element (camera-to-subject distance) affects the depth of field in photography.
Media forms: Narrative</td></tr>
<tr><td>Page 1 Learning experience (Attending, apprehending)</td><td>Media Technology</td></tr>
<tr><td>Distance from the subject:
The third factor that has an effect on the depth of field is the distance to the subject - also called focusing distance, as well as camera-to-subject.
- The closer you are to your subject, the smaller the DOF will be.
- The farther you are from your subject, the greater the DOF will be.
Notice the difference between the first and second photographs</td><td>Text,
Pictures</td></tr>
<tr><td>
The first photo was taken from 0.5 meters distance from the camera, and this gives a narrower DOF.
The second photo was taken from 2 meters distance from the camera, and this gives a wider DOF.</td><td></td></tr>
</table>

Page 2	**Media Technology**

How does the distance to subject affect depth of field (DOF)?

The difference between the three illustrations below is the **distance to subject**:



1-The first illustration with 0.5 meters distance from the subject reduces the DOF (shallow DOF)

2- The second illustration with 1 meters distance from the subject gives an average range of DOF.

3-**The third illustration** with 2 meters distance from the subject increases the range of DOF.

Text,
Illustration

<table>
<tr><td colspan="2">Learning Outcome 2C: To demonstrate an understanding of how the individual element (camera-to-subject distance) affects the depth of field in photography.
Media forms: Interactive</td></tr>
<tr><td>Page 3</td><td>Media Technology</td></tr>
<tr><td>Camera simulator
Further reinforcement is provided by allowing the student to practice and investigate the effect of changing camera-to-subject distance virtually on images.

The application: demonstrates the concept of depth of field virtually.
To reinforce this understanding, the application
demonstrates the following:
Changing camera-to-subject distance (1.5 meter, 3 meter, 5 meter) and shows the students what effects this has on the picture</td><td>2D Simulation</td></tr>
<tr><td colspan="2">Learning Outcome 2C: To demonstrate an understanding of how the individual element (camera-to-subject distance) affects the depth of field in photography.
Media forms: Formative Evaluation</td></tr>
<tr><td>Page 4</td><td>Media Technology</td></tr>
</table>

Answer questions about changes in distance to test your understanding of depth of field and confirm the achievement of LO-2C.

Q1-The photograph below was taken with the subject (bicycle) 3 meters away. If I moved back to 4 meters away, what effect would this have on the depth of field?

A - Increase the depth of field.

B - Decrease the depth of field

C - No effect on the depth of field.

D - Change picture size.

Interactive Text/ Images

Page 5 **Media Technology**

Q2- You are using a lens focused on a subject 20 meters away. What is the approximate depth-of-field range?

A- 10 meters to subject only

B- 15 meters to infinity

C- 20 meters to infinity

D- 30 meters to infinity

Interactive Text/ Images

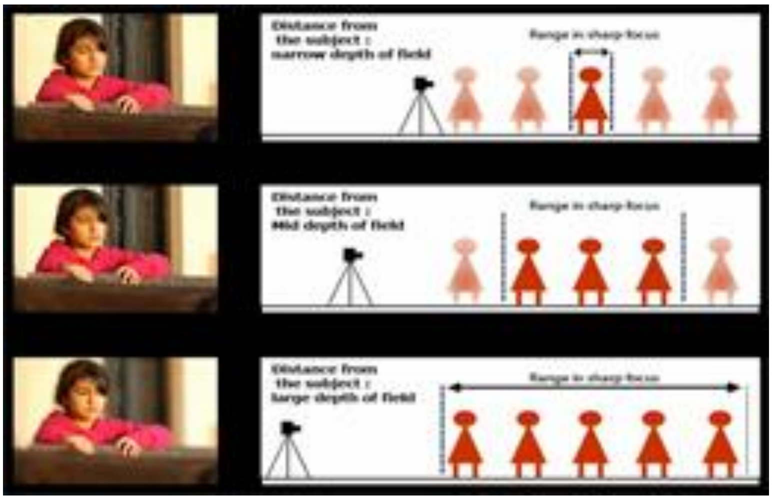
Page 6	**Media Technology**
Q3- The following images have been taken from different distances to the subject, and some have been cropped to eliminate perspective. Consider the images shown and drag and drop the related picture to the correct illustration (Distance from the subject): 	Interactive Images/ Illustration

Table 8-9 Learning Outcome 2C Rationale of Pedagogy / Media used.

<table>
<tr><th colspan="3">Rationale of Pedagogy / Media used</th></tr>
<tr><th colspan="3">This section corresponds to Table 8-8 Design process of prototype</th></tr>
<tr><td colspan="3">Learning Outcome 2C: To demonstrate an understanding of how the individual element (camera-to-subject distance) affects the depth of field in photography.
Media Form used: Narrative</td></tr>
<tr><td rowspan="2">Page 1</td><td>Pedagogy 1:</td><td>To explain how the individual element (distance from the subject) affects depth of field in a photograph.
Comparison is used to demonstrate the relationship between distance from the subject in depth of field</td></tr>
<tr><td>Media use 1:</td><td>Two versions of the same picture are used to enable the student to compare between their sharpness, as each version has its own distance from the subject in relation to lens view and sharpness.</td></tr>
</table>

<table>
<tr><td rowspan="2">Page 2</td><td>Pedagogy 2:</td><td>Illustration is used to allow the student to visualize the subject from different perspectives and to show the effectiveness of depth of field from different stages: shallow, medium and large. There is no perceivable pedagogic advantage to using audio, richer media or interactivity for this particular learning outcome because its financial cost is high, and instructional return is minimal.</td></tr>
<tr><td>Media use 2:</td><td>To visualize, in detail and from different perspectives, how changing the distance from the subject increases and decreases the depth of field in each illustration.</td></tr>
<tr><td colspan="3">Learning Outcome 2C: To demonstrate an understanding of how the individual element (camera-to-subject distance) affects the depth of field in photography.
Media Form used: Interactive</td></tr>
<tr><td rowspan="2">Page 3</td><td>Pedagogy 3:</td><td>To investigate and visualize the concept of how distance from the subject effects DOF</td></tr>
<tr><td>Media use 3:</td><td>2D simulation is used to investigate and visualize how distance from the subject affects DOF by changing the distance from the subject using a sliding bar on the virtual camera. This bar allows the students to change the distance from the subject and investigate the effect. This also gives them some virtual experience in using the camera in a real situation by adjusting its distance from the subject to obtain the desired effect.
The level of interactivity and media richness is close to high as different types of pictures are of high quality and vividness, and much detail. Also, changing the sliding bar produces sound effects to give the impression that the student is using a real camera. There is no perceivable pedagogic advantage to using 3D Simulation/VR for this particular learning outcome because the 2D simulation used is low in cost and achieves the predetermined instructional objectives.</td></tr>
</table>

<table>
<tr><td colspan="3">Learning Outcome 2C: Understanding of how the individual element (camera-to-subject distance) affects the depth of field in photography.
Media Form used: Formative Evaluation</td></tr>
<tr><td rowspan="2">Page 4,5,6</td><td>Pedagogy 4:</td><td>Multiple Choice and drag/drop question types to measure students' understanding of how distance from the subject affects depth of field in order to ensure their achievement of LO-2C</td></tr>
<tr><td>Media use 4:</td><td>1. Interactive multimedia is used. Text enables the student to theoretically understand the concept of the subject. Images enable the student to apply their knowledge to differentiate between pictures. Sound is used to reinforce students' responses.
2. To double check students' understanding of the effect of distance from the subject and the DOF range size, illustrations and images with multiple answers are used to match the correct distance from the subject number with its illustration.
3. To double check students' understanding of the effect of distance from the subject and the DOF range size, two sets of illustrations and images with drag/drop technique are used to match the correct picture in the first situation with its relevant illustration in the second situation.</td></tr>
</table>

Learning Outcome 3: To apply the knowledge gained from understanding how the individual elements affect a photograph by combining these elements (Aperture, focal length of a lens, camera-to-subject distance)

- Achievement of Learning Outcome 3ABC (narrative) is supported by text, illustration, picture.
- The choice of media used here will have low interactivity and low to medium vividness.
- Achievement of learning outcome 3ABC (simulative) is supported by 2D Simulation.
- The choice of media used here will have high interactivity and high vividness.

- Assessment of learning outcome 3ABC (evaluative) is achieved by Interactive Multimedia (text-image).
- The choice of media used here will have high interactivity and high vividness.
- To illustrate increase and decrease in the depth of field in each picture by combining different elements i.e. reducing and increasing the aperture diameter (f-number), different focal length of a lens and changing the camera-to-subject distance in each picture using 2D simulation. For individual students to note the change in the DOF in each picture, audio, video and animation etc. are not necessary. 3D is costly and not required for this as it is practiced and investigated with the help of the scroll bar only.
- As more explanation is only required on the different focal length vs. DOF it does not require audio, video or animation etc. Investigation and visualization of the concept of how individual elements affect DOF (focal length lens) is done by changing the sliding bar focal length using 2D simulation. 3D is costly and not necessary for this as it requires practicing and investigating with the help of the scroll bar only, as summarized in Table 8-10 Design Process of Prototype (DOF) and Table 8-11 Rationale of Pedagogy / Media used.

Table 8-10 Learning Outcome 3.

Design process of prototype (Depth of Field) using advanced Multimedia	
For Rationale of Pedagogy / Media used for the Learning Outcome 3, please refer to Table 8-11.	
Learning Outcome 3: To apply the knowledge gained from understanding how the individual elements affect the photograph by combining these three elements: Aperture + focal length lens + camera-to-subject distance. **Media forms: Narrative**	
Page 1 **Learning experience (Attending, apprehending)**	**Media Technology**

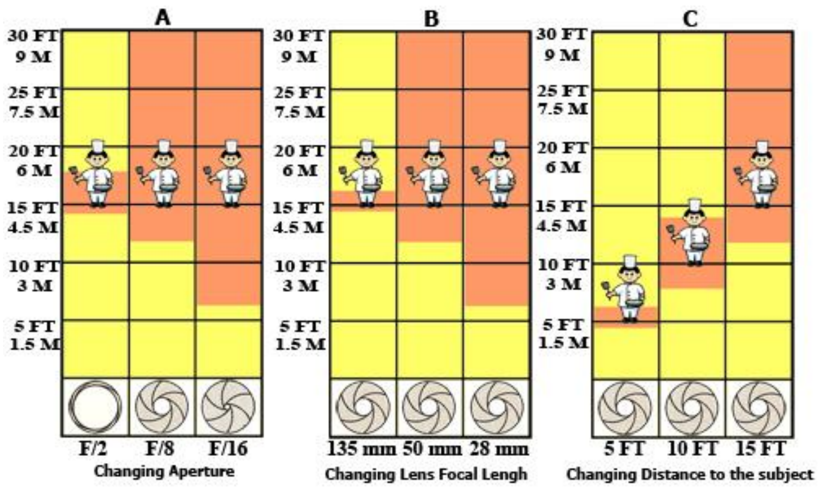
The application reminds students that Depth of Field is governed by three factors: aperture, focal length of the lens and camera-to-subject distance

Combining the factors that affect depth of field:

This is a detailed explanation of each of the three factors affecting depth of field. The illustration below demonstrates the collective effect of all three factors and their relationship.

Note: The orange shaded areas indicate depth of field.

How to achieve the desired depth of field using the three changing factors:



Shallow depth of field:

a) Use a large aperture like f/2,

b) Use a longer focal length, 135mm,

c) Move closer to your subject or use a combination of factors.

Large depth of field:

a) Use a small aperture like f/16,

b) Use a shorter focal length, 28mm,

c) Move further away from your subject or use a combination of factors.

Text,
Illustration

<table>
<tr><td colspan="2">Learning Outcome 3: To apply the knowledge gained from understanding how the individual elements affect the photograph by combining these three elements: Aperture + focal length lens + camera-to-subject distance.

Media form used: Simulation</td></tr>
<tr><td>Page 2</td><td>Media Technology</td></tr>
<tr><td>

Camera simulator
The application then allows students to apply their knowledge by letting them practice, experiment and visualize how depth of field is affected by changing the 3 factors - aperture, focal length lens and camera-to-subject - in combination using the virtual camera, and how it is altered by the factors using the virtual camera by changing the sliding bar of the 3 factors.

The application demonstrates the concept of depth of field, and how it is altered by three factors using the virtual camera by changing the sliding bar of the 3 factors -aperture, focal length lens and camera-to-subject.

</td><td>2D Simulation</td></tr>
</table>

<table>
<tr><td colspan="2">Learning Outcome 3: To apply the knowledge gained from understanding how the individual elements affect the photograph by combining these three elements: Aperture + focal length lens + camera-to-subject distance.
Media form used: Summative Evaluation</td></tr>
<tr><td>Page 3</td><td>Media Technology</td></tr>
<tr><td>Answer questions about changes in three factors - aperture, focal length lens and camera-to-subject distance - to evaluate your understanding of depth of field and to confirm achievement of LO3.
Q1: Which of these 4 images has the shallowest depth of field?

</td><td>Interactive
Text/
Images</td></tr>
<tr><td>Page 4</td><td>Media Technology</td></tr>
<tr><td>Q2: These two photographs were taken from the same position and with the same telephoto lens. What, if anything, have I changed to get from the image seen in 1 to get to what can be seen in 2?


A – Both are the same.
B - Changed the focus.
C - Changed the aperture from f/5.6 to f/16
D - Changed the aperture from f/16 to f/5.6</td><td>Interactive
Text/
Images</td></tr>
</table>

<table>
<tr><td>Page 5</td><td>Media Technology</td></tr>
<tr><td>

Q3: These two photographs were taken with the same aperture using a wide angle lens, What have I changed to get from the image seen in 1 to get to what can be seen in 2?

A - Changed the aperture from F4 to F22.
B - Changed the focus from 0.5 to 20 meters.
C - Changed the distance from 0.5 to 20 meters.
D - Changed the focus from 20 to 0.5 meters.

</td><td>Interactive
Text/
Images</td></tr>
<tr><td>Page 6</td><td>Media Technology</td></tr>
<tr><td>

Q4: These two photographs were taken from the same position with the same aperture, What, if anything, have I changed to get from the image seen in 1 to get to what can be seen in 2?

A - Both are the same.
B - Changed from 70mm lens to 18 mm lens.
C - Changed the shutter speed to give a longer exposure.
D - Changed from 18 mm lens to 70 mm lens.

</td><td>Interactive
Text/
Images</td></tr>
</table>

<table>
<tr><th>Page 7</th><th>Media Technology</th></tr>
<tr><td>Q5: I have taken a photograph at f/5.6 – but I need the blue rail in the foreground and background <u>also</u> to be in focus. What can I do?

A - Change to smaller aperture.
B - Move closer to the subject.
C - Change to a wider angle lens.
D - Both A + C.</td><td>Interactive Text/ Images</td></tr>
<tr><th>Page 8</th><th>Media Technology</th></tr>
<tr><td>Q6: The photograph shown is not what I want; I would prefer only the man’s face to be in focus. I used a 50 mm lens, aperture at f/8 and I am 2.5 meters away from the subject. What should I alter to get what I want?

A - Use a wider angle lens and move closer.
B - Use a telephoto lens and the aperture at f/22.
C - Use a telephoto lens and the aperture at f/3.5.
D -Use a 50 mm lens, change the aperture to f/11 and move closer.</td><td>Interactive Text/ Images</td></tr>
</table>

<table>
<tr><th>Page 9</th><th>Media Technology</th></tr>
<tr><td>Q7: I have used the following combination to take a photograph. Which image best represents the kind of image I would get? I have used a wide angle lens, aperture of f/16 and I am close to the subject.

</td><td>Interactive
Text/
Images</td></tr>
<tr><th>Page 10</th><th>Media Technology</th></tr>
<tr><td>Q8: The photograph shown is not what I want; I want both girls to be in focus. I used a 70mm lens, aperture at f/4.5 and I am 2 meters away from the subject. What should I alter to get what I want?

A- Change to a wider angle lens and move closer.
B- Use a telephoto lens and increase the aperture to f/22.
C- Change the aperture to f/16 and move 1 meter back from the subject.
D -Change the lens to 85mm lens, the aperture to f/5.6 and move 1 meter back.</td><td>Interactive
Text/
Images</td></tr>
</table>

Page 11	**Media Technology**
Q9: In photo 1, I used an 18 mm lens, aperture of f/8 and I am 1.2 meters away from the subject. What should I alter to get what I see in photo 2?  A- Move closer, use a 25mm lens and change the aperture to f/22. B- Maintain the same position and same lens, but change the aperture to f/1.8. C- Maintain the same position and same aperture, but change the lens to 70 mm. D- Move backwards and use a 50mm lens, and change the aperture to f/8.	Interactive Text/ Images
Page 12	**Media Technology**
Q10: I have used the following combination to take a photograph. Which image best represents the kind of image I would get? I have used a telephoto lens, aperture of f/4.2 and I am about 4 meters away from the subject. 	Interactive Text/ Images

From these 10 questions, if the student answered between 90 to 100 % correctly, this gives a pass. A score between 70 and 89% means that the student has to choose which section(s) to repeat. If the student answered less than 70% correctly, s/he has to go back to the beginning of the lesson.

Table 8-11 Learning Outcome 3 Rationale of Pedagogy / Media used.

<table>
<tr><th colspan="3">Rationale of Pedagogy / Media used</th></tr>
<tr><td colspan="3">This section corresponds to Table 8-10 Design Process of Prototype</td></tr>
<tr><td colspan="3">Learning Outcome 3: To apply the knowledge gained from understanding how the individual elements affect the photograph by combining these three elements: Aperture + focal length lens + camera-to-subject distance.
Media Form used: Narrative</td></tr>
<tr><td rowspan="2">Page 1</td><td>Pedagogy 1:</td><td>To illustrate the increase and decrease in the depth of field by combining different elements i.e. reducing and increasing the aperture diameter (f-number), different focal length lens and changing the camera-to-subject distance.</td></tr>
<tr><td>Media use 1:</td><td>1. Illustration of f-number and aperture size + focal length lens and camera-to-subject distance combined together vs DOF, with the help of illustration.
2. Explanation of these concepts could be done through text and illustration. Each illustration helps the student to note the change in the DOF in each illustration; however, this explanation does not require audio, video and animation etc. because this illustration can increase the retention of concept learning and explain all the 3 elements affecting DOF in one frame to compare the effects.</td></tr>
<tr><td colspan="3">Learning Outcome 3: To apply the knowledge gained from understanding how the individual elements affect the photograph by combining these three elements: Aperture + focal length lens + camera-to-subject distance.
Media Form used: Simulation</td></tr>
</table>

<table>
<tr><td rowspan="2">Page 2</td><td>Pedagogy 2:</td><td>To experiment and practice with the various combinations of the concepts of how aperture size, focal length lens and camera-to-subject distance affect DOF.</td></tr>
<tr><td>Media use 2:</td><td>1. 2D simulation (2D view) to combine these three elements by changing the 3 corresponding sliding bars for more visualization and involvement.
2. The level of simulation is high both in interactivity and vividness, as the students experiment and practice the three elements affecting DOF that they have studied previously.
3. 2D simulation using rich media needs to work efficiently in order to simulate the behaviour of a real camera. 2D media is chosen due to costs, time, and production skills available. Moreover, there is no perceived major advantage in using a 3D simulation in this case due to nature of the pedagogic content. The AMPE model is used to guide the choice of media used.</td></tr>
<tr><td colspan="3">Learning Outcome 3: To apply the knowledge gained from understanding how the individual elements affect the photograph by combining these three elements: Aperture + focal length lens + camera-to-subject distance.
Media Form used: Summative Evaluation</td></tr>
<tr><td>Page 4,5,6, 7,8,9, 10,11, 12,13</td><td>Pedagogy 4:</td><td>In line with assessment criteria used in Bahraini universities, the following scores are adopted for this photography unit:
1- A 100-90% score equals 'excellent performance'; the student satisfactorily completed all course requirements.
2- A 90-89% score equals 'very good performance'; the student may choose to review some course requirements according to his/her self-evaluation.
3- An 80-79% score equals 'good performance'; the student may choose to review course requirements according to his/her self-evaluation.
4- A 70-69% score equals 'fair performance'; the student must repeat the complete course.
5- A score of less than 60% equals 'fail'; the student must</td></tr>
</table>

		repeat the complete course.
	Media use 4:	Interactive multimedia is used. Text enables the student to theoretically understand the concept of the subject. Images enable the student to apply their knowledge to differentiate between pictures. Note: all media methods used in questions are the same as with previous L.O. evaluation questions.

8.2.3.2. Development and Production of the Prototype

In this section, the detailed development and production of the prototype are discussed.

In this study, the researcher developed a functional prototype using advanced multimedia for Photography Education in the area of depth of field, as an attempt to implement and test the new design model. Design processes were applied according to the adapted ASSURE model to develop an advanced multimedia e-learning resource for teaching the concepts of depth of field (DOF). The procedures involved in developing and producing the prototype are shown below in detail, including flowcharts, script writing, scenarios, and pedagogical interpretations.

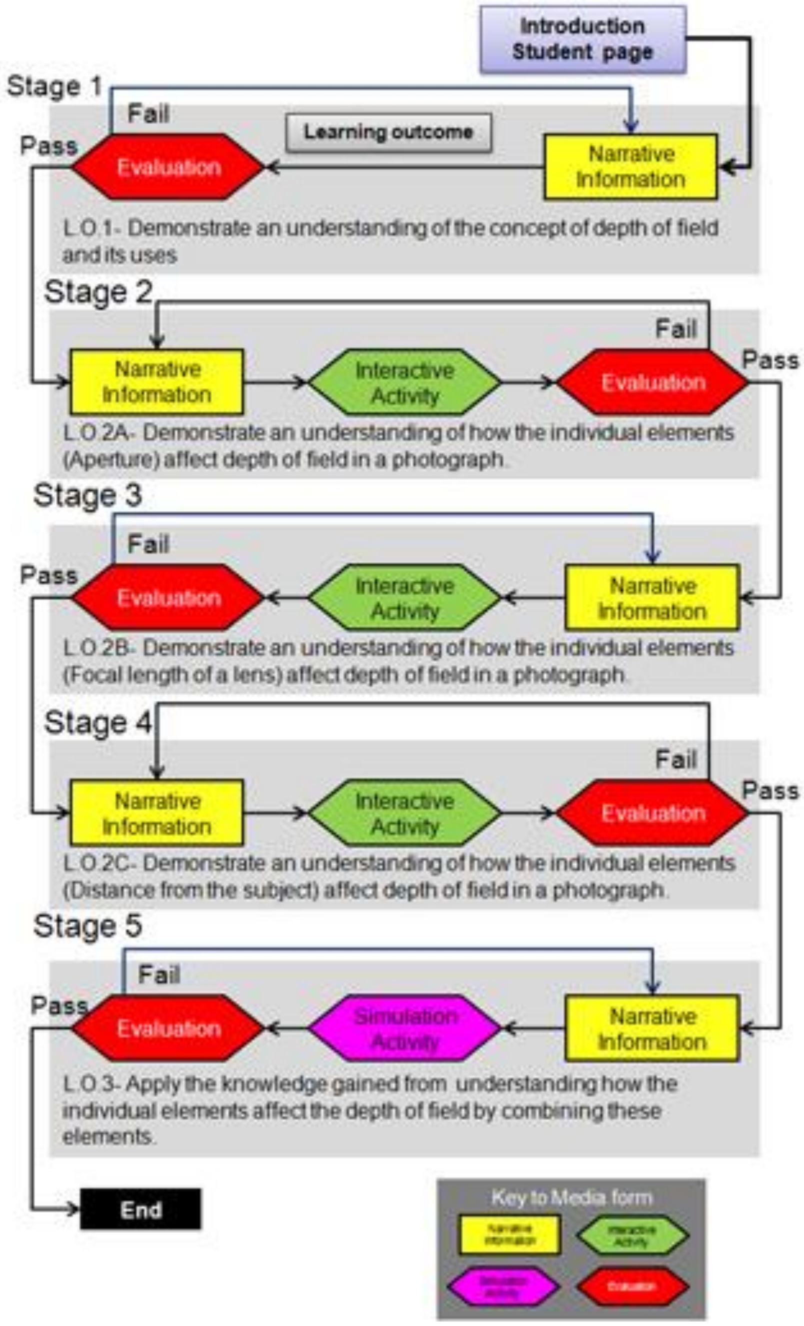
8.2.3.3. Flowcharts for the 'DOF' e-learning resource

Two lesson plans were developed: one for the students and the other for administrators. These are presented as flowcharts and are discussed below.

- **Students' Flowcharts:**

The flowchart in ** To **ensure mastery of learning, students cannot proceed to LO-2 unless the students answer all the questions correctly i.e. they have to retake only parts of L.O-1 that they have got wrong.**

Figure 8.1 below shows the navigational structure of the prototype (CD-ROM) for students. It is an outline of the prototype structure which is built to identify the steps taken to produce the prototype as perceived by, and for, the students. Flowcharts, storyboards, and scripts for interactive applications are often used to save time and improve the quality of the final product by assisting in the planning and preparing stage of the prototype.



** To ensure mastery of learning, students cannot proceed to LO-2 unless the students answer all the questions correctly i.e. they have to retake only parts of L.O-1 that they have got wrong.

Figure 8.1 Linear navigational structure of the prototype for students.

❑ Administrators' Flowcharts:

The flowchart in Figure 8.2 below shows the navigational structure of the prototype (CD-ROM) for administrators. It is an outline of the prototype structure which is built to identify the steps taken to produce the prototype as perceived by, and for, the administrators.

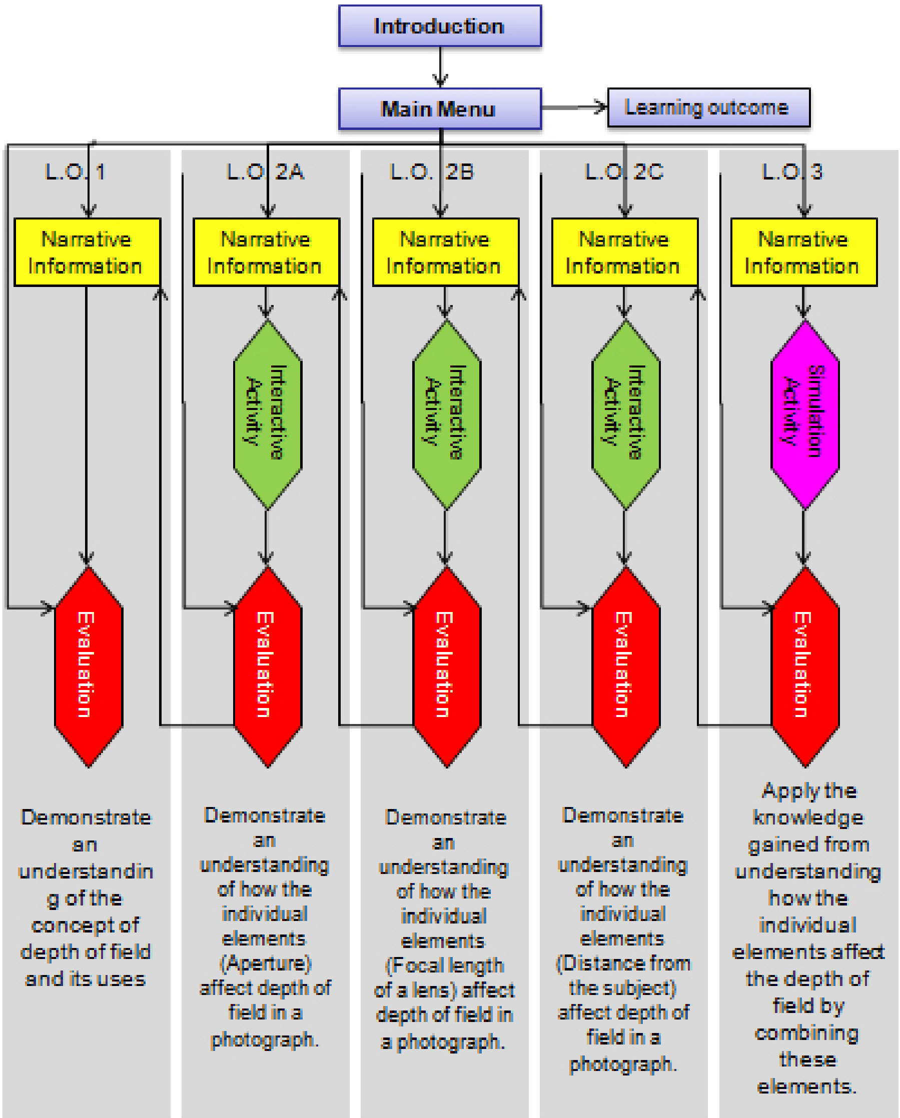


Figure 8.2 **Branching navigational structure for administrators.**

8.2.3.4. User Interface Design

The overall structure of the prototype is based on the design process for the prototype which has been presented in section 8.2.3.1, and supported by graphical flowcharts for both students and teachers in section 8.2.3.3.

Based on the design process of the prototype and the flowchart, a user interface design of the prototype was created with a high level of interactivity and vividness. Sufficient menu options with linear self-guides are provided so that students can work independently and linearly, that is step-by-step. This is because each Learning Outcome (LO) is based on the previous LO. In this way, students will have to understand each LO before they can go to the next; thus, the LOs are interdependent on each other.

Another structure with a branching navigational flowchart was designed for the administrators, allowing them to use it both linearly, that is step-by-step, and non-linearly, going straight to a particular topic from the main menu.

All screens in Figure 8.3 to Figure 8.12 illustrate the interface design created using image editing software and multimedia authoring tools such as:

- Adobe Photoshop, Illustration: to edit the pictures with the virtual camera and design the charts.
- Adobe Flash: to design and animate the virtual camera, and;
- Match Ware Mediator 8 Pro: to create the DOF interactive CD-ROM application.

8.2.3.5. Prototype Production

- ❖ **Virtual Camera production:**

A new and simplified implementation of the common manual controls of any standard DSLR camera was designed through a set of graphical objects and control scripts. Adobe Flash was used as a design package, utilizing its capabilities to create vector-based graphics, and controlled through Action Scripting.

Common controls and factors of digital photography such as aperture, focal length of lens, or the distance from the photographed subject were made available in the program to portray and educate the student about the impact of these factors on the photograph and the DOF presented in it. Each of these factors can be controlled alone to view different examples, but the three can also be changed together to show more complex examples.

❖ **Virtual camera features:**

1. Dynamic virtual camera programming enables settings to be changed easily.
2. Each virtual camera can change the images for different factors easily by changing the setting of aperture, focal length of lens or the distance from the subject, on the notepad file (varsfile) attached with the virtual camera files.

❖ **Prototype setup steps:**

1. Design flow chart for the prototype on paper, based on the design process of the prototype model.
2. Prepare the theoretical photography content with Microsoft Word.
3. Prepare and process the photographs with Adobe Photoshop.
4. Design 2D simulation using Adobe Flash.
5. Design the main page and interface design of the prototype.
6. Design the prototype template using Match-Ware Mediator software.
7. Design the prototype buttons.
8. Insert the theoretical learning content, pictures and 2D simulation (virtual camera) program.
9. Program the buttons and links between pages and main Menu page.
10. Prepare the questions and program them with photographs.

11. Pilot action the prototype to ensure it functions properly and correct the errors, if any.
12. Export the prototype and copy it to CD-ROM

8.2.4. Stage 4 - Methods, Media, and Materials Utilised

The aim of the learning resource was to address these issues and support both the teachers in their teaching, and the students with their individual learning activities for them to develop understanding and use of depth of field in their photographic work, which is a standalone approach.

The e-learning resource was designed and produced for delivery using CD-ROM or DVD created using Match Ware Mediator 8, Adobe Flash software. In terms of human resource availability, the following were allocated:

- Staff: two photography lecturers (full-time) at University of Bahrain, and Royal University-Bahrain.
- Assistant staff: two technicians (one technician each in University of Bahrain and Royal University-Bahrain). Their role was to set up and install the software and application on the computer. They also gave support to the students as, and when, needed.

The following “5 Ps” describe the process:

- **Preview the materials:**

The photography lecturer previews the depth of field instructional and e-learning materials (CD-ROM) and PowerPoint presentation for the pre- and post-test before using. The lecturer reviews the class material before going to class.

- **Prepare the materials:**

Both the photography lecturer and the assistant prepare the e-learning materials and computers to support the instructional and learning activities in the computer laboratory before the students’ arrival.

- **Prepare the environment:**

The learning takes place in a computer laboratory; all facilities are arranged for students' correct use of DOF e-learning materials, computers, and white screen. Certain factors are taken in consideration for the instructional situation including: comfortable seating, adequate ventilation, climate control and suitable lighting.

- **Prepare the learners:**

To prepare the students, the lecturer presents the overall plan and objectives for the DOF lesson. Each student receives a hand-out describing the DOF e-learning material activity. In addition, the evaluation procedures are given to each student and presented using PowerPoint presentation.

- **Provide the learning experience:**

During the introductory phases of this lesson, the lecturer presents materials using a computer and data projector

1- The lecturer starts by revising and linking the key points of the previous lesson that are related to 'DOF' by PowerPoint presentation.

2- The new learning experiences in DOF are covered in three main outcomes (with the second outcome having three sub-outcomes), namely:

i. Learning Outcome 1: To demonstrate an understanding of the concept of depth of field and its uses.
ii. Learning Outcome 2A: To demonstrate an understanding of how the individual element (Aperture) affects the depth of field in photography.
iii. Learning Outcome 2B: To demonstrate an understanding of how the individual element (focal length lens) affects the depth of field in photography.
iv. Learning Outcome 2C: To demonstrate an understanding of how the individual element (camera-to-subject distance) affects the depth of field in photography.

v. Learning Outcome 3: To apply the knowledge gained from understanding how the individual elements affect the photograph by combining these three elements: Aperture + focal length lens + camera-to-subject distance.

These outcomes are presented separately using the advanced multimedia application.

8.2.5. Stage 5 - Require Learner Participation

This stage involves independent study, activities, and assignments to be completed by the students.

In the Depth of Field e-learning resources, there are three main learning outcomes (with the second outcome having three sub-outcomes). The student is required to achieve the first learning outcome followed by the second and then the third, as explained in ** To **ensure mastery of learning, students cannot proceed to LO-2 unless the students answer all the questions correctly i.e. they have to retake only parts of L.O-1 that they have got wrong.**

Figure 8.1 (Linear navigational structure of the prototype for students). For each learning outcome, the student uses the e-learning resources and the students need to follow several different steps. Learning Outcome 1 uses a narrative method as an independent self-study in DOF. After that, the students need to answer three multiple-choice questions with the drag and drop technique as a formative assessment of their understanding. If a student can pass by answering all three questions s/he can proceed to the second learning outcome. If a student fails to answer the three questions, s/he has to return to the previous learning outcome section. Learning Outcomes 2A, 2B and 2C use independent self-study, which is a narrative method. They investigate the content using the virtual camera to practice what has been achieved. Then the student has to do a formative assessment following the same procedure as in Learning Outcome 1.

8.2.6. Stage 6 - Evaluate and Review

The e-learning application contains two types of assessments: formative and summative. In the DOF e-learning resource, there is an interactive multimedia formative assessment with each learning outcome. Each assessment contains three questions, which the student is required to interactively answer by using the drag and drop technique. At the end of the DOF resource, there is a summative assessment which contains ten multiple-choice questions (details are given in 8.3.4).

8.3. Screen shots from the prototype

The prototype title and introduction page are as shown in Figure 8.3 and Figure 8.4, below. The first is an image related to the subject of the lesson to give a general idea of a shallow (unclear background) DOF, so that the student will understand how this picture was taken after completing the lesson.

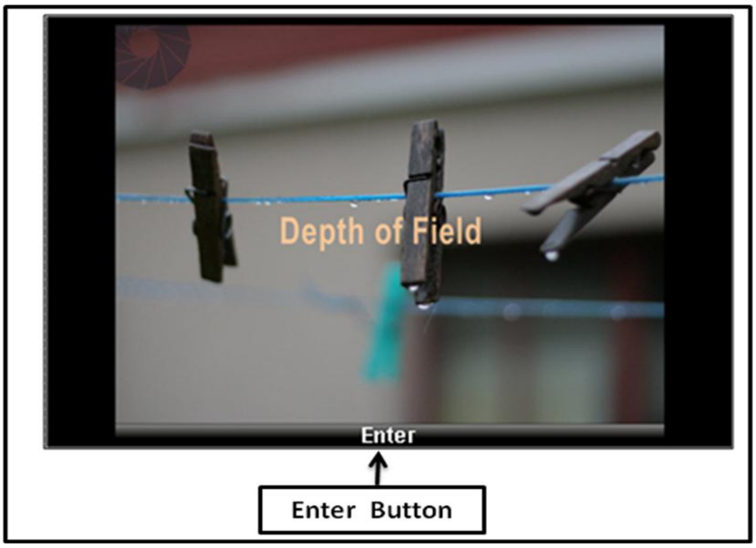


Figure 8.3 Starting page for the prototype with subject title.

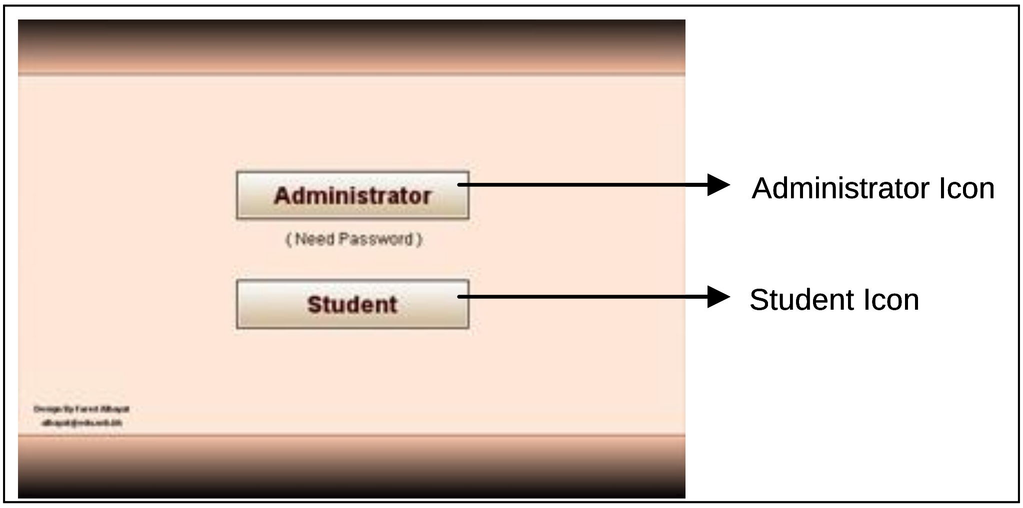


Figure 8.4 Introduction page for user

First of all, the user inserts the prototype CD-ROM in the computer. The screen appears with the animated title ‘Depth of Field’, as represented in Figure 8.3 above. The user clicks the ‘Enter’ button at the bottom of the page to move to the next screen, as shown in Figure 8.4.

Figure 8.4 contains two icons, the Administrator icon and the Student icon. The Administrator icon will lead the lecturer to a new page which shows navigational branching. On the other hand, when the student presses the Student icon, s/he will start the e-learning resource. The lecturer will be able to branch to all sections in the lesson and see all lesson icons, but the student cannot see the difference between Figures 8.1 and 8.2

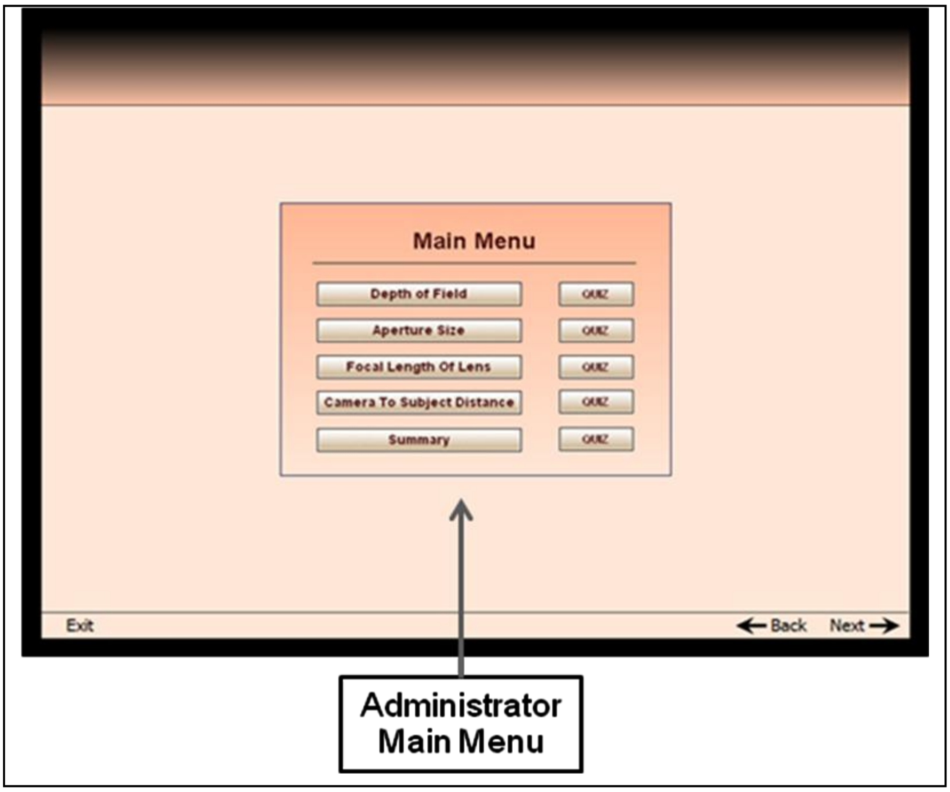


Figure 8.5 **Main menu for instructor.**

The student needs to follow the instructions from the CD-ROM step-by-step, but the lecturer can either follow the step-by-step instruction or select any learning outcome subject directly from the menu.

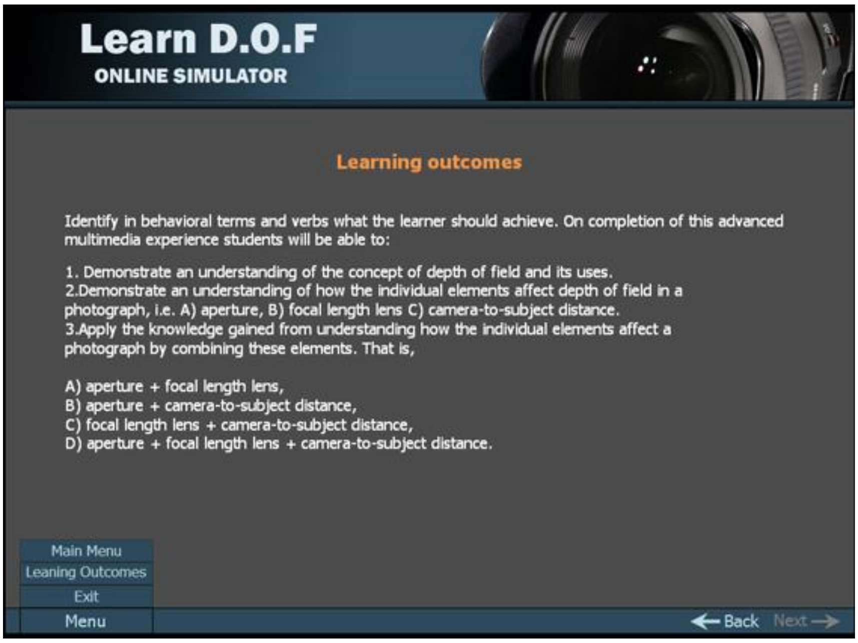


Figure 8.6 **Learning outcomes for the administrator only.**

Figure 8.6 shows the learning outcomes of the prototype. Only the instructor can display the learning outcome at any stage of the prototype, using the menu icon.

Part 1 Learning Outcome 1: Demonstrate an understanding of the concept of depth of field and its uses – **Narrative pages**

This is the first page of the students' lesson, which has to be completed before they click on to the second page; however, they can go back as it is first page of the lesson.

Page 1 is the introduction. Only the 'next' button is active as there is no active back page. Therefore, the student can only go forward with the 'next' button, but the instructor has more options so that he can go to any of the other pages through the main menu, exit the program or read the learning outcome, as shown in Figure 8.7

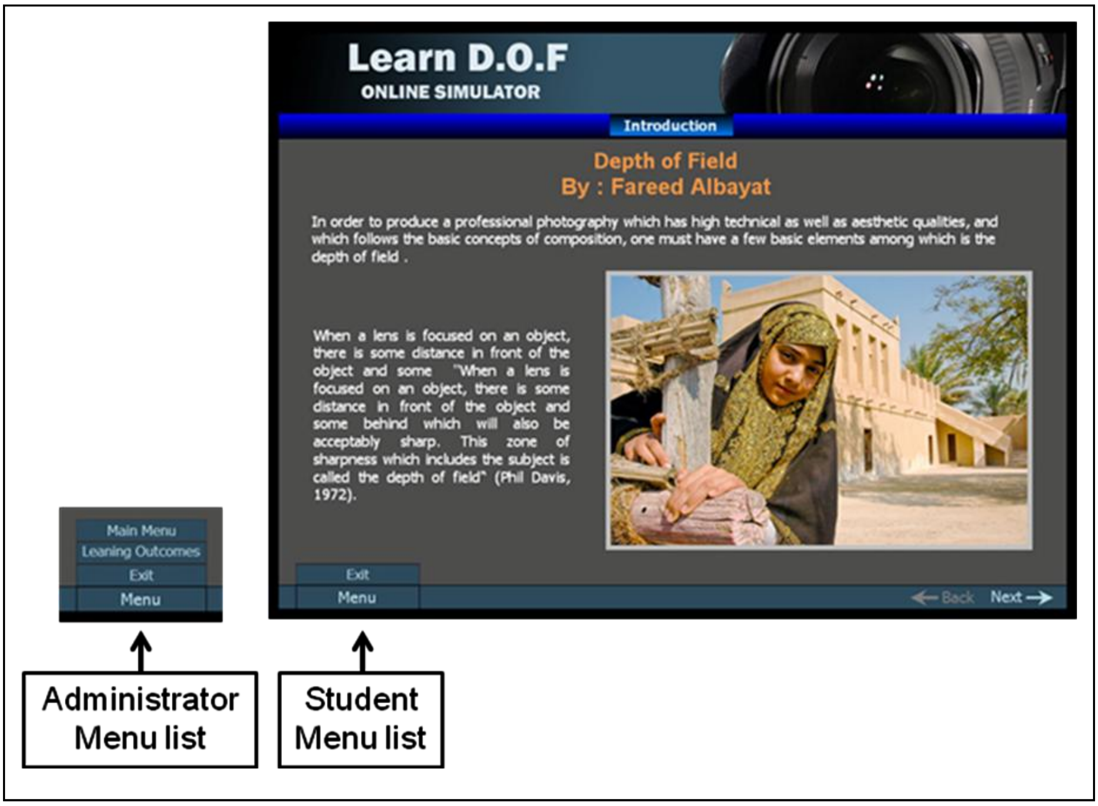


Figure 8.7 Page 1 Introduction page to Learning Outcome 1.

Figure 8.7 shows the first page of Learning Outcome 1. At the lower part of the screen there are two options. To the left is the 'Menu' icon for instructors only, which provides two options: 'Learning Outcomes', which leads the instructors to the learning outcomes page, and 'Exit', which allows the instructors to leave the application at any time. On this page, the instructors will be shown all the learning outcomes of the DOF resources if they need to check. On the right, there is the 'Next' icon, which leads the student to the next page, as shown in Figure 8.8.

The instructor can go to any topic, but the student can only use it linearly, as shown in the flowchart in ** To **ensure mastery of learning, students cannot proceed to LO-2 unless the students answer all the questions correctly i.e. they have to retake only parts of L.O-1 that they have got wrong.**

Figure 8.1 and Figure 8.2.

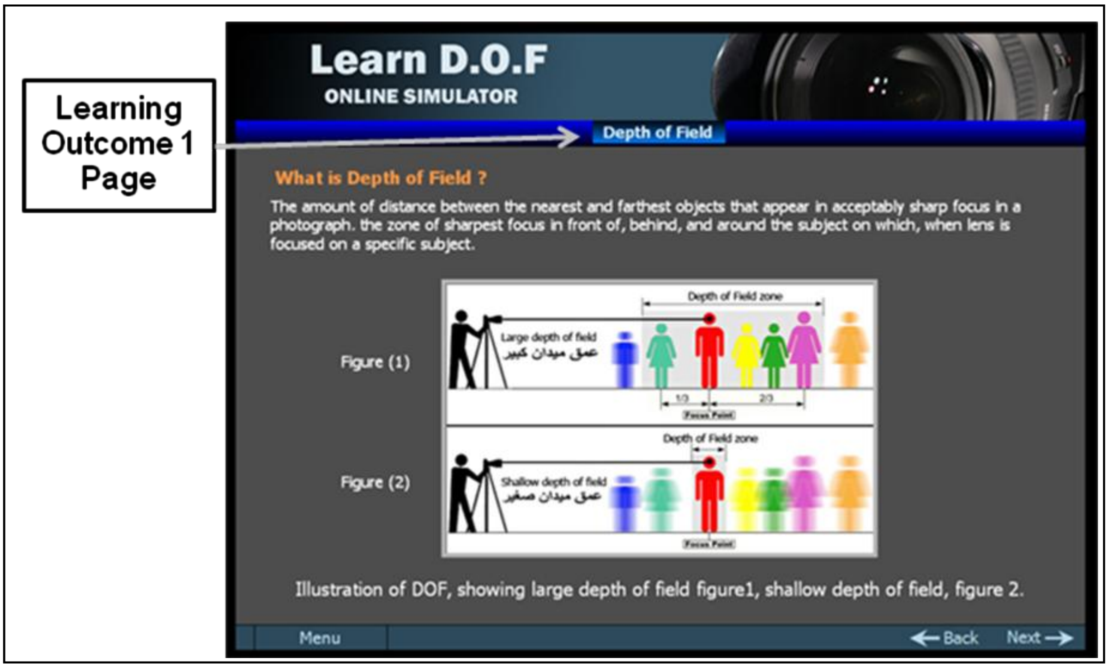


Figure 8.8 Learning Outcome 1- Concept of depth of field (Page2)

Figure 8.8 is a continuation of the previous page shown in Figure 8.7 above, and continues explaining what Depth of Field is.

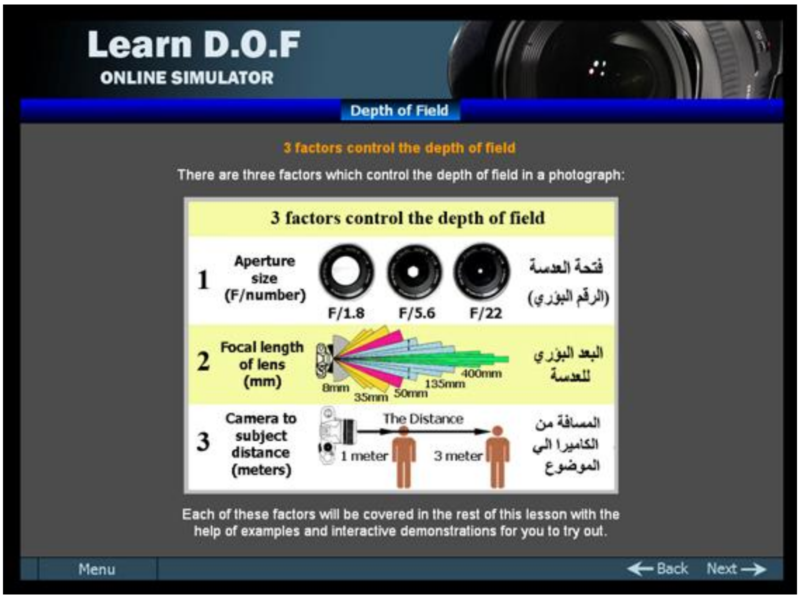


Figure 8.9 Learning Outcome 1- Concept of depth of field (Page 3)

Figure 8.9 is a continuation of the previous pages and shows the main factors which control depth of field.

Part 1 Learning Outcome 1: Demonstrate an understanding of the concept of depth of field and its uses – **Evaluation pages 1, 2 and 3**

In Figure 8.10, Figure 8.11 and Figure 8.12, the student has to answer the three questions given in order to successfully move to the second learning outcome. Each question has four multiple choice answers.

- ❑ Three parts of formative assessment for LO 1

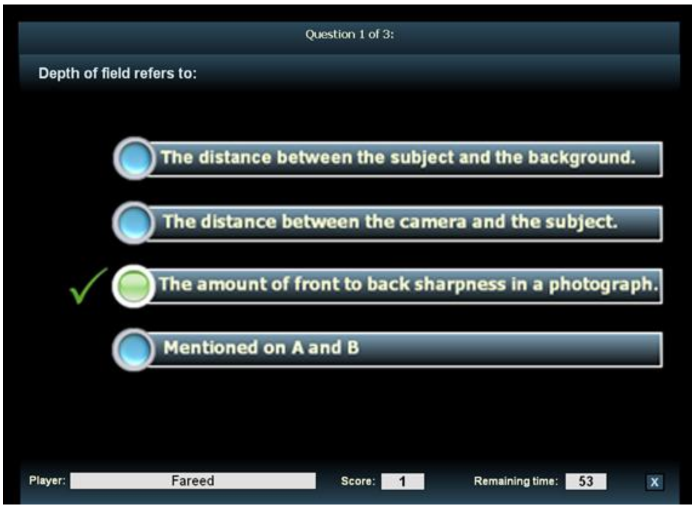


Figure 8.10 Question 1 with correct answer

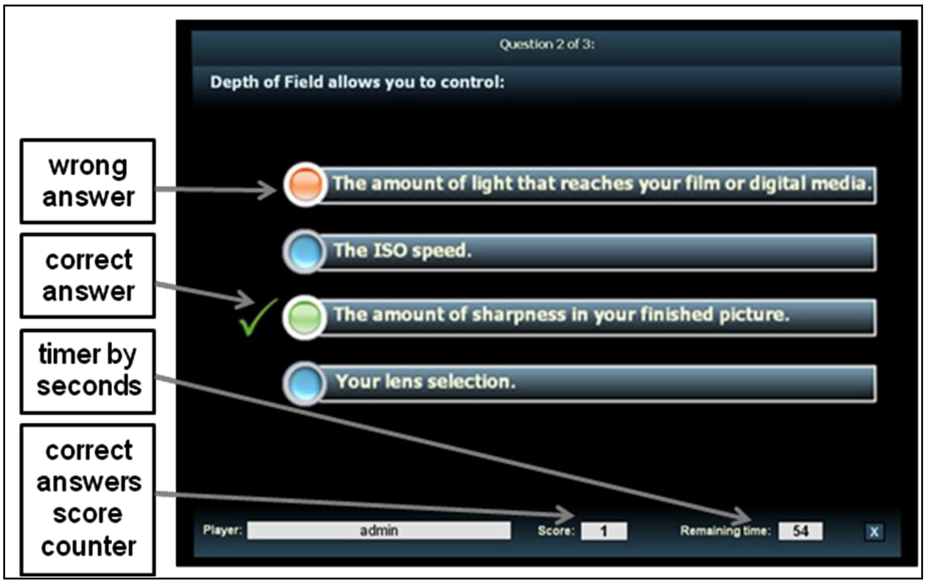


Figure 8.11 Question 2 with wrong answer

If the student selects the correct answer, the circle at the beginning of the sentence will turn green and a tick sign (√) will appear immediately beside the correct answer, as shown in Figure 8.10. On the other hand, if the student selects a wrong answer, the circle will turn red and the circle next to the correct answer will turn green with a tick sign (√) to show the student which answer is correct, as indicated in Figure 8.11 above.

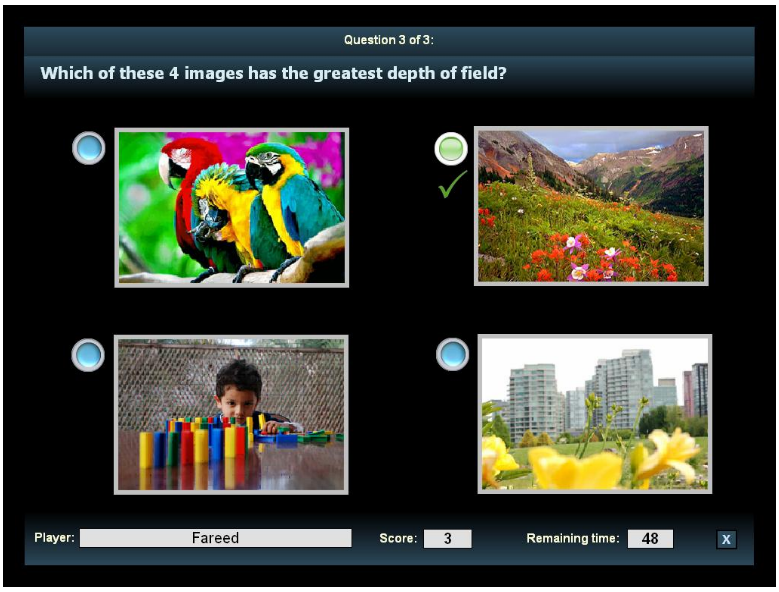


Figure 8.12 Question 3 with correct answer

In Figure 8.12, which illustrates Question 3, the procedure is the same as that shown in Figure 8.10 and Figure 8.11, except that the possible answers are presented as images instead of words and sentences.

Furthermore, the students have a time limit of thirty seconds to answer each of the questions and, if the student does not provide an answer in the specified time, the answer will be considered wrong even if s/he did not select an answer. The time limit of thirty seconds for answering each question is based on the average time taken during the researcher's pilot testing with eight students. However, the instructor can adjust the time for the questions based on his needs or his students' level; therefore, the questions have flexible time adjustments.

If the student answers the three questions correctly, another page will appear, displaying the results (see Figure 8.12). If the student answers all the questions correctly for each section of the LO, s/he will be directed to the next section. However, if the student is not able to answer all questions in each section correctly, the prototype will take the student back to repeat that section. The 'Continue' button will respond according to the answer given by the student in the lesson. Therefore, the student will be taken to the next level if s/he answers all the questions correctly, but s/he will be taken back to the previous lesson if there are any mistakes in the answers. The following two figures, Figure 8-13 and Figure 8-14, present the results as shown to the students. Figure 8-13 is shown when all three answers are correct. Figure 8-14 shows the percentage of questions answered correctly; in this case two out of three questions were answered correctly.

Figure 8.13 All answers are correct

Figure 8.14 Two out of three answers are correct

Part 2 Learning Outcome 2A: Demonstrate an understanding of how the aperture affects depth of field in a photograph - **Narrative pages**

The student's learning experience, as shown in Figure 8.15, Figure 8.16 and Figure 8.17, is *attending and apprehending*. The student will need to read the content and look at the illustrations and the pictures, in order to understand the aperture sizes and their effects on the depth of field (DOF) of a photograph. Moreover, the student can visualize these effects from different perspectives or angles to help the student to see the camera, the target subject and the effect of DOF.

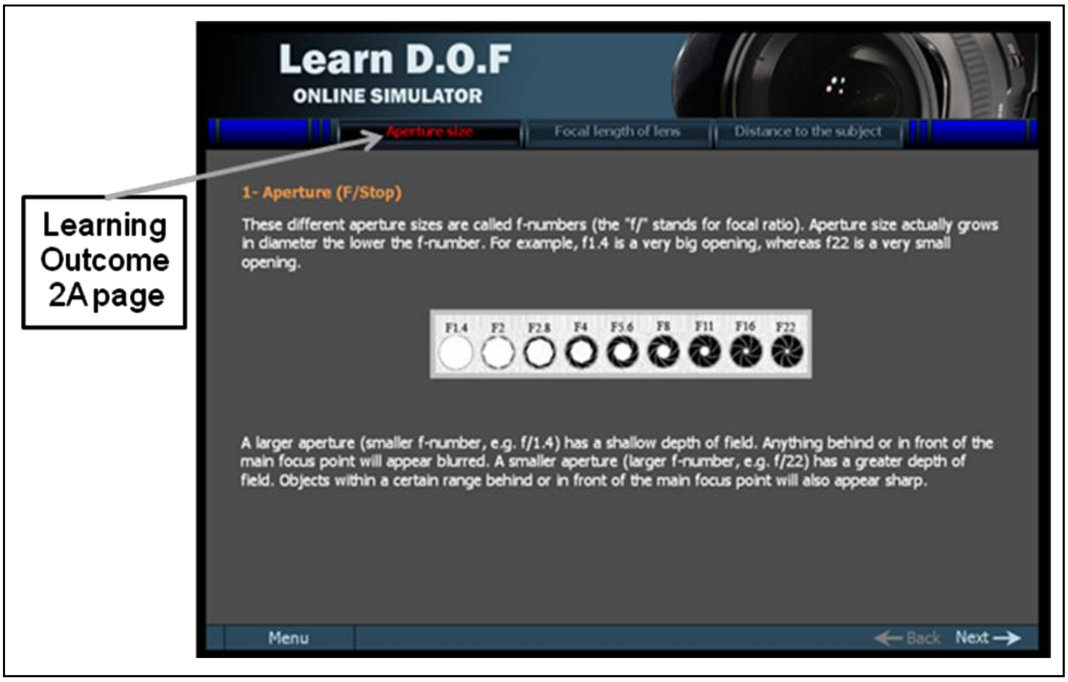


Figure 8.15 Learning Outcome 2A- Aperture affects DOF (page 1).

Figure 8.16 Learning Outcome 2A- Aperture affects DOF (page 2).

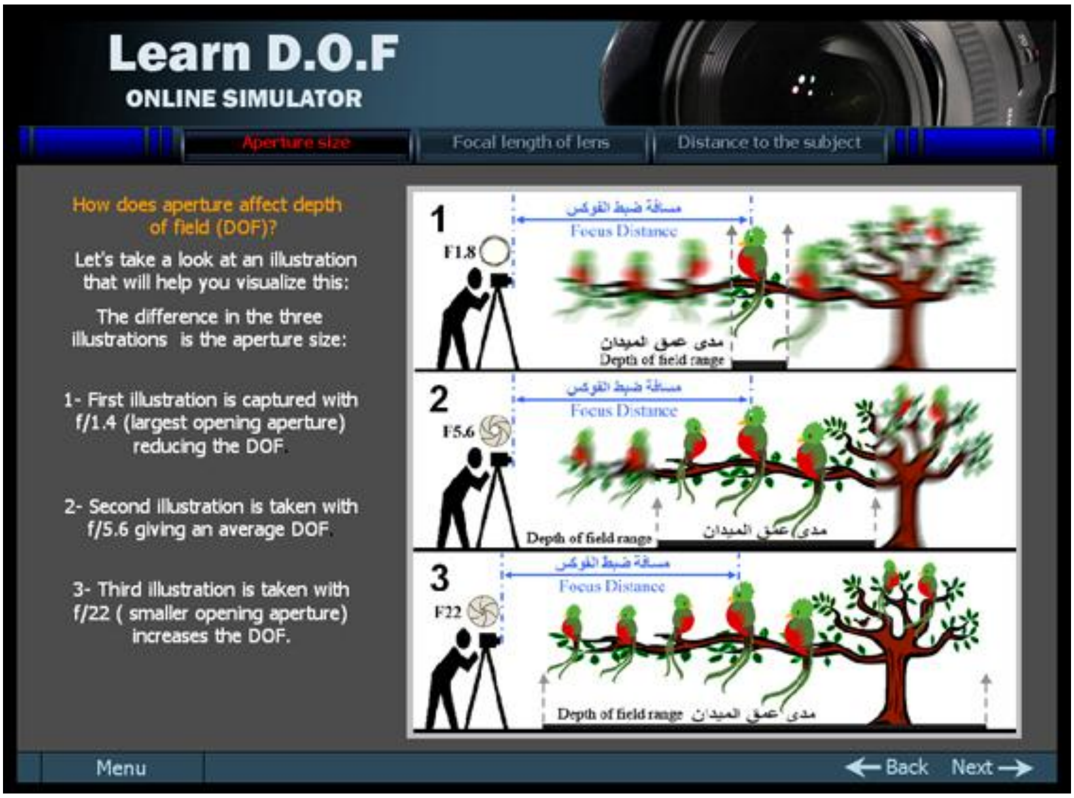


Figure 8.17 Learning Outcome 2A- Aperture affects DOF (Page 3)

Part 2 Learning Outcome 2A: Demonstrate an understanding of how the aperture affects depth of field in a photograph - ***Interactive pages*.**

Figure 8.18 shows a virtual camera which is used to provide the student with an investigating learning experience. The student is required to change the aperture size by moving the F-stop indicator at the bottom of the virtual camera. 2D simulation is used to allow students to investigate and visualize how apertures affect DOF by changing the focal number/ aperture using the sliding bar on the virtual camera. This bar allows the students to change the f-numbers and investigate how the aperture sizes affect DOF in the picture. This also gives them some virtual experience of using a camera in a real situation, adjusting its aperture to obtain the desired effect. ‘Help’ buttons are intended only to help the instructors to change the virtual camera images and the settings. The people, objects and scenery buttons are titles for an exercise, and these can be changed together with the settings. These buttons are dynamic buttons for ease of use by the instructors.

Figure 8.18 Virtual Camera sliding bar for changing the f-numbers

Part 2 Learning Outcome 2A: Evaluation pages 1, 2 and 3

Figure 8.19, Figure 8.20 and Figure 8.21 show three questions that the student has to answer successfully in order to be able to move on to the next learning outcome. Each question has four multiple choice answers.

- ❑ Three parts of formative assessment for LO 2A

Figure 8.19 Question 1

The terms for answering in Figure 8.19 are exactly the same as the terms in Figure 8.10, and Figure 8.12.

Figure 8.20 Question 2

For the question shown in Figure 8.20, the student will use the drag and drop technique to match the focal number to the relevant picture.

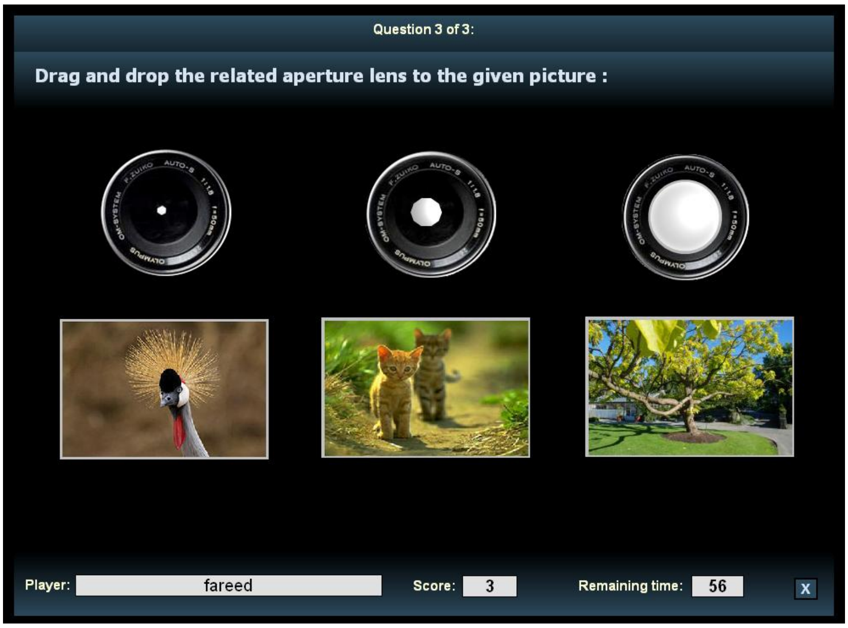


Figure 8.21 Question 3

Part 3 Learning Outcome 2B: Demonstrate an understanding of how the focal length of the lens affects depth of field in a photograph.

Figure 8.22 to Figure 8.27 show the narrative, interactive and evaluative pages.

The student will follow the same procedure mentioned above in Stage 2 Learning Outcome 2A, with the only difference being that the variable affecting depth of field is now the focal length, rather than the aperture size.

Figure 8.22 LO 2B- Focal length of the lens affects DOF (page 1).

Figure 8.23 LO 2B- Focal length of the lens affects DOF (page 2).

Figure 8.24 LO 2B Focal length of the lens affects DOF

- ❑ Three parts of formative evaluation for LO 2B

Figure 8.25 Evaluation page 1

Figure 8.26 Evaluation page 2

Figure 8.27 Evaluation page 3

Part 4 Learning Outcome 2C: Demonstrate an understanding of how the distance from the subject affects depth of field in a photograph**.**

The student will follow the same procedure mentioned above in Stage 2 Learning Outcome 2A, the only difference being that the variable affecting depth of field is now distance from the subject, rather than aperture size.

Figure 8.28 **LO 2C- Distance from the subject affects DOF (page 1).**

Figure 8.29 **LO 2C- Distance from the subject affects DOF (page2).**

Figure 8.30 **LO 2C - Distance from the subject affects DOF**

- ❑ Three parts of formative evaluation for LO 2C

Figure 8.31 Evaluation page 1

Figure 8.32 Evaluation page 2

Figure 8.33 Evaluation page 3.

Part 5 Learning Outcome 3: Demonstrate an understanding of how the individual elements affect depth of field in a photograph, i.e. A) aperture, B) focal length of a lens C) camera-to-subject distance. **Narrative pages.**

The student's learning experience, as shown in Figure 8-33, is attending and apprehending. Figure 8.34 illustrates this for the student. The student will need to read and understand how to combine the three elements - reducing and increasing the aperture diameter (f-number), different focal length lens, and changing the camera-to-subject distance - which affect DOF in photography, as shown in the chart.

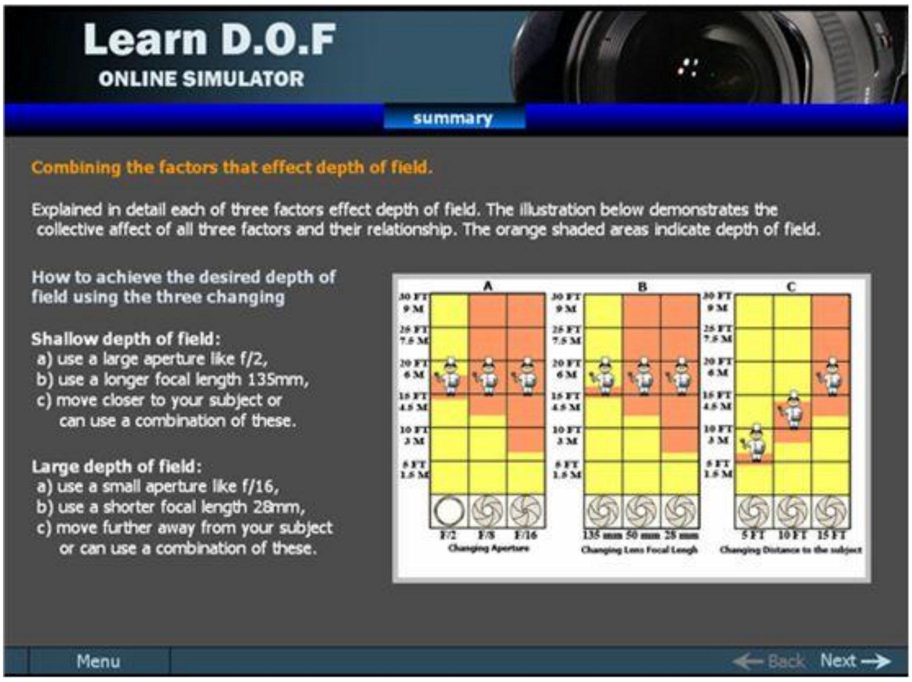


Figure 8.34 **LO 3 - How to achieve the desired depth of field.**

Part 5 Learning Outcome 3 Demonstrate an understanding of how the individual elements affect depth of field in a photograph, i.e. 1) aperture, 2) Focal length of a lens, 3) camera-to-subject distance (see Figure 8.35).

Simulation pages

The student's learning experience, as illustrated in Figure 8-34 and 8.35, is to experiment and practice by using the sliding bar on a virtual camera to change the three factors and observe the changes in them, namely:

No 1. Changing the aperture.

No 2. Changing the focal length of the lens.

No 3. Changing the camera-to-subject distance.

Figure 8.35 **Learning Outcome 3- DOF Simulation page.**

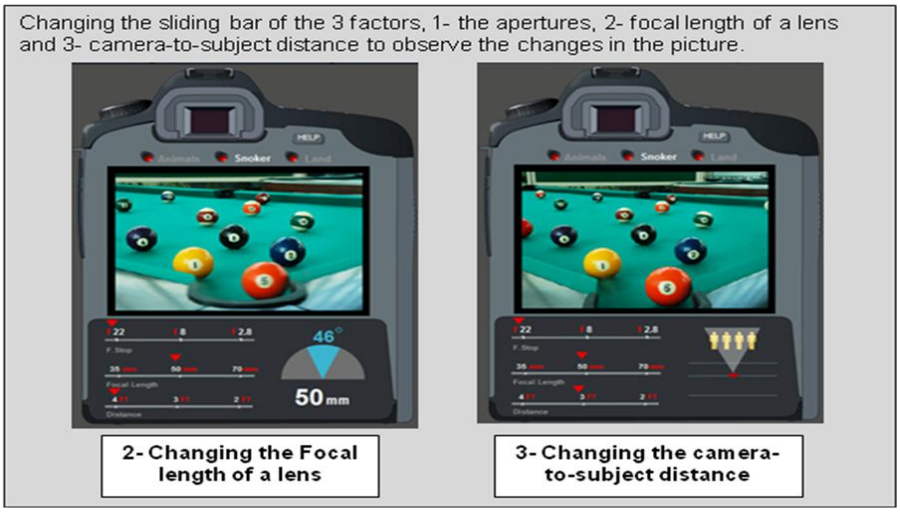


Figure 8.36 **Simulation page.**

A 2D simulated camera is used to practice and visualize how the three elements affect DOF by changing the focal number/ aperture, focal length of a lens and camera-to-subject distance using the sliding bar on the virtual camera. This gives the students a virtual experience of how to use the camera in a real situation. The virtual camera is designed with three examples (see Figure 8.34 and 8.35); the user can choose any one of them by clicking on the red button to see a different exercise for their practice.

Final evaluation

For the **final evaluation**, the researcher used ten multiple choice questions. However, the questions are hidden from the prototype while the students practice. This is because these questions are used in the final test of the prototype to measure its effectiveness for both the controlled and experimental groups. More details of this are given in Chapter 9.

All print screens for the final evaluation are presented in Appendix 8-1.

8.4. Conclusion

This chapter presented the design rationale of the prototype, based on the proposed Design Model. In order to experimentally test and validate the proposed model, the prototype will be deployed in the classroom as part of the field work in order to test its effectiveness by testing achievement of LO's and obtaining end-user feedback. Thus, the next chapter will describe in detail the field work to test the prototype and design model on which it is based.

Chapter Nine

Depth of Field

Prototype Evaluation

9. Depth of Field Prototype Evaluation

9.1. Introduction

In this chapter, the researcher describes the tests to evaluate the advanced multimedia prototype developed based on the Advanced Multimedia in Photography Education (AMPE) model. The ultimate purpose of this prototype testing is to evaluate the effectiveness of the Design Model. There are three tests presented in this chapter, as follows:

Test 1: Pedagogical design factors.

Test 2: Multimedia design factors.

Test 3: The effectiveness of E-learning resources: - pre- and post-test together with questionnaire survey to perform hypotheses testing.

9.2. Methods of Data Collection and Analysis

Throughout this study, the researcher was aware of the need to gather only sufficient, valid and reliable data that is relevant to the work, and not to be burdened with unnecessary data.

Data was collected from various sources. These included personal observations, interviews, and a questionnaire which was especially prepared by the researcher for the purpose of this study.

Different approaches and techniques were used throughout the research to evaluate the closed-end questions of the questionnaire to determine the effects of design and performance factors. First, the critical review results had to be evaluated to find out which educational photography web sites were suitable for survey by the students and why. After the students' survey had been completed, a range of hypothesis tests were carried out to find the problems faced by the students when using these web sites. Then, the design factors were considered and gaps identified.

With the help of all this information and analysis, a prototype was developed and qualitative analysis was carried out by observing the students while they used the prototype, then interviewing them and asking them to complete questionnaires. Various statistical treatments were carried out throughout the research project some of which are explained in this chapter.

9.3. Evaluation Background

In this section, the researcher presents the overall evaluation procedure used to test the satisfaction level of the multimedia prototype, which was developed based on the Advanced Multimedia in Photography Education (AMPE) model.

9.3.1. Advanced multimedia in teaching and learning photography

During the initial stage of the project, observations were made and feedback obtained, from different teachers and students, on the problems they face in the teaching and learning of photography. Suggestions were considered and comparisons were made to enable the researcher to gain sufficient knowledge about the key problems. At a later stage of the project, this knowledge was updated by gaining information on the various sources already available, and the current developments in the teaching and training in photography. The shortcomings of these approaches and methodologies were identified and this enabled the definition of the goal to not only mitigate those gaps but also to develop a whole new approach to the teaching of the subject using the latest multimedia technology. There is now a very rapidly changing environment where changes occur every day and so it is necessary to remain up-to-date.

The design model was developed based on this research and again evaluated, and feedback was taken on the design aspects of the approach. Later, when the prototype was developed based on this design model, an understanding was obtained of the degree of user satisfaction that it generates, and to what extent the approach facilitates learning.

Therefore, it is clear that monitoring and evaluation is a continuous activity and adds extra value to the process of the whole research.

9.3.2. Overall testing plan for the study

The overall design for the testing plan for the advanced multimedia prototype in teaching and learning photography is summarized in Figure 9.1

Test 1 is to assess the Pedagogical Design Factors.

Test 2 is to assess the General Design Factors.

Test 3 is to assess the Effectiveness of E-learning Resources.

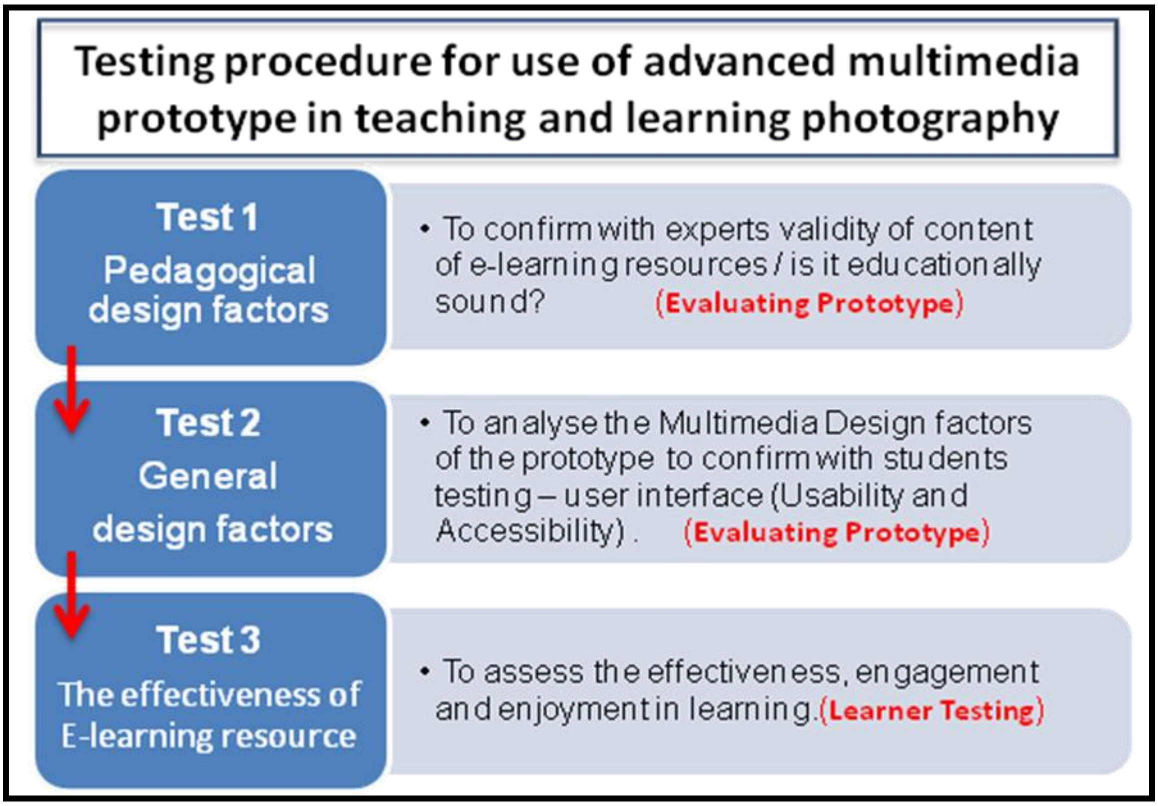


Figure 9.2 Overall Testing Plan for the Study.

9.3.3. Evaluation Procedure

The researcher set out an overall evaluation protocol in a step-by-step manner so as to simplify it. The detailed step-by-step evaluation procedure is presented in a summary chart, as shown in
Figure 9.3.

Testing procedure for the use of advanced multimedia prototype in teaching and learning photography				
Testing Stage	**Aims of the test**	**The Participants**	**How many Participants**	**Testing Method**
Test 1: Pedagogical design factors	To confirm with experts the validity of the content of learning resources.	Highly educated photography lecturers (Colleges and Universities)	2 Bahrain, 2 UK, 1 Oman, 1 Kuwait, 1 Canada Total: 7 lecturers	Questionnaire on Pedagogical design factors
Test 2: Multimedia design factors	To analyse the Multimedia Design Factors of the prototype to confirm the effectiveness of the interface and content, in terms of usability and accessibility	Multimedia Designers	3 Multimedia Designers	Questionnaire on Multimedia Design Factors
		Second-year students of photography	25 students	
Test 3: Effectiveness of E-learning resource	To determine the effectiveness of the prototype e-learning application for photography (DOF) to enhance learning in order to validate the proposed design model.	Second-year students of photography	100 Students divided into 4 Groups (25 per group)	1-Pre- and post-test. 2- Questionnaire

Figure 9.3 Testing Procedure for the Prototype Evaluation.

9.4. Test 1 Pedagogical design factors

The aim of the test of the pedagogical design factors was to confirm with experts the validity of the content of the learning resources, and to determine whether it was educationally sound.

The chosen testing method was a questionnaire, which is presented in Appendix 9-1. The questionnaire had fourteen questions based on Likert Scale responses. The 5-point Likert Scale responses were as follows:

1 - Very Poor
2 - Poor
3 - Fair
4 - Good
5 - Very Good

At the end of the questionnaire, the researcher provided a box for comments or suggestions for improvement, basically forming an open-ended question.

The participants in this test are experienced photography lecturers from both colleges and universities in their respective countries. In total, there were seven lecturers from the following countries: Bahrain (two), UK (two), Oman (one), Kuwait (one), and Canada (one).

9.4.1. The Pedagogical Design Questionnaire

Pedagogical design has to be evaluated through the participants themselves, in that they have to see the prototype and validate the content, which was done through Test 1. At this stage, the researcher developed a questionnaire in English, which was then forward-translated into Arabic by a person whose mother tongue is Arabic. This translation enabled a pedagogy expert to review the questions contained in the questionnaire. Once this review took place, and it was confirmed that the questionnaire was acceptable, the Arabic form of the questionnaire was put through back-translation into English to ensure that the original meaning and intention was not lost in the translation, due to cross cultural values.

9.4.2. Validity of the questionnaire

The researcher anticipated the need to ensure the validity of the questionnaire built for the purpose of this study, and content validity is usually established by professionals who select appropriate content for questions and statements. This leads to the results of a questionnaire or survey being considered valid if the questions are appropriate and necessary to identify a specific attribute, state or quality (Glenn, 2008). In this case, the pedagogical design criteria were based on Nielson's (1994) work, with some additions influenced by Squires and Preece (1999), and Wright (2003).

The questionnaire itself was presented to external experts, who were experienced photography teachers from different countries including Bahrain, United Kingdom, Oman, Kuwait and Canada. They were asked through the questionnaire to validate the content and pedagogical design of a new Photography (Depth of Field) e-learning application, and they were found to be in total agreement that the items of the questionnaire measured what it was supposed to measure. The following section presents the detailed results of this validation process.

9.4.3. Pedagogical Design Results

In this section the researcher presents the findings of the pedagogical design factors test, which are shown in Table 9-1, and presented pictorially in Figure 9.4. Examination of the table and the figure shows that expert photography teachers rated the content of the e-learning resource highly, since thirteen items of the questionnaire obtained an average score of more than 4. Only three items were rated less than 4, but the scores given were close to this value. This means that the pedagogical design of the prototype was rated ‘good’ to ‘very good’ and, therefore, can be considered valid.

Irrespective of a few negative comments given by the experts on the content and pedagogical design outcome, they indicated that the learning goals and outcome were clear, and the phrasing of the items was suitable for the students in Bahrain. Furthermore, the scores reflected their opinion that the content was correct, relevant and well structured. They also found that there was a clear link and relationship between each learning outcome which reflected the prototype content. All individual learning activities were considered appropriate.

Table 9-1 Experts’ average rating of each item of the Pedagogical Design.

No.	Questions	Average score out of a maximum of 5
1	Are there clear learning goals and outcomes for this e-learning resource?	4.86
2	Is the language used suitable for the level of the user?	4.28
3	Does the content support the achievement of the learning outcomes?	4.00
4	Is the content accurate, relevant and current?	4.28
5	Is the content suitably organised and structured to support the learner?	4.28
6	Are the learning activities enough to achieve the learning outcomes and support learners?	4.00
7	Is there a clear relationship between different parts of the lesson?	4.71
8	Are all the individual learning activities appropriate?	4.42
9	Do these learning activities support the achievement of the learning outcome?	4.42
10	Does the order that the materials are presented in support learning?	4.57
11	Does the feedback support the learner?	**3.86**
12	Is the feedback appropriate to the learner’s responses?	**3.71**
13	Does the resource support a range of learning styles?	**3.71**
14	Will the resource be attractive to, and engage, the students?	4.14

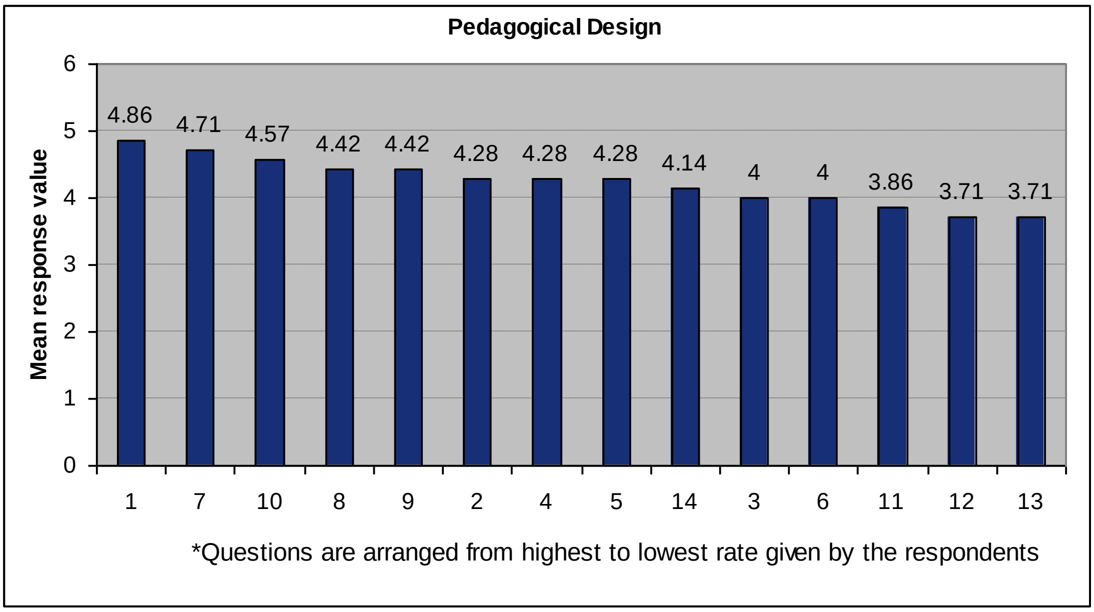


Figure 9.4 Experts' rating of each item of the Pedagogical Design.

The experts' comments included the need for consistent use of language, for example, to avoid the use of both "large" and "big" etc. when indicating the same thing. This also applied to the use of the words "small" and "shallow" when referring to the same concept. Other comments were to correct the grammar and reorganise the content. The researcher made all the required changes according to this feedback from the experts.

Regarding the low scores given to items 11, 12, the researcher discovered that the procedure does not take the user back to the specific thing he got wrong, but takes him through the whole unit. Accordingly he modified this procedure in a way that takes the user back to the specific thing he gets wrong. The content included in each section of the prototype was prepared so as to give the learner comprehensive information about each objective he is expected to achieve. Through this procedure, the learner can find the accurate information he did not understand in the first attempt.

Some of the comments also recommended making changes to some pictures, and this was carried out as the pictures did not reflect the intended content clearly. Other comments were used as questions in the pilot questionnaire. The

Pedagogical Design questions were presented in both English and Arabic in the hope of facilitating the tasks for many of the private university students who do not have a strong command of the English language.

9.5. Test 2 Multimedia Design Factors

The aim of Test 2 was to analyse the Multimedia Design Factors of the prototype to confirm the effectiveness of the interface and content in terms of Usability and Accessibility. The chosen testing method for Multimedia Design Factors was a questionnaire, which is presented in Appendix 9-2. This questionnaire was based on a 5-point Likert Scale. The responses for this questionnaire were as follows:

1 - Very Poor
2 - Poor
3 - Fair
4 - Good
5 - Very Good

All together there were fourteen questions in this questionnaire.

Participants in this test were three experienced multimedia designers and twenty-five second-year students of photography at Bahrain University.

9.5.1. The Multimedia Design Questionnaire

At this stage, the researcher developed the questionnaire in English, which was then forward translated into Arabic by a linguist whose mother tongue is Arabic. This translation enabled the pedagogical experts to review the questionnaire and, when checked and confirmed that the questionnaire is acceptable, the Arabic questionnaire was back-translated to English to ensure that the original meaning and intention was not lost due to cross cultural values. The translation was also put through this forward and backward translation process to reduce the chances of error.

9.5.2. Validity of the questionnaire

The validity of the multimedia design questionnaire was assured through two indicators. First, it had been built on the multimedia design criteria which were again based on Nielson (1994), with some additions influenced by Squires and Preece (1999), and Wright (2003). Secondly, three experts checked the questionnaire and agreed that it measured what it was supposed to measure.

9.5.3. Evaluation of the prototype design

For the evaluation of the multimedia design of the prototype, students needed to use the prototype and then record their feedback on the questionnaire, providing comments at the end of the questionnaire. The researcher arranged a session in a computer laboratory with twenty-five computers where the prototype had previously been installed. The students were asked to look at the prototype, evaluate it, and provide their ratings on the questionnaire form together with their comments. This procedure would be considered validation of the prototype.

9.5.4. Test Results

The results of the evaluation of the multimedia design of the prototype are presented in Table 9-2. It is clear from this table that both experts and students gave high ratings to almost all aspects of the prototype design. The average scores were nearly all 4 and above. Both groups agreed that the design of the prototype had a high level of fun or enjoyment, it was very easy to navigate, the text was easy to read, it had clear icons, the directions given were also clear, it made good use of colour, and it provided a clear route to a starting point or to the main menu.

No major design problems were reported in the evaluation, and the comments made by the experts and students in terms of enhancing the prototype are detailed in the following sections, 9.5.5., and 9.5.6.

Table 9-2 Multimedia design factors test results

	Multimedia design factors	Students	Experts
1	Screens designed in clear and understandable manner	3.9	3.66
2	Ease of navigation	4.6	4.33
3	Clarity of content	3.9	4
4	Ease of reading text	4.6	4.66
5	Clarity of icons	4.3	4.66
6	Clarity of directions given	4.3	4.33
7	Use the color to present information	4.6	4.66
8	Clarity of indication of the current location	3.9	4
9	Clarity of route to a starting point or main menu	4.5	4.66
10	Use of multimedia components to present information	4.2	4.66
11	Use of headings and subheadings to organize the information	4.6	4.33
12	Level of attractiveness	3.9	4
13	Level of engagement of screen and contents	4	4.33
14	Consistency and adherence to navigation standards and conventions	3.8	4
15	Flexibility and ease of use	4.1	4.33
16	Level of fun or enjoyment	4.65	4.66
17	The sound is of good quality and enhances the presentation of information.	4.4	4.66

9.5.5. Multimedia Experts' Comments

The feedback from the multimedia experts' comments was used to make the necessary corrections and amendments in the multimedia design of the prototype. The general comments were as follows:

1. The experts indicated that all the prototype headings and text should be in the same size and colour for consistency and standardization, as illustrated in Figure 9.5 below.
2. The experts suggested that, in order not to confuse the students, the main page icon be included in each of the pages. Each page should then show the same icon for the students. The researcher was also asked to correct the main page colour to match the other pages.
3. The multimedia experts suggested presenting the prototype question for evaluation at the end of each learning outcome in both English and Arabic.

4. It was also suggested that the forward and backward button be corrected so that it was standard on all pages.

   The suggestions were applied to the prototype, as illustrated in Figure 9.5 below.

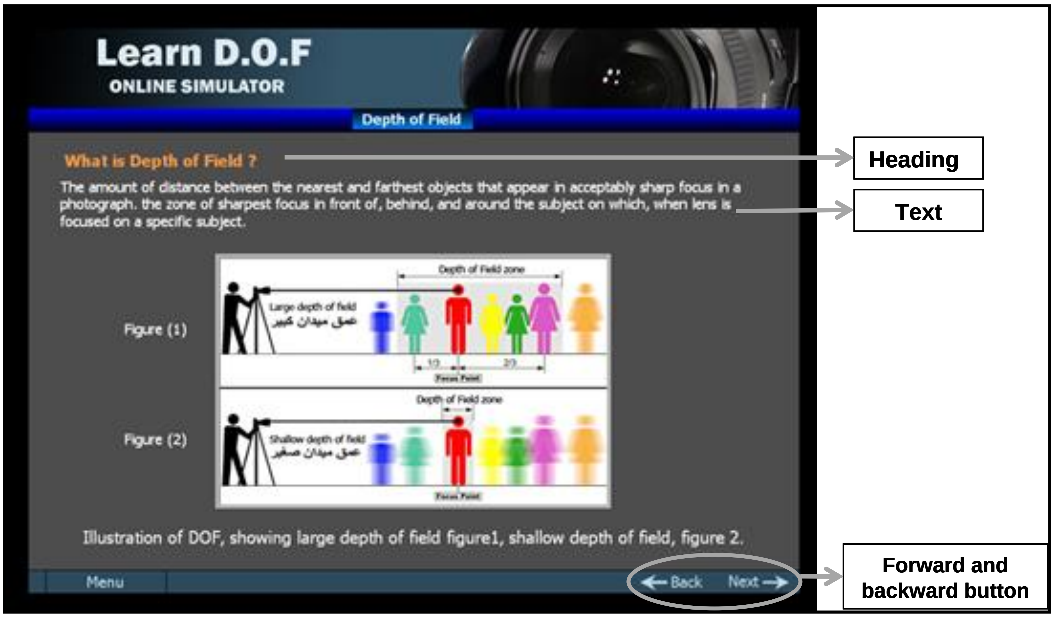


Figure 9.5 Standardisation of prototype pages

9.5.6. Students' Comments

The students also provided their comments, which were as follows:

1. Re-size the pictures
2. Add both English and Arabic in the charts
3. Add two language options in the prototype
4. Add more activities
5. Make the main menu clearer
6. Add more examples to the simulation camera

The comments were very useful for the researcher to improve the prototype, and the improved version of the final prototype questions was used for the pre-test and the post-test.

9.6. Test 3: The Effectiveness of the E-Learning Resources

9.6.1. Introduction

The third test involves two types of testing. The first test is quantitative, using pre-test and post-tests that investigate students' learning. The second test consists of a quantitative questionnaire examining the students' responses regarding the learning experience in terms of the effectiveness of learning depth of field in photography, the level of student engagement in the subject and the level of student enjoyment in the subject. This was followed by qualitative open-ended questions.

9.6.2. Aim of the Test

The aim of the test was to determine the effectiveness of the advanced multimedia prototype application for photographic depth of field (DOF) to enhance learning in order to validate the proposed design model.

9.6.3. The research objectives

This test examined whether students have a better learning experience, including effectiveness, engagement and enjoyment, when using advanced multimedia learning materials. This was done by comparing the difference in effectiveness between the prototype Advanced Multimedia learning application and traditional approaches, using a low level of multimedia to teach depth of field.

In order to do this, the test was designed to measure three key factors, which were the level of students': A). effectiveness in learning; B). engagement in learning; and C). enjoyment of learning. In conducting the evaluation, the researcher used an achievement test and a questionnaire for the measurement of the above factors, in order to test three different hypotheses based on these selected factors (these factors are discussed in the following chapter). These three factors are closely associated with photography learning enhancement. Table 9-3 shows the hypotheses and the named factors which were tested.

Table 9-3 Hypotheses of the study and how they are tested

Hypotheses	Factor	How the hypothesis is tested
Hypothesis 1 Ho: Advanced multimedia-based learning applications do not give an effective higher level of learning when compared to traditional approaches.	Effectiveness	▪ The achievement test consists of ten questions (see Appendix 9-3 to 9-6). ▪ Responses to questions 1 to 10 of the questionnaire. (see Appendix 9-8)
Hypothesis 2 Ho: Advanced multimedia-based learning applications do not give a higher level of engagement when compared to traditional approaches.	Engagement	▪ Responses to questions 11 to 18 of the questionnaire. (see Appendix 9-8)
Hypothesis 3 Ho: Advanced multimedia-based learning applications do not give a higher level of enjoyment when compared to traditional approaches.	Enjoyment	▪ Responses to questions 19 to 28 of the questionnaire. (see Appendix 9-8)

9.6.4. Testing Method

The three aspects that were measured, effectiveness, engagement and enjoyment, lend themselves to two different analytical methods. Learning was tested using a quantitative approach via pre-test and post-tests, so that the added value of the learning experiences could be analysed. Engagement and enjoyment are more difficult to measure; however, after examining the literature, it was considered that a qualitative questionnaire based on 'A Toolkit for writing surveys to measure student engagement, reflective and responsible learning' (Ruhe, 2006) would be most appropriate. In addition, a similar study looking at the Rule of the Third, which was undertaken by Lister in 2005, was also taken into account.

Ruhe (2006) states that engagement “is usually defined in terms of attributes like intrinsic motivation, positive effect, persistence, effort and self-confidence”, and the toolkit suggests a number of test criteria which have been used in the questionnaire, as mentioned below (see also Appendix 9-8):

The pre- and post-tests will allow the effectiveness of the advanced multimedia application (the prototype) to be compared with traditional teaching materials (using basic multimedia such as narrative PowerPoint) and methods.

The test was conducted in Arabic, the students' first language, although some technical terminology was in English; for example depth of field, f-stop and aperture. The translated test questions were examined by Arabic experts in the Department of Education, Physical Education and Photography, to ensure that the meaning of the questions had not changed from the original intention in English. A pilot test was conducted with a small number of students to identify the strengths and weaknesses of the test.

9.6.5. Experimental Design

The researcher used a mixed-model design for the test, combining quantitative and qualitative methods. Regarding the quantitative method, the researcher followed the pre-test/post-test control group quasi-experimental design (see Table 9.3). Two instruments were developed for the purpose of this study, which were an achievement test (pre-test and post-test) and a questionnaire. The test and the questionnaire were constructed so that the students could answer them by themselves.

Table 9-4 Experimental design

Groups		Pre-test (Learning)	Treatment *	Post-test (Learning)	Questionnaire on the perceptions of Effectiveness, Engagement and Enjoyment of Learning
Control Group	Traditional approaches	√	✕	√	√
Experimental Group	Advanced Multimedia	√	√	√	√

- *Treatment means that an experimental action has been taken with the group.
- √ means that the group took this test.
- ✕ means that the group did not take this test.

Effectiveness in learning was estimated through two methods: first of all, a comparison of both the experimental and control groups' achievement in an achievement test; secondly, a comparison of the opinions of the two groups of students in a specially constructed questionnaire measuring their views of the respective method applied. Engagement and enjoyment in learning in the two groups of students were assessed through their responses to specific items in the questionnaire used for measuring effectiveness.
Regarding the qualitative method, the participants' comments, opinions, and suggestions were obtained through the open-ended questions included in the aforementioned questionnaire.

9.6.6. Data Analyses

The Statistical Package for Social Sciences (SPSS) was used for data analysis, and the following statistics were obtained.

- *T-test Independent Sample* was used to measure the statistical differences in means between the experimental and control groups.
- *T-test Paired Sample* was used to measure the differences in achievement between the pre-performance and post-performance of the experimental group.
- *Effect Size Technique* was used to show the extent of the programme's effect on the experimental group. Effect size is calculated by different methods, the most commonly used being that mentioned by Ary et al. (2002). According to this method, effect size is calculated by the following equation:

$$\Delta = \frac{\bar{x}_e - \bar{x}_c}{s_c}$$

Δ = effect size.
$\bar{x}_e$ = mean of the experimental group.
$\bar{x}_c$ = mean of the control group
s_c = standard deviation of the control group.

Criteria for judgement of the value of effect size, according to Cohen (cited in Ary et al., 2002, p.151), are as follows:

- Δ = 0.20 effect size is small.
- Δ = 0.50 effect size is moderate or average.
- Δ = 0.80 effect size is high.

9.6.7. Achievement test

In order to assess the effectiveness of learning using the advanced multimedia application, ten multiple choice questions were developed by the researcher. Each question item measures the extent of the students' understanding of the concept of depth of field. For this purpose, each question was followed by five multiple choice answers. The fifth choice was ''Don't know'' to avoid the students guessing if they did not know the correct answer to the question.

The test was presented in two parts. In the first part, students in the two groups (control and experimental) were given an answer sheet on which to answer each of the ten questions (see Appendix 9-3) and, in the second part, students viewed a PowerPoint presentation with text and images (see Appendix 9.4).

When conducting the pre-test, the researcher repeated the same procedure for the post-test except that, in the new post-test, the images, text and some numbers were replaced to suit the post-test purposes, as can be seen in Appendix 9-5 for the post test answering sheet, and the post-test PowerPoint presentation is presented in Appendix 9-6.

Validity and Reliability of the Achievement test

The test was given to seven external referees, who were experienced photography teachers, (two from Bahrain, and two from United Kingdom and one each from Oman, Kuwait, and Canada) and who were asked to read the questions, check the extent to which the photographs matched the content of the questions and make necessary amendments. They suggested the development of two identical versions of the test questions - pre-test and post-test - provided that both tests were on the same level of difficulty as the test sample.

The test was administered to twenty students from the Educational Technology Department at the University of Bahrain, College of Education, for the purpose of piloting it in order to check the suitability of the photographs, clarity of content and adequate PowerPoint presentation speed. All comments were taken into consideration in the final version. Cronbach's Alpha $\propto$ was found to be .848, which indicates that the questionnaire is reliable.

9.6.8. The Questionnaire

Original items in the questionnaire were modified and adapted to the needs of the students and circumstances, to reflect the content being measured. The English version of the questionnaire was forward translated to Arabic, and the Arabic version was back-translated again to English, followed by a comparison of the two English versions for equivalence. It was important for the researcher to do this to reduce any chance of human error and the inevitable cross-cultural factors.

The questionnaire consists of twenty-eight question items divided into three areas:

- Effectiveness in learning (ten items).
- Engagement in learning (eight items).
- Enjoyment of learning (ten items).

In addition, it includes three open-ended questions which asked for the participants' opinions regarding the method of teaching-learning, and the media, applied with them.

Validity and Reliability of the Questionnaire

The engagement, enjoyment and learning questionnaire was presented to five external referees, who were faculty members from different institutions. All referees are listed in Appendix 9-7 of this study.

The referees were asked to read each question and to comment on the items in terms of wording and content, and to give their comments and suggestions for improving the questionnaire measurement.

The questionnaire was administered to twenty-five students at the College of Education, selected at random, to check the reliability of the questionnaire. Cronbach's Alpha was used to determine the reliability of each factor measured in the questionnaire, and a high level of reliability was indicated (See Table 9.5), with values of .906 for effectiveness, .885 for engagement, and .881 for enjoyment.

Table 9-5 Cronbach's Alpha Reliability Values for Questionnaire Factors

No.	Factor	Cronbach's Alpha
1.	Effectiveness in learning.	.906
2.	Engagement in learning.	.885
3.	Enjoyment in learning.	.881

The questionnaire is presented as Appendix 9-8 of this study.

9.6.9. Testing Procedure

To determine the effectiveness of the teaching-learning method and the use of advanced multimedia, the researcher took the following steps, as shown in Figure 9.6.

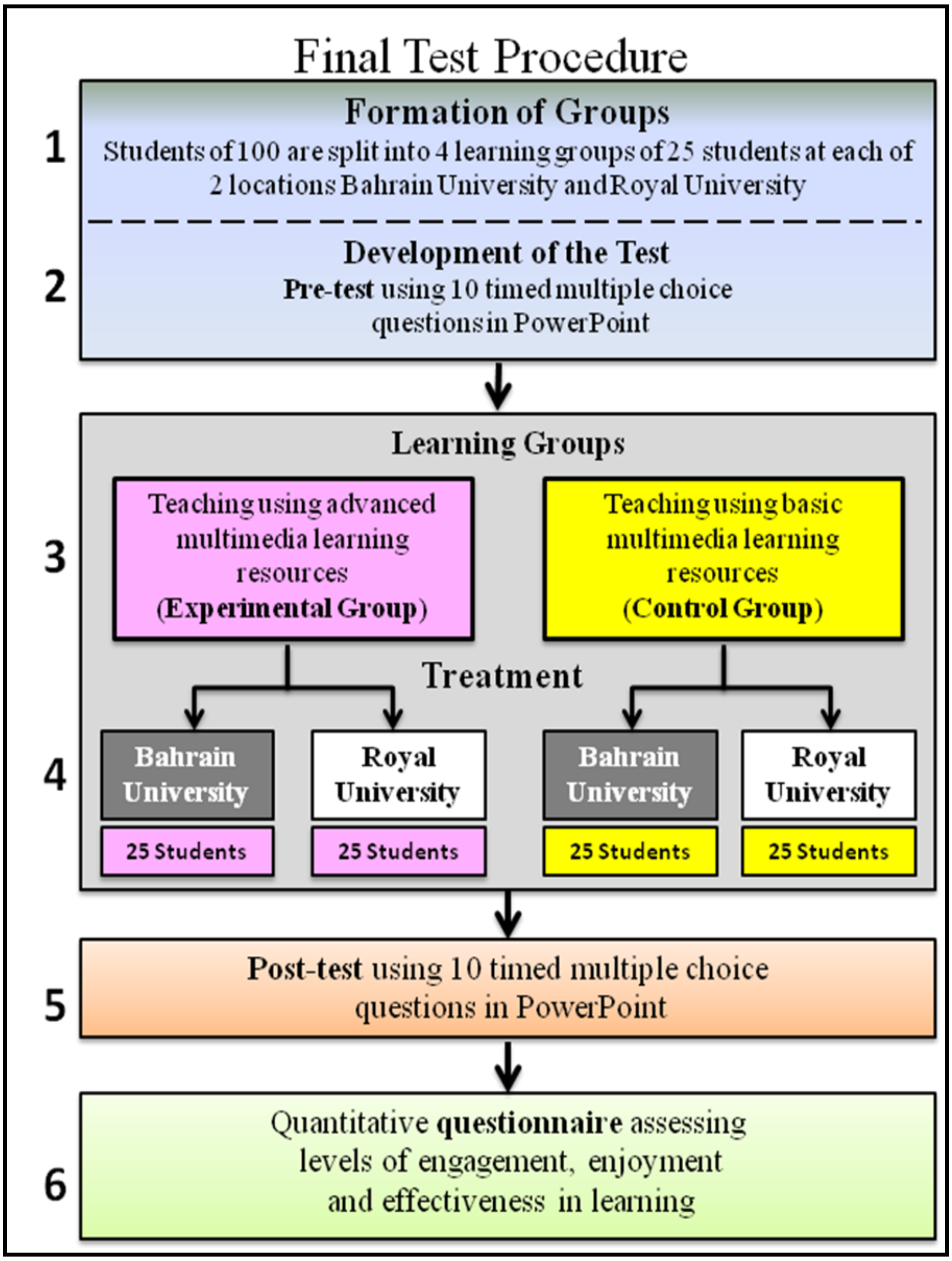


Figure 9.6 Final Testing Procedure.

(Source: Albayat, 2010).

9.6.9.1. Step 1: Formation of Groups

At the beginning of the assessment of teaching and learning effectiveness, the researcher had to form the necessary groups of students. For the purpose of this study, the researcher selected two different groups, namely the Control group and the Experimental group.

As previously discussed in Chapter 8, the students of both the groups were selected from 2nd. Year photography students in the two universities mentioned at the time the researcher conducted the study. All students who were taking photography courses in the two universities were included in the sample of the study. Students from these groups were randomly assigned to the experimental and control groups. The details of these groups are presented in Table 9-6 below.

Table 9-6 Formation of groups

Group Type	Total No. of Students	Participants' Details	No. in group	Lecturer
Control Group (Traditional teaching approach using Basic Multimedia)	50	University of Bahrain	25	Instructor 1
		Royal University	25	Instructor 2
Experimental Group (Advanced Multimedia learning application)	50	University of Bahrain	25	Instructor 1
		Royal University	25	Instructor 2

Once the groups were formed, the role of the lecturer was to deliver the course content using basic multimedia with the control group, and advanced multimedia application with the experimental group (this application is explained in detail in Chapter 8, Section 8.2.4).

9.6.9.2. Step 2: Development of the Pre-Test

Once the different groups of students were identified in this study shown in Table 9-7 below, the researcher developed the relevant test which, at this stage, consisted of a pre-test using ten timed multiple choice paper tests while looking at a projected image in PowerPoint.

Table 9-7 Development of the pre-test.

Testing Method	No. of students	Test and questionnaire time
Test on Depth of Field using timed multiple choice questions in PowerPoint for both the Control and Experimental Group	100	30 minutes

9.6.9.3. Step 3: Pre-treatment of the Learning Groups

Prior to the treatment (see the following section 9.6.9.4), the final test was administered to all participants in both the experimental and control group in the normal educational setting, and it took the students thirty minutes to finish the test. The author was present during administration of the test, and the instructions were found to be clear for all participants. Due to the researcher's engagement with other responsibilities, he assigned the task of administering the test to the University of Bahrain sample to a colleague from the College of Education, who performed the task successfully. With regard to the Royal University sample, another colleague at that university also administered the test without any difficulties.

9.6.9.4. Step 4: Treatment

University of Bahrain Student Group: 50 students

Control group:

The first instructor from the University of Bahrain taught the students (n=25) using the Traditional Approach, with a standardised package of learning materials containing a PowerPoint presentation (basic multimedia), as shown in Appendix 9.9. In the same educational setting, students were divided into five groups, where each was provided with a real 35mm camera, which gave each student in the group enough time to experiment with depth of field, to see its effect on their photograph and pass the camera on to their colleagues, in turn.

Experimental group:

The first instructor from Bahrain University taught the students (n=25) using the advanced multimedia prototype. The students in the classroom were given the full time of thirty minutes to investigate and explore the concept of how aperture might affect depth of field in photography. In addition, each student was asked to answer questions about the content of the subject matter. Unlike the control group, the teaching-learning package included the use of simulation or interactive, formative assessment, because the use of advanced multimedia was being assessed.

Howthorn effect was taken into consideration in this study through not informing the experimented group that it is under experimentation. Such knowledge might damage the experiment since this group will pay extra ordinary effect to prove the success of this experiment, which is known as Howthorn effect. This effect is a form of reactivity whereby subjects improve or modify an aspect of their behavior being experimentally measured simply in response to the fact that they are being studied, not in response to any particular experimental manipulation. (Clark & Sugrue, 1991, p. 333).

The lecturer in the control group taught the subject using basic multimedia as a supplementary teaching aid whereas, in the experimental group, advanced multimedia resources were used. Therefore, the students in the experimental group had the opportunity to learn and practice through both real 35 mm camera and the advanced multimedia functions (virtual camera), which was not available to the control group.

The Henry effect was also taken into consideration through not informing the control group that it is competing with the experimental group. Such knowledge might compromise the experiment since it makes the control group paying more effort to excel the experiment group, which is known as The Henry effect. This effect is an experimental bias introduced into social experiments by reactive behavior by the control group. It is essentially the opposite of the Hawthorne Effect.

In a controlled social experiment if a control is aware of their status as members of the control group and is able to compare their performance with that of the treatment group, members of the control group may actively work harder to overcome the "disadvantage" of being in the control group. (Cook & Campbell, 1979).

Royal University Student Group: 50 students
The same procedures which were applied to the students from Bahrain University were again applied to the students from Royal University. As such, the procedures were the same for both the control and experimental groups. The only difference was the location of the classroom and the instructor, who was a faculty member of Royal University.

Control factors: The following factors were constant, namely the content of the subject of photography, subject text, diagrams, and explanations. This was done so as to eliminate the differences that might be attributed to using different photographs or diagrams.

It should be noted that two educational institutions of the same level, that is universities, were chosen for the treatment so as to gain more credibility for the instruments of the study.

9.6.9.5. Step 5: Post-Test

At the end of the treatment session of the experimental group, a post-test was re-administered to all participants in both the University of Bahrain and Royal University. The same procedure was followed with the control group, and it took thirty minutes to finish the items. The post-test developed consisted of ten items, and was the same test as that administered prior to the treatment with slight modifications in terms of the numbers and the pictures to eliminate the possibility of memorization of the correct answers.

9.6.9.6. Step 6: Application of the questionnaire

The questionnaire was applied after completion of the treatment for both groups. Students were encouraged to answer all the questionnaire items clearly in order to express their opinions directly and honestly, as reflected in Table 9-8 below.

Table 9-8 Effectiveness, Engagement and Enjoyment Questionnaire

Testing Method	No. of students	Test and questionnaire time
Questionnaire All students were asked a range of questions about their learning experience	100	No time limit

9.7. Findings of the study

The results of the study are presented in three categories, according to the three factors under focus in this study, which are: effectiveness of learning, engagement in learning, and enjoyment in learning. The following sections show the results for these factors.

9.7.1. Achievement test results

The researcher used the pre-test to identify the baseline before proceeding to evaluate the effectiveness of the advanced multimedia prototype (experimental group) compared to the basic learning materials (control group).

Table 9-9 shows that the two groups achieved elements equally at the pre-test. The mean for the control group is 2.1, whereas the mean for the Experimental group is 2.0. The result is displayed graphically in Figure 9.7 and, in the pre-test aimed at investigating the concept of depth of field in photography, there are no statistically significant differences ($t=0.489$, $df=87.354$, not sig.) between the initial test scores of students in the experimental group and the initial test scores of students in the control group.

Table 9-9 T-test comparison for both groups on the pre-test result

Group	No.	Mean	Std. Deviation	df	t-test	Sig. (2-tailed)
Control group (Traditional)	50	2.1200	.82413	87.354	0.489	0.626
Experimental group (Multimedia)	50	2.0200	1.18649			

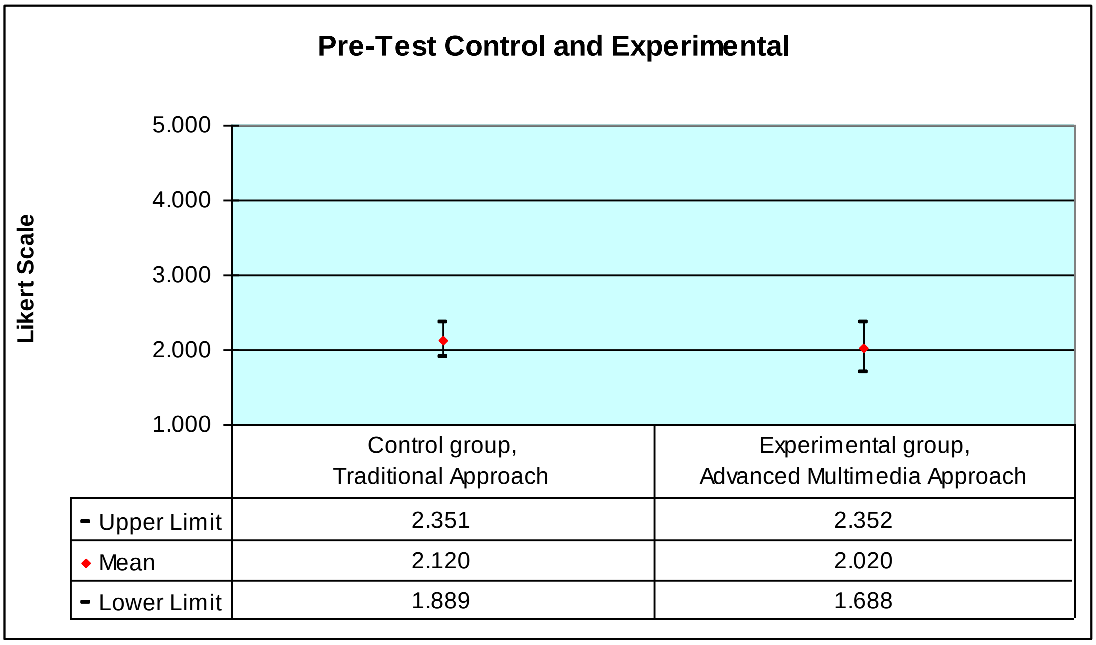


Figure 9.7 Pre-test: Control and Experimental Groups

When the two group's post-test results were compared (see Table 9-10), an evident difference appeared. The experimental group seemed to have highly outperformed the control group. The average performance of the experimental group was 7.62, whereas that of the control group was 6.14. The t-test of results showed that this difference was highly statistically significant (t=6.196, df=84.55, sig at $p<0.001$).

Table 9-10 T-test comparison for both groups on the post-test result

Group	No.	Mean	Std. Deviation	df	t-test	Sig. (2-tailed)
Control group (Traditional)	50	6.1400	.92604	84.549	-6.196	0.000
Experimental group (Multimedia)	50	7.6200	1.41263			

Improvement in Achievement

The focus of this study was improvement in achievement of the experimental and the control group. Table 9-11 shows that the improvement of the experimental group was better than that of the control group on all of the items of the test. In addition, the overall average for all of the items of the experimental group (5.60) was also higher than that of the control group (4.02). The control group increased from 2.12 pre-test to 6.14 at the post-test assessment; that is a difference of 4.02. The experimental group increased from 2.02 at the pre-test measurement to 7.62 at the post test assessment; that is a difference of 5.6. These results indicate that while both of the approaches reflect an improvement and changes, the experimental group demonstrated greater improvement and changes, as shown in

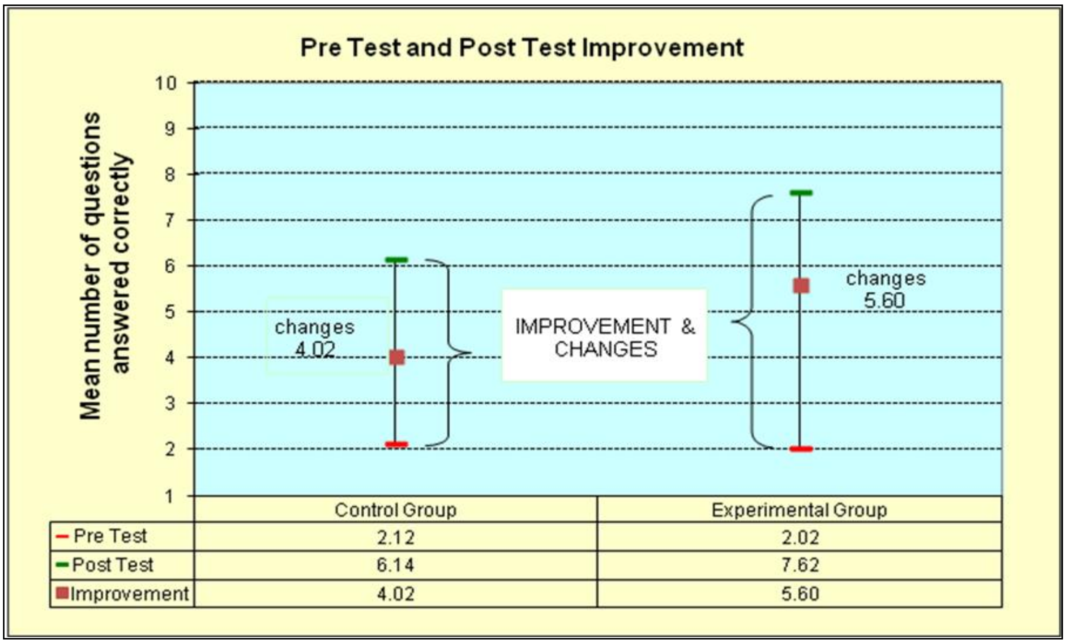


Figure 9.8 (The t-test results are presented in Table 9-12 below).

Thus, based on students' achievement, it can be concluded that we can reject hypothesis one, which states that advanced multimedia-based learning applications do not give a higher level of learning when compared to traditional approaches in terms of effectiveness of learning. According to Cohen, the effect size is:

$$\Delta = \frac{\bar{x}_e - \bar{x}_c}{s_c} = \frac{5.6 - 4.02}{1.20355} = 1.31$$

This value of effect size (1.31) is much higher than the criterion set by Cohen (1993) of 0.80 for deciding that the value is large. Therefore, we can conclude that the prototype had a significant effect on the experimental group.

Table 9-11 T-test comparison of both groups on changes in achievement

Group	No.	Mean	Std. Deviation	df	t-test	Sig. (2-tailed)
Control group (Traditional)	50	4.0200	1.20357	98	-6.164	0.000
Experimental group (Multimedia)	50	5.6000	1.35526			
Effect size = 1.31						

Table 9-12 Comparison of mean improvement in each item for both groups

Pre-/Post-Test Question No.	Improvement and changes in both groups	
	Control group	Experimental group
1	4.2	7.4
2	3.7	5.0
3	2.2	4.2
4	2.6	3.0
5	4.4	5.8
6	3.4	6.0
7	4.0	7.0
8	4.2	6.2
9	4.4	5.0
10	4.0	6.6
Average	**4.02**	**5.60**

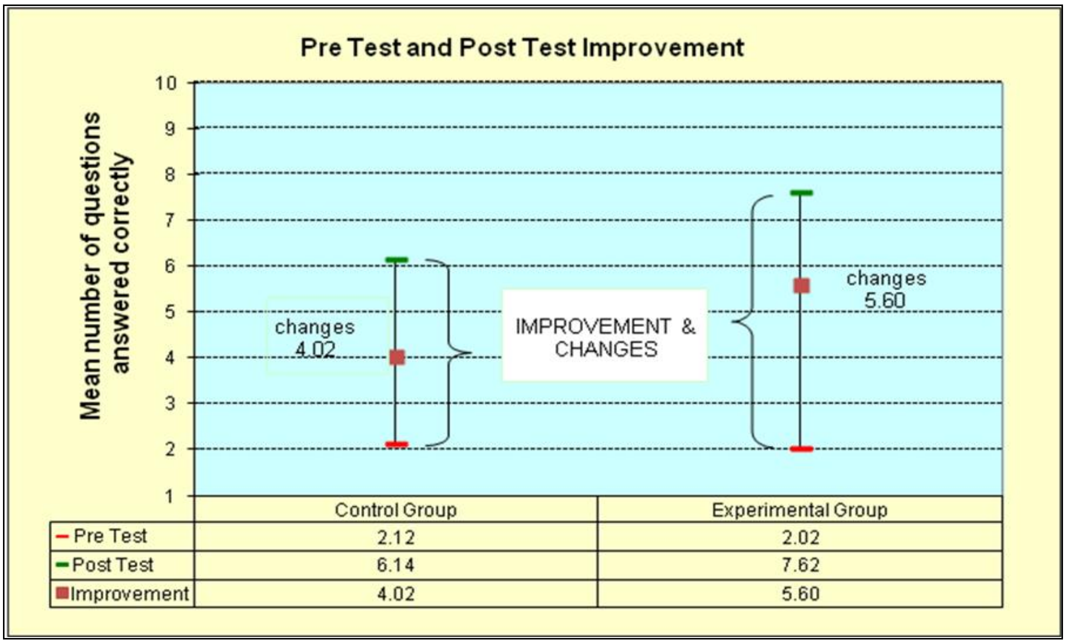


Figure 9.8 Pre- & post-test improvement & changes in both groups

9.7.2. Students' views of E-Learning Resource

The researcher used a questionnaire to gauge the student views in relation to the engagement, enjoyment and effectiveness in learning. Two sources of data provided the results: students' responses to the closed items of the questionnaire represent the quantitative source, and the open responses to last items of the same questionnaire represent the qualitative source. The following sections describe the results obtained on each of the three key factors (effectiveness, engagement, and enjoyment).

9.7.2.1. Perceptions of Effectiveness in Learning

Table 9-13 shows that the overall average rating of students in the experimental group (43.36) on the ten items in the questionnaire that measure effectiveness was much higher that of the control group (33.18). The t-test results indicated that the difference between the two groups was statistically highly significant (t=9.678, df = 98, significant at P<0.001). Thus, we conclude that the students' opinions give further support to the rejection of the first hypothesis, which states that advanced multimedia-based learning applications do not give a higher level of learning when compared to traditional approaches in terms of effectiveness in learning; which means that we can accept the alternate hypothesis which states that ‘’Advanced multimedia-based learning applications give an effective higher level of learning when compared to traditional approaches‘’.

Effect size was found to be 1.98, which is much higher than the criterion set by Cohen (1993) of (0.80) for deciding that the value is large.

Therefore, we can conclude that the e-learning resource has a great effect on the experimental group.

Table 9-13 Comparison of t-test results for Perceptions of effectiveness in learning

Group	No.	Mean	Std. Deviation	df	t-test	Sig. (2-tailed)
Control group (Traditional)	50	33.18	5.138	98	-9.678	0.000
Experimental group (Multimedia)	50	43.36	5.379			
• Effect size = 1.98						

When considering the average rating of each of the ten items of the questionnaire that measure effectiveness on learning (see Table 9-14 and Figure 9.9 below), we can see that the rating given by the experimental group was much higher than that of the control group on each item.

Table 9-14 Mean for each of the items for Perceptions of effectiveness in learning

Questionnaire Question No.	Perceptions of Effectiveness in Learning	
	Control group (Traditional with basic multimedia)	Experimental group (Advanced Multimedia)
1	3.20	4.60
2	2.88	4.08
3	3.44	4.30
4	3.14	4.44
5	3.54	4.02
6	3.52	4.36
7	3.56	4.34
8	3.82	4.34
9	3.06	4.40
10	3.02	4.48
Average	**3.32**	**4.34**

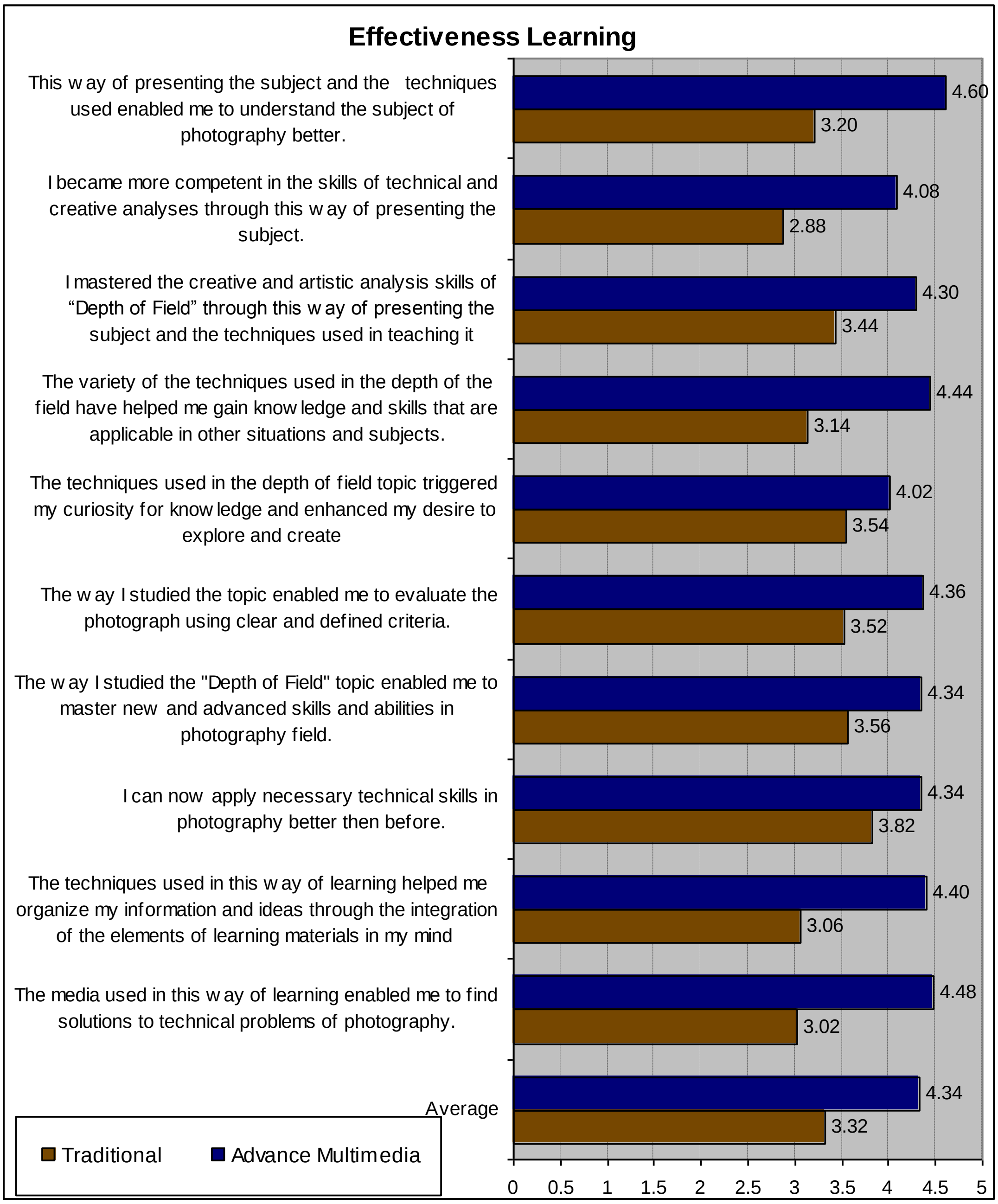


Figure 9.9 Graphic Comparison for Perceptions of Effectiveness on Learning items

9.7.2.2. Perceptions of Engagement in Learning

Table 9-15 shows that the overall average rating of students in the experimental group (32.92) on the eight items in the questionnaire that measure engagement in learning was much higher than that of the control group (23.96). The t-test results indicated that the difference between the two group was statistically highly significant (t=9.570, df = 98, significant at P<0.001). Thus, we can conclude that the students' opinions give further support to the rejection of the second hypothesis, which states that advanced multimedia-based learning applications do not give a higher level of learning when compared to traditional approaches in terms of engagement in learning. This means that we can accept the alternate hypothesis which states that ''Advanced multimedia-based learning applications give a higher level of engagement in learning when compared to traditional approaches''.

Effect size was found to be 1.83, which is much higher than the criterion set by Cohen (1993) of (0.80) for deciding that the value is large.

Therefore, we can conclude that the experimental group using the e-learning resource has a higher level of engagement in learning than the control group using basic multimedia.

Table 9-15 Comparison of t-test results for Perceptions of engagement in learning

Group	No.	Mean	Std. Deviation	df	t-test	Sig. (2-tailed)
Control group (Traditional)	50	23.96	4.90	98	- 9.570	0.000
Experimental group (Multimedia)	50	32.92	4.44			
Effect size = 1.83						

When looking at the average rating of each of the eight items of the questionnaire that measure engagement in learning (see Table 9-16 and Figure 9.10 below), we can see that the rating given by the experimental group was much higher than that of the control group on each item.

Table 9-16 Mean for each item for perceptions of engagement in learning

Questionnaire Question No.	Perceptions of Engagement in Learning	
	Control group (Traditional with basic multimedia)	Experimental group (Advanced Multimedia)
11	3.66	4.62
12	2.76	3.68
13	3.26	4.08
14	2.34	3.70
15	2.28	4.00
16	2.38	4.40
17	3.00	4.34
18	3.28	4.10
Average	**2.99**	**4.12**

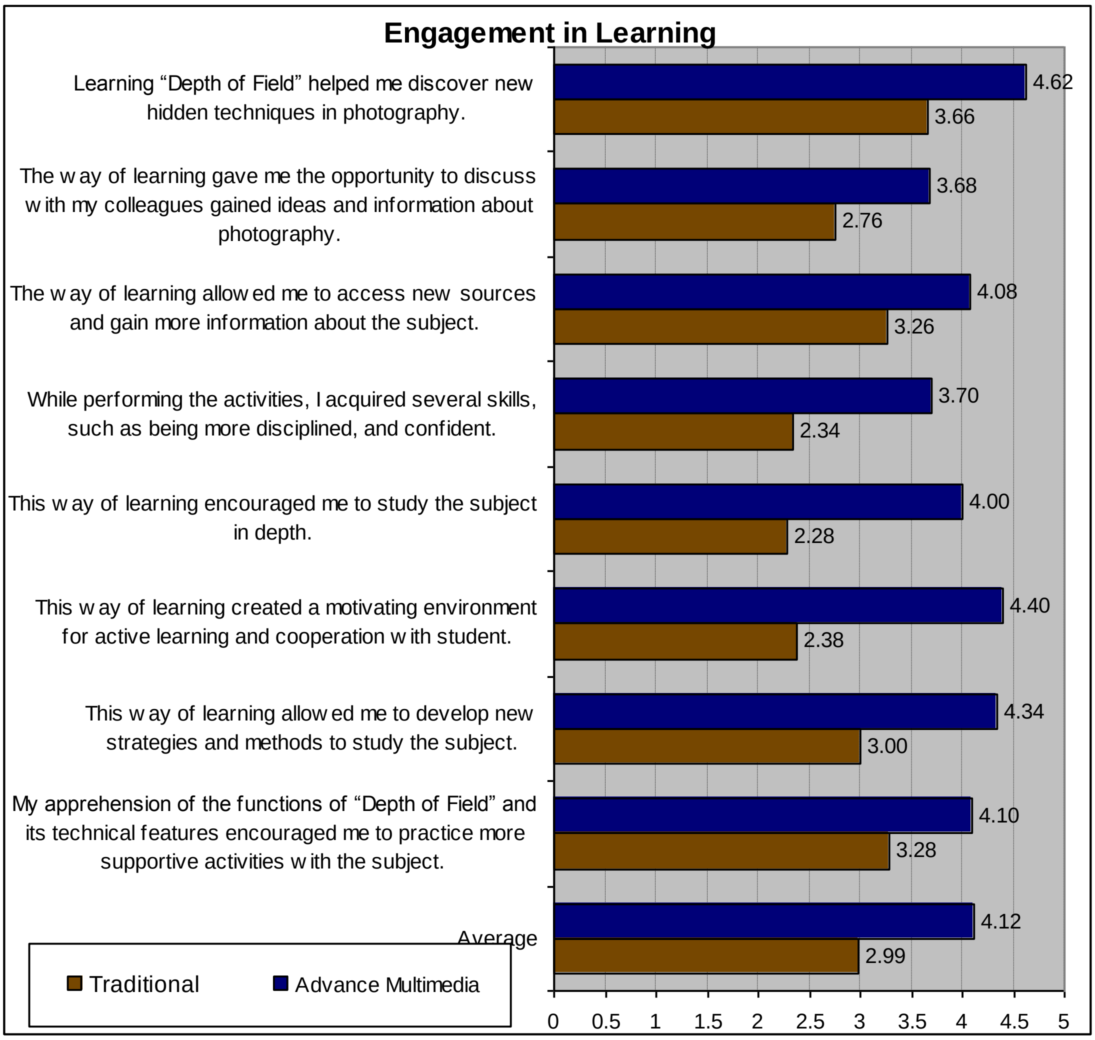


Figure 9.10 Graphic Comparison for Perceptions of Engagement in Learning items

9.7.2.3. Perceptions of Enjoyment in Learning

Table 9-17 shows that the overall average rating of students in the experimental group (42.68) on the ten items in the questionnaire that measure enjoyment in learning was much higher than that of the control group (31.10). The t-test results indicated that the difference between the two groups was statistically highly significant (t=10.601, df = 98, significant at P<0.001). Thus, we can conclude that the students' opinions give further support to reject the rejection of the third hypothesis, which states that advanced multimedia-based learning applications do not give a higher level of learning when compared to traditional approaches in terms of enjoyment in learning. This means that we accept the alternate hypothesis which states that ''Advanced multimedia-based learning applications give a higher level of enjoyment when compared to traditional approaches''.

Effect size was found to be 2.02, which is much higher than the criterion set by Cohen (1993) of (0.80) for deciding that the value is large.

Thus we can conclude that the Experimental group using the e-learning resource has a higher level of enjoyment in learning.

Table 9-17 Comparison of t-test results for perceptions of enjoyment in learning

Group	No.	Mean	Std. Deviation	df	t-test	Sig. (2-tailed)
Control group (Traditional)	50	31.10	5.262	98	-10.601	0.000
Experimental group (Multimedia)	50	42.68	5.655			
Effect size = 2.02						

When considering the average rating of each of the ten items of the questionnaire that measure enjoyment in learning (see Table 9-18 and Figure 9.11 below), we can see that the rating given by the experimental group was much higher than that of the control group on each item.

Table 9-18 Mean for each item for perceptions of enjoyment in learning

Questionnaire Question No.	Perceptions of enjoyment in Learning	
	Control group (Traditional with basic multimedia)	Experimental group (Advanced Multimedia)
19	2.74	4.36
20	3.00	4.20
21	4.14	4.46
22	4.12	4.26
23	2.26	3.80
24	2.26	4.32
25	3.04	4.42
26	3.56	4.40
27	3.02	4.10
28	2.96	4.36
Average	**3.11**	**4.27**

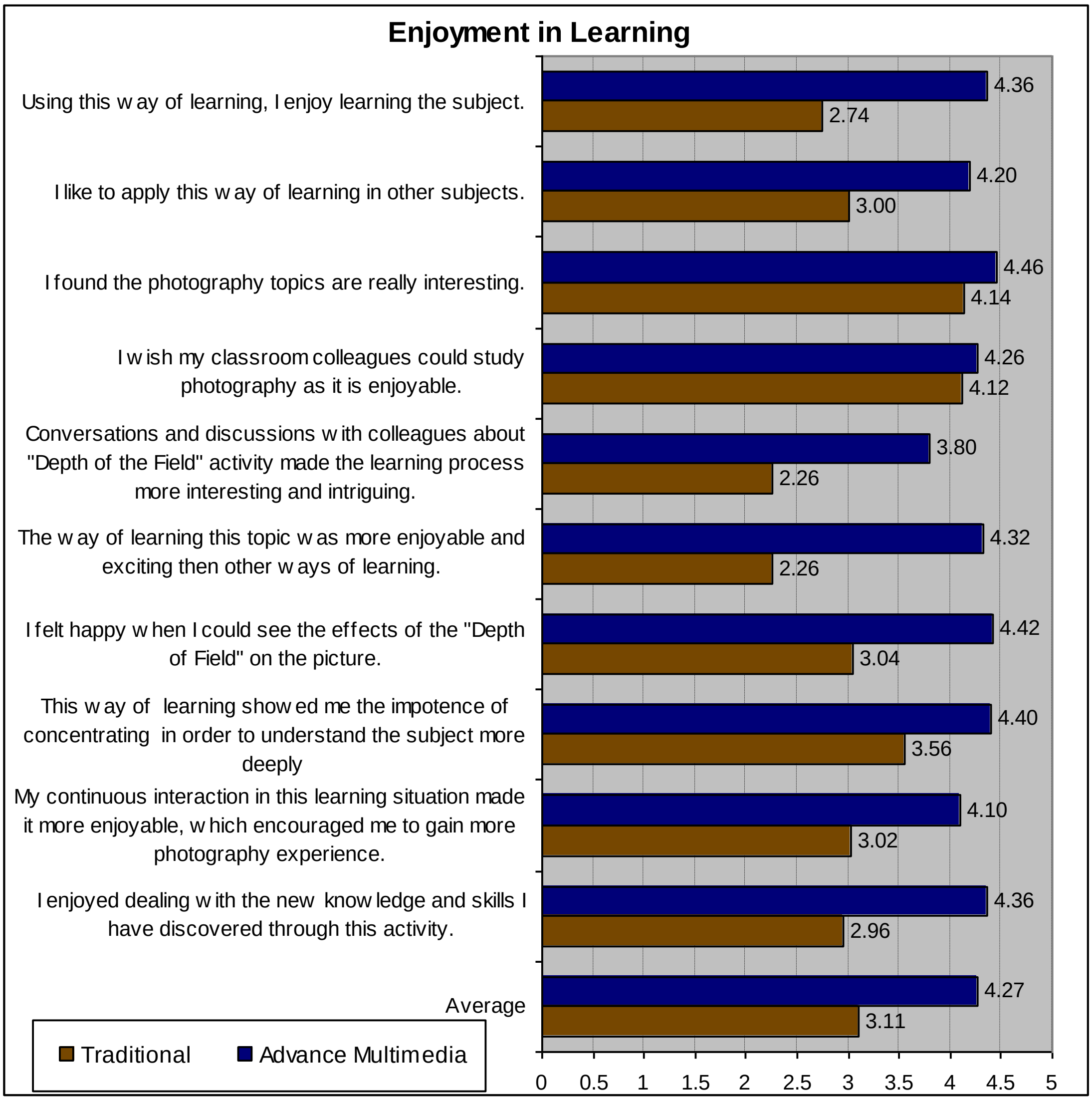


Figure 9.11 Graphic comparison of enjoyment in learning items

9.7.2.4. Result of the Open-ended questions

Students were also asked three open-ended questions. Their comments were grouped and the main ideas presented on each question were summarised. Table 9-19 shows a summary of the main idea regarding each of these questions, along with the percentage of occurrence.

Students' responses to the open-ended questions indicated that the advanced multimedia method (used with the experimental group) helped them gain both better technical photography skills and deeper understanding of the concepts. On the other hand, the traditional method only helped the other group of students (the control group) to understand the theoretical information without giving them the opportunity to have any practical experience.

A high percentage of students (90%) indicated that learning through the control group (traditional approach) deprived them of practical and applied activity in class. However, 88% of students in the experimental group (advanced multimedia approach) used the virtual camera to repeat the learning activity without any additional cost.

The experimental group indicated that they enjoyed the subject, and were engaged in the related activity more than their counterparts in the control group.

In the classroom, the experimental group students each had access to a virtual camera. In the control group, students were allowed to experiment using real cameras but only in groups, due to the limited availability of cameras. Even after the lesson was over, the experimental group students had the opportunity to practice using the virtual camera at any time, but the control group students did not have the opportunity to use the cameras outside class time. This situation is reflected in the students' feedback, in which 84% of the control group students complained about the shortage of cameras. This view is strengthened further by the fact that 79% of the control group students stated that the small number of cameras prevented them from applying what they had been taught. They suggested having more cameras available to practice the related skills.

In further support of the argument above, the researcher emphases the fact that, even if every student in the control group was given a real camera, they would still have difficulty in visualising the technical aspects in relation with each other and the effect they have on the visual scene in the view finder. In contrast, the experimental group, which used the virtual camera, had the benefit of experimentation and visualisation of the technical aspects far beyond what the real camera could offer them, including the visual scene in the view finder.

The control group indicated that they were keen to apply their knowledge to practical activities in their study but they claimed that the shortage of cameras for practice limited them in this. The experimental group recommended promoting teaching and learning other topics using this method.

To sum up, it was clear from students' open responses that there is a sizeable difference between the control and experimental group, in favour of the latter group. The differences are summarised in Table 9-19, which presents a tabulated summary of the open responses of the two groups, together with percentages of the frequencies of these responses.

Table 9-19 Students' comments on the open-ended questions

Q 1	Question	Identify the technical skills in photography that you have acquired through the study of 'Depth of Field' subject
	Control group Traditional Approach group using basic multimedia	❖ 80% of the students learn only theoretical information and knowledge about the factors influencing depth of field
	experimental group Advanced Multimedia group	❖ 81% of students gained better control skills over the depth of field factors of aperture, focal length and distance from the subject. This learned experience was emphasised practically through the virtual camera. ❖ 93%, a high ratio, of students who studied depth of field through the virtual camera said that they were able to understand the three factors of depth of field better.
Q2A	Question	What is your opinion of the way that depth of field is taught and learned with regard to the number and type of activities used in the class?
	Control group Traditional Approach group using basic multimedia	❖ 91% of students said there were no practical and applied activities used to facilitate comprehension in the class
	experimental group	❖ 60% of students stated that the quantity and types of the applied activities clearly facilitated

	Advanced Multimedia group	the process of understanding the subject. ❖ 88% of students said that the varied activities using virtual camera multimedia enabled students to repeat exercises without any cost.
Q2B	Question	What is your opinion of the way depth of field is taught and learned with regard to encouraging students to engage with the subject during the learning process?
	Control group Traditional Approach using basic multimedia group	❖ 78% of students stated that engagement was limited to the teacher's explanation and photo presentation only
	experimental group Advanced Multimedia group	❖ 65% of students felt more engaged in the subject as a result of observing the changes taking place directly in the picture using the virtual camera.
Q2C	Question	What is your opinion of the way depth of field was taught and learned with regard to making the learning process more enjoyable and entertaining?
	Control group Traditional Approach using basic multimedia group	❖ 85% of students said they had no enjoyment or motivation, and that class methodology lacked interaction, thus enjoyment was limited.
	experimental group Advanced Multimedia group	❖ 86% of students stated that using the virtual camera made students enjoy the subject and motivated them to take the next one. ❖ 77% of students said that the high level of interaction and vividness of the virtual images added more enjoyment and stimulated students to learn more.
Q 3	Question	What recommendations do you have for improving the learning of "Depth of Field", being a student of photography?
	Control group Traditional Approach using basic multimedia group	❖ 78% of students who learned the lesson in a traditional way would like to have more applied and practical activities. ❖ 84% of students complained about the shortage of cameras available. ❖ 79% of students stated that the limited number of cameras available prevented them from applying what they had been taught. They suggested having more cameras to practice the skills.
	experimental group Advanced Multimedia	❖ 84% of students recommended promoting teaching and learning other topics using this method.

	group	❖ 62% of students suggested increasing the number of applied activities using a virtual camera. ❖ 76% of students said that the depth of field prototype would be better supported by being both in English and Arabic.

9.8. Summary

This chapter presented the tests and results used for evaluating the depth of field prototype developed in this study, based on advanced multimedia in a photography education model. Three different types of tests were conducted: pedagogical design factors, multimedia design factors and effectiveness of E-learning resources.

The pedagogical design factors test, Test 1, tested the experts' confirmation of the validity of the learning content using a questionnaire. The results confirm a high validity of the learning content as a whole.

The multimedia design factors test, Test 2, tested for confirmation of the effectiveness of the interface and content in terms of usability and accessibility, using a questionnaire. The result confirmed a high level of interface and content effectiveness in both usability and accessibility.

The effectiveness of the E-learning resource involved two different types of tests, namely the pre- and post-test to evaluate achievement, and a questionnaire for surveying students' opinions.

Data analysis indicated that the experimental group was equivalent to the control group in terms of level of knowledge prior to the application of the treatment applied on the experimental group. However, the experimental group outperformed the control group in terms of effectiveness, engagement and enjoyment of learning. The t-test results showed highly significant differences between these groups on the above factors. Consequently, the null hypotheses tested in this study were rejected on each of these factors in favour of the experimental group, in terms of the three factors mentioned. In addition, the improvement in achievement of the experimental group was significantly higher than that of the control group.

Students' open responses indicated that the experimental group helped them to gain skills and understanding regarding the subject of depth of field, whereas the control group only helped them to understand the theoretical information without giving them the chance to have practical experience, engagement, or enjoyment.

In the next chapter the researcher concludes the study with sections on discussion, recommendations and conclusions.

Chapter Ten

Discussion, Recommendations and Conclusions

10. Discussion, Recommendations and Conclusions

10.1. Introduction

This study was aimed at conducting research in order to produce an innovative design model for the effective development of an advanced multimedia learning resource to support the teaching of key aspects of photography, focusing on Bahrain. The specific objectives of this study were to determine the effectiveness of the proposed design model to enhance learning, and to identify where the proposed design model could be adapted to enhance teaching in other countries and subjects.

In the first stage, primary research (reported in Chapter 4) was carried out to identify the fundamental issues and problems faced by both students and teachers of photography. The primary research was conducted with students using a quantitative questionnaire, and with teachers of photography using qualitative interviews both in Bahrain and the United Kingdom. This research had the broader objective of examining and comparing the experience of photography teaching and learning in both countries.

In the second stage (Chapter 5), an evaluation was carried out on existing e-learning resources with a particular focus on photography and the use of interactive multimedia rich environments. The aim of this critical review was to develop design strategies for future e-learning resources using interactive multimedia rich environments (advanced multimedia). The critical review was conducted mainly through the use of a qualitative method by applying a critical review form developed by the researcher and, to a lesser extent, by using a quantitative method through the review of existing e-learning material with an emphasis on photography, which was done by the researcher himself.

In the third stage (Chapter 6), some of the e-learning resources examined in the previous stage were further examined using student feedback from both qualitative and quantitative methods in the form of a questionnaire and informal observation. This was because the critical review conducted by the researcher in the previous stage was quite subjective; hence, the student survey provided an added level of objectivity to the analysis.

In the fourth stage of this study (Chapter 7), a design model based on the ASSURE model was developed by the researcher for using advanced multimedia in photography education. This model was subsequently applied and tested in the development of a prototype for photography lessons.

An advanced multimedia prototype application suitable for the learning and teaching of photography was developed (Chapter 8) to test the validity and effectiveness of the proposed Design Process model. The design processes were applied according to the adapted ASSURE model to develop an advanced multimedia e-learning prototype resource for teaching the concepts of Depth of Field.

Finally, in the fifth stage (Chapter 9), the prototype was tested to evaluate the effectiveness of the Design Model through three different tests: namely, pedagogical design factors, multimedia design factors and the effectiveness of e-learning resources. The following sections present a discussion of the main findings of this study.

10.2. Discussion of the finding from the initial primary research

The results from the primary research stage revealed that both students and teachers agreed that the high numbers of students in class, coupled with poor availability of cameras with accessories, were the main problems in teaching and learning photography. The increase in student numbers was a general situation both in Bahrain and in the United Kingdom. Specifically, the finding showed that the staff-student ratio in photography courses in the University of

Bahrain jumped from 1-31 in the 2000-2001 academic year to 1-74 in the 2006-2007 academic year (UOB timetable, 2000-2007). The increase in student numbers was not supported with an increase in the number of cameras available, thereby creating a shortage of cameras. In fact, it was not feasible to increase the number of SLR cameras due to the high cost.

The main topics that photography students had difficulty with were identified as being Depth of Field and exposure, from both a technical and creative perspective. It is possible that these difficulties were related to, or at the very least compounded by, the lack of equipment.

From these initial results, the researcher proposed that for teaching-learning to be purposeful and effective for the benefit of the students, it needed to be based on a blend of face-to-face classroom-based lectures, duly supplemented by e-learning resources using advanced interactive multimedia such as virtual cameras. This would address the shortage of real cameras and the lack of teachers, as the e-learning resources and virtual cameras would provide opportunities for self-learning anytime and almost anywhere.

Advanced Multimedia is recognized as being more beneficial to students in terms of motivation and learning (Zimmer, 2003), (Teoh & Neo, 2007), (Iskander, 2007), (Albayat, 2007b), (Koh et al., 2010) because it has richer media including more interactivity and vividness, and utilizes different learning experiences. In addition, compared to a traditional approach, advanced multimedia is more helpful in overcoming a shortage of cameras and teachers, and in facilitating engagement and enjoyment in the learning of difficult technical aspects of photography, such as Depth of Field.

The results of the student questionnaire applied in the primary research supports Teoh (2010), who indicated that the effectiveness of multimedia and interactivity as a learning medium clearly enables knowledge transfer and, at the same time, promotes engagement in learning which surpasses its status quo of a mere tool of delivery. Many students who participated in the questionnaire of the primary research had reported high levels of interest resulting from enriching multimedia experience, thus harnessing ownership in self-learning. Based on these findings, it was proposed that new rich media technology should be implemented in teaching and learning photography (Albayat, 2007a).

Irrespective of these positive aspects of advanced multimedia, still it might not be available always to some students, since it needs high speed internet connection for retrieving.

10.3. Discussion of the finding of the critical review, students' feedback and observation of e-learning resources

The initial critical review of e-learning resources currently used in photography revealed that the Photonhead and Kodak resources used the greatest variety of multimedia content. This multimedia content included, for instance text, photographic images, illustrations, sound, animation and simulations.

The overall findings from the student feedback confirmed the findings of the earlier critical review carried out in this study. E-learning resources and components using advanced multimedia obtained higher results compared to those using more basic multimedia in terms of helpfulness of content to learning, level of engagement, and level of enjoyment or fun.

The findings from the critical review, student feedback and observation of the e-learning resources provided the evidence to support the proposal and related hypothesis that advanced multimedia can be used to provide more effective learning and higher levels of engagement and enjoyment. Furthermore, they provided the basis for the development of a new design model using the most advanced multimedia possible in order to be effective. This design model was then tested through the evaluation of a prototype.

10.4. Discussion of the findings of the prototype evaluation in terms of pedagogic and design factors

The pedagogic design factor results (Test one) revealed that expert photography teachers rated the content of the e-learning resource highly, which meant that the prototype and all individual learning activities were appropriate. The experts indicated that the learning goals and outcome were clear, the phrasing of the items was suitable for the purpose, and there was a good link and relationship between each learning outcome which reflected the prototype content. Their responses pointed to the fact that the content was accurate, relevant and well-structured.

The multimedia design factors results (Test two) indicated that both experts and students agreed that there were no major design problems. Experts and students found that the design of the prototype had a high level of fun or enjoyment, was very easy to navigate, easy to read, had clear icons and directions, and used color effectively.

10.5. Discussion of the results of the effectiveness of the prototype e-learning resource and design model

The results of Test three, in which the application was tested with students, are presented in terms of learning effectiveness, engagement and enjoyment.

10.5.1. Discussion of the results on the effectiveness of learning

The effectiveness of learning involved two different student tests, namely the pre- and post-test, to evaluate achievement, and a questionnaire to find out the students' opinions.

The improvement in achievement (pre-test and post-test) indicated that, while both of the approaches (one using advanced multimedia based on the new design model, and the other using traditional media) yielded changes and improvement, the experimental group which used the advanced multimedia approach obtained a significantly (t=6.164, df=98, sig. at P< 0.001) higher mean value of (5.60), as compared to the control group which used the traditional media, where the mean value obtained was (4.02). These results seem to indicate that the experimental group demonstrated a significantly greater improvement in achievement compared to the control group. Consequently the first hypothesis, which stated that advanced multimedia- based learning applications do not give a higher level of learning when compared to traditional approaches in terms of effectiveness on learning, was rejected.

Data analysis of the first ten items in the questionnaire that measured the effectiveness of learning revealed that the average rating given by the experimental group (43.36) was much higher than that of the control group (33.18). The t-test results indicated that the difference between the two groups was statistically significant (t=9.678, df = 98, significant at P<0.001). This provided further evidence to reject the first hypothesis. The test result also provided evidence to support the validity of the new design model in terms of learning effectiveness.

In addition, qualitative evidence from students' comments confirmed these conclusions, that the advanced multimedia application based on the design model provided a more effective learning experience.

The results referred to above, together with the conclusions from this study seem to support previous research, which has found that advanced multimedia helps the learner achieve the learning objective and recall the information, skill, or behaviour that was learned (Dick & Carey, 1992). Cunliffe and Elliott (2003) have stated that interactive multimedia provides a range of interactivity for the benefit of effective learning-teaching, while Wolfgram (1994) commented that "People only remember 15 per cent of what they hear and 25 per cent of what they see, but they remember 60 per cent of what they interact with". Interactive multimedia has also been found to be a very adaptive tool capable of changing attitude or belief (Stephanae, 1994).

Alick's (1999) work is also supported by the findings of this study, in that he stated that well-design multimedia instruction enables students to have more privacy, allowing them the experience of trial and error, failing tests and asking embarrassing questions without disclosure. Advanced multimedia approaches enable and enhance the human computer relation in motivating learning for improved and effective learning processes, as also suggested by Keong et al. (2009).

Previous studies by Savage and Vogel (1996) are also confirmed by the results of this study in that an advanced multimedia approach seems to supports the learner in many ways, such as fast and effective conveyance of information and keeping the students interested in learning. Different learning styles and preferences are also well supported by this approach (Moore et al., 1996), and it encourages learners to interact both behaviorally and cognitively (Keating, 1997). This research also supports the claim that advanced multimedia provides a vehicle for a richer learning context (Moore et al., 1996), while providing a motivating environment (Newby et al., 1996).

10.5.2. Discussion of the results regarding engagement in learning

Data analysis of the second eight items in the questionnaire, which measured engagement in learning, indicated that the average rating given by the experimental group (32.92) was much higher than that of the control group (23.96). The t-test results showed that the difference between the two groups was statistically significant (t=9.570, df = 98, significant at $P<0.001$). Thus the second hypothesis, which stated that advanced multimedia based learning applications do not give a higher level of learning when compared to traditional approaches in terms of engagement in learning, was rejected.

In addition, qualitative evidence from the students' comments supported this result, as 65% of students from the experimental group (advanced multimedia method) felt more engaged in the subject as a result of using the virtual camera and observing the changes taking place directly in the pictures. On the other hand, 78% of students in the control group (traditional approach) felt that their engagement was limited to the teacher's explanation and photo presentation only.

These results support previous studies (Lin & Gregor, 2006; Marks, cited in Mitchell, 2003) in that authentic multimedia based instructional work can lead to higher levels of student engagement, and increase involvement. This is because as more senses and activity are required of the student, more learning and progress occurs (Alick, 1999).

10.5.3. Discussion of the results of enjoyment in learning

Data analysis of the third ten items in the questionnaire, which measured enjoyment in learning, revealed that the average rating given by the experimental group (42.68) was much higher than that of the control group (31.10). The t-test results indicated that the difference between the two groups was statistically significant (t=10.601, df = 98, significant at $P<0.001$). Therefore the third hypothesis, which stated that advanced multimedia-based learning applications do not give a higher level of learning when compared to traditional approaches in terms of enjoyment in learning, was also rejected.

Qualitative evidence from students' comments further supported this result in that 86% of the students using the advanced multimedia method (the experimental group), in the form of the virtual camera, enjoyed studying the subject and were stimulated to take the next lesson. On the other hand, 85% of the control group students reported a lack of enjoyment or stimulation as the classroom methodology was not enjoyable and has limited interaction.

The results presented above support previous studies in terms of the positive effect of multimedia on students' enjoyment of learning. Iskander's (2007) findings are upheld by the present study as he indicated that multimedia enhances the use of guided simulation (one component of advanced multimedia) and related software which motivates and stimulates students' learning and promotes their understanding of photography. Research carried out by Alick (1999) is also supported by the findings of this study, given that he found increased motivation in students as a result of well-designed multimedia instruction, through immediate feedback, multisensory involvement and greater enjoyment of learning.

To sum up, it is evident that in all three major factors (effectiveness, engagement, and enjoyment in learning) the results are very encouraging and seem to support the use of this design model in order to employ advanced multimedia to teach students about the difficult and complex technical aspects of photography.

As stated previously, one of the current issues for photography teaching in Bahrain is the lack of staff, cameras and equipment. The results of this study indicate that this problem can be addressed, to some extent, by using the virtual camera developed for the new advanced multimedia design model applied in this study. The main reason for this is that using the virtual camera in classes with large number of students compensates for the lack of staff.

The above results reveal that the design model seams that it enhance learning of students, the topic on photography education at the university. Such results fulfill the first specific objective of this study.

Regarding the second specific objective of this study, it is clear that the design model developed in this study is fixable that it could be adapted to enhance teaching and learning at other universities wherever shortage of equipments and faculty members exist. The design model developed in this study was based on ASSURE which is a very general model that is designed to be used as a guide for various types of technological teaching tools, including the many forms of computer programs and it is general enough to be applied in many fields of higher education.

10.6. Contributions to Knowledge

This study has contributed a great deal of valuable knowledge and information in the particular field of study. The researcher was able to compile a vast amount of information from both students and photography teachers, and a number of different methods were used in this task - interview, questionnaire survey, observation, critical review and student feedback among others.

The entire study was conducted in a way that it would objectively evaluate different dimensions of photography teaching and learning. The design model for teaching photography using advanced multimedia applied in this investigation provided many insights into the teaching and learning of the technicalities of photography in the area of depth of field. These new insights and information can be used to develop future advanced multimedia contents for teaching photography.
Specific contributions to knowledge are now presented in detail.

10.6.1. New definition of Advanced Multimedia

The researcher used the definition of Albayat (2007c) to Advanced Multimedia which is as follows: “In a teaching-learning environment, ‘Advanced Multimedia’ can be defined as a combination of rich interactive media, which provides high levels of interactivity and vividness. It uses advanced media hardware and software tools including Virtual Reality and Simulation”. This definition is based on the classification of various media technologies, in terms of vividness and interactivity, by Steuer (1993), which is already discussed in detail on chapter 2, section 2.5.1of this study.

10.6.2. Development of a new Design Model

The researcher has developed a new theoretical design model in order to apply advanced multimedia in photography education. This was subsequently used, tested and validated through the development of a prototype in photography lessons using a step-by-step approach.

This design model provides a framework for designing, implementing, and evaluating an e-learning resource in photography. The researcher chose the ASSURE model as the basis for creating a new model in order to use advanced multimedia to develop an effective student learning experience. The existing ASSURE model provided insufficient guidance on matching the appropriate media and learning styles Therefore, the researcher proposed a new design model for using Advanced Multimedia in Photography Education (AMPE) in photography courses, which combines the existing ASSURE model and Laurillard’s Conversational Framework and adding insights from Steuer's Classification Model and the research.

The researcher discovered that step three of the ASSURE model (media and technology selection) needed to be modified in a way that the instructor would be assisted by a guide or framework to help select the appropriate forms of media technology to provide a suitable learning experience.

In order to do this, the researcher also adopted and adapted Laurillard's conversational framework (2002) to enable the instructor to select the appropriate media technology, from basic media to advanced media, for each learning experience. The researcher was not satisfied that Laurillard’s framework adequately incorporated new advanced media technology. Thus, this conversational framework was further developed using the work of Steuer's Classification Model (1993) to differentiate the various types of multimedia by focusing on levels of vividness and interactivity. The researcher used Steuer's Classification Model to develop the design model for this stage. Moreover, the findings of this study were also incorporated into the design model in terms of recommending the selection of the most advanced multimedia types in order to achieve the highest level of learning effectiveness, engagement and enjoyment, assuming that the necessary resources were available. The findings enabled the researcher to accept all the three alternate hypotheses, which are:

Hypothesis 1

Ha: Advanced multimedia-based learning applications give a higher level of learning when compared to traditional approaches.

Hypothesis 2

Ha: Advanced multimedia-based learning applications give a higher level of engagement when compared to traditional approaches.

Hypothesis 3

Ha: Advanced multimedia-based learning applications give a higher level of enjoyment when compared to traditional approaches.

The design model can be extended to be used in teaching other topics of photography, such as focusing techniques, rule of third, lighting techniques, and achieving the desired exposure with a combination of shutter speed and exposure. In addition, the design model could possibly be adapted to any other area of teaching, especially practical courses in the science and engineering fields.

For this purpose, the researcher plans to introduce the design model through workshops, seminars and training sessions for staff from different department within the University of Bahrain, upon completion of this study. The technology transfer will be done using Depth of Field as an example.

10.6.3. New design processes and methods

The researcher has formulated a prototype for teaching and learning Depth of Field based on the new design model. In order to experimentally test and validate the proposed model, the prototype was deployed in the classroom as part of the field work of this study to test its effectiveness through achievement of learning outcomes, and end-user feedback.

A prototype was built to validate the design model which was developed based on the Advanced Multimedia in Photography Education (AMPE) model. The adapted model provides a framework for selecting and matching the appropriate media and learning styles based on a set of learning outcomes corresponding to an e-learning resource in photography, which was later field tested with students. The design process of the prototype model started from a low level learning experience, and advanced to a high level; that is, Narrative -> Interactive -> Simulative -> Evaluative.

The functional prototype was developed using advanced multimedia for photography education in the area of Depth of Field in an attempt to implement and test the new design model. Design processes were applied according to the adapted AMPE model to develop a new advanced multimedia e-learning resource for teaching the concept of Depth of Field. The new knowledge embedded in the procedures involved in developing and producing the prototype is shown in Chapter 8.

This new design process and the flowchart used for the creation of the prototype provide a valuable new design-based knowledge resource for future designers and researchers.

10.6.4. New virtual camera e-learning resource

A new virtual camera-based (2D simulation) learning resource was designed and developed as part of this research, and it incorporates new simplified controls simulating any standard DSLR camera. Common controls and factors of digital photography such as aperture, focal length of lens, and distance from the photographed subject are available in the virtual camera to portray, and educate students about, the impact of these factors on the photo and the effect on Depth of Field in it. The features of the virtual camera include new dynamic programming systems, which enable settings to be changed easily and which allow dynamic changes to be made to the images for different photographic exercises and topics in relation to the setting of aperture, focal length of lens and distance from the subject. As such, any inexperienced teacher can use and manage the virtual camera easily without any complex programming.

Upon completion of this study, the researcher is interested in publishing the findings to introduce the application of the virtual camera to other lecturers and universities in Bahrain and the region for the teaching of photography. The researcher has already had the opportunity to introduce the virtual camera application at Sultan Qaboos University, in Oman during a recent visit there to conduct workshops in photography, and keen interest was shown in the application.

10.7. Dissemination of knowledge gained

Throughout the course of this study, the researcher was able accumulate a great deal of knowledge. Moreover, the researcher had the opportunity to publish two conference papers and one journal article, all of which are highlighted below.

1st Publication: Conference paper

Title: “Teacher utilization of technology-rich learning environments. A critical analysis and review of e-learning materials for teaching photography to undergraduate students”, World Conference on Educational Multimedia, Hypermedia and Telecommunications (EDMEDIA) 2007, Vancouver, Canada June 25, 2007, AACE . The publication is attached as Appendix 10.1

2nd Publication: Conference paper

Title: “Issues in teaching and learning photography: Teachers’ and students’ perspective in Bahrain and UK”, ICT-Learn2007, Sixth International Internet Education Conference, September 2-4, 2007, Ramses Hilton, Cairo, Egypt. The publication is attached as Appendix 10.2

3rd Publication: Journal article

Title: “The Development of a Design Model for Learning and Teaching Photography in the Classroom Using Interactive Multimedia”, Malaysian Journal of Educational Technology, Volume 7, Number 1, June 2007, ISSN: 1675-0292. The publication is attached as Appendix 10.3 in the CD-ROM.

10.8. Limitations of the study

Several limitations can be commented on regarding this piece of research. First of all, the research was conducted at only two universities in Bahrain (University of Bahrain and Royal University – a female university), whereas including other universities in Bahrain might give better representation from Bahraini students. This would have enabled the researcher to work towards more comprehensive findings which represent students all over Bahrain. Furthermore, only the second-year students in the two universities participated in this study. A wider study would comprise students at different stages of their studies.

Another limitation of the study could well be the validity and reliability of the investigations conducted. However, the researcher has attempted to minimise the impact by using multiple methods of data collection to complete this study. The triangulation methodology was widely used throughout to ensure data was collected from different sources, such as feedback, comments, interviews, critical review, survey and observation.

It is known that in some studies the 'novelty effect' can influence how respondents react to a system (Clark & Sugrue, 1988). However it is the author's view that in this study the Educational Technology students have had some exposure to technology of this type and such effect would be minimal.

In addition to the above limitations, no account has been taken into consideration for extended effect of the treatment over time. No re-testing took place at a later date (the difference in recall might diminish over time; remain the same, or even increase).

A final comment on limitations has to do with limited resources. In order to develop the prototype, the researcher was obliged to invest his own skills, time and money. With more resources, an improved prototype could no doubt be developed.

10.9. Significance of the Study

This study has impact and significance on different factors affecting teaching and learning with advanced multimedia, and these are as follows:

10.9.1. For the researcher

The researcher has twenty-seven years of experience teaching photography in Bahrain, and the completion of this study has enabled the researcher to contribute in three major areas:

Firstly, the researcher has contributed through the effective development of a design model, and production of an innovative prototype for teaching and learning key aspects of photography. Moreover, this study helped in solving the lack of resources necessary for teaching photography to large groups of students with limited numbers of cameras in Bahrain.

Secondly, the researcher determined the effectiveness of the proposed design model in enhancing learning.

Thirdly, the researcher identified where the proposed design model could be adapted to enhance teaching in other areas.

10.9.2. For photography teachers

It is hoped that photography teachers can benefit greatly from this study as a more effective teaching method has been made available for their teaching practice. This will help teachers to enable more students to understand the complexities of photography topics and this, in turn, should make teaching photography more satisfying for the teachers. Likewise, the advanced multimedia method of teaching should help them to overcome some of the pressures associated with the lack of photography staff and equipment.

10.9.3. For photography students

It is hoped that this study will be beneficial for photography students as the new proposed method and associated application would appear to be more enjoyable and increase engagement in learning, while improving the level of learning. The advanced multimedia techniques employed should enable students to independently understand key points of photography much more easily and faster. It should also allow them to have more privacy so that trial and error, failing tests and asking embarrassing questions can all be experienced without disclosure. The students can use the advanced multimedia learning method whenever they need and want, as well as in a variety of places. Moreover, as with staff, it should help to address the students’ problems associated with limited staff and equipment.

10.9.4. For the universities

The final beneficiaries of this research are universities as the outcomes of this study should help to improve the learning and teaching of photography. The successful application of the advanced multimedia method has the potential to improve effectiveness and efficiency for both students and teachers in learning and teaching photography. This, in turn, can help to overcome the shortage of staff, the lack of equipment, and the heavy dependence on foreign teachers to teach photography in all Bahraini Universities.

10.10. Recommendations

The recommendations take a holistic approach incorporating all the comments, feedback and data analyses obtained as part of this study. The recommendations are directed at three areas and are set out in the following sections.

10.10.1. For the university

Universities are recommended to deploy advanced multimedia as a viable tool to overcome the current overcrowding of classes, the lack of resources and equipment, and the shortage of faculty members for teaching photography.

10.10.2. For photography teachers

Photography teachers are recommended to enroll in training programmes for developing and using advanced multimedia concepts and approaches. While some photography teachers have a good knowledge of photography, they are unable to interact with, or capitalize much on, advanced multimedia resources. In order to equip teachers with the necessary advanced multimedia-based teaching skills, the following recommendations should be applied:

- Conduct advanced multimedia training programmes for current teachers
- Develop awareness programmes for teachers

- Introduce an advanced multimedia teaching module for all teachers, to facilitate their photography teaching.
- Monitor the performance of teachers using advanced multimedia applications as part of a refresher course for active teaching personnel

10.10.3. Curricula of photography courses

The curricula of photography courses have to be changed to include advanced multimedia approaches, including sound, animation and simulation. New course curricula must include a higher level of theoretical and practical aspects of photography using advanced multimedia concepts. To achieve this objective, the following recommendations should be taken into consideration:

- Include advanced multimedia teaching materials for photography education.
- Build in simulation, illustration, sound and animation as part of the teaching curriculum. Sound, for example, gives the feeling of using a real camera when the candidate is clicking the button of the virtual camera.
- Extend the scope of advanced multimedia to cover all other areas of photography, such as focusing techniques, rule of third, lighting techniques and achieve the desired exposure by a combination of shutter speed and exposure.

10.11. Suggestions for future research

Researchers are recommended to further test this study at other universities in Bahrain, in order to assess the application and relevance of the results. Furthermore, future studies can also include other areas of photography: lighting techniques, lighting exposure, relationship between speed shutter and aperture, camera parts and the relationship between them.

Other researchers could test a 3D Virtual camera covering Depth of Field and other aspects of photography. More investigation might also be carried out into whether the new design model could be applied to areas outside of photography.

10.12. Conclusion

The aim of this study was to identify and develop efficient methods for using advanced multimedia in photography teaching and learning especially among Bahraini students at the university level. The findings of this investigation, together with the model and hypotheses testing, have enabled the researcher to safely successfully achieve this aim.

The study was able to empirically demonstrate the efficiency of the advanced multimedia in comparison to basic multimedia and a traditional approach, in terms of learning and teaching photography. Moreover, it has developed a new design model for its successful implementation.

The overall finding of this study is that the advanced multimedia enhances effectiveness, engagement, and enjoyment in learning. These results are very encouraging for the use of advanced multimedia to teach students on the difficult and complex technical aspects of photography, especially at universities of comparable condition in Bahrain. The main results have then been translated into actionable recommendations to be implemented, so as to enable these efforts to bear fruit among students, and to overcome the initial problem of a high number of students with a low number of teachers. The study has also demonstrated that the virtual camera is a suitable solution for the lack of cameras in the classroom environment, and can help in the teaching of difficult technical photographic knowledge in an efficient and practical manner.

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Appendices

Appendices

Appendix 4-1 Preliminary study Student Feedback Survey

Faculty of Art and Design

QUESTIONNAIRE

With students

The Development of a Design Model for the Teaching of Photography Using Advanced Multimedia

This questionnaire is part of a process to determine current' difficulties and problems faced by students on photography courses and identification of a suitable subject area for development.

The researcher strictly promises confidentiality of all information disclosed. Anonymity is also guaranteed.

Please tick the appropriate response that best describes your opinion. In instances where spaces have been provided, kindly write down your opinion. At the end of the questionnaire please write down any additional information you may want to give

Full Name:(option)	
Gender : Male ☐ Female ☐	Address :
Age: Less than 20 ☐ 20-25☐ 6-30☐ Over 30☐	
Nationality:	
Course Name :	
Subject :	
Email Address:	
What is your previous photography experience : None ☐ **Family snaps** ☐ **GCCE Photography** ☐ **A' Level Photography** ☐ **Other Please state**	

I would now like to get some background details from you.

• How many months / years of experience do you have in photography? **None**☐ Less than 6 Months☐ From 6 to12 Months☐ 1 to2 Years☐ More than 2 year☐
• Reason for attending photography course? Hobby ☐ Course Requirement ☐ Others ☐ …………….

3a- What difficulties and problems do you face when studying photography courses?		Very easy	Easy	Not Sure	Difficult	Very difficult
1	Grasping the technical aspects					
2	Grasping the artistic aspects					
3	Grasping the historical aspects					
4	High student numbers in class					
5	Applying the techniques demonstrated					
6	Access to resources					
7	Student interaction during class					
8	Access to outdoor photography activities					
9	Confidence in taking photos of people					
10	Confidence in taking photos outdoors					
11	Cultural concerns taking photographs					
12	Religion concerns taking photographs					
13	Gender concerns taking photographs					
14	Camera availability					
15	Camera accessories availability					
16	Material costs					
17	Availability of laboratories					
18	Understanding the teacher					
19	Others: Please state ……………					

3b- What do you consider to be the main the difficulty or problem studying photography and why?

4a- How easy did you find it to grasp the following technical aspects of photography?	Very easy	Easy	Not Sure	Difficult	Very difficult
☐ Lenses					
☐ Shutter speed					
☐ Aperture					
☐ Depth of field					
☐ Exposure and daylight					
☐ Exposure and indoor light					
☐ Exposure and flash					
☐ Loading the film					
☐ Use of view finder					
☐ Focusing Techniques					
☐ Tripod					
☐ ISO Rating					
☐ Others: Please state …					

4b- Which technical aspect was the most difficult to learn and why?

5a- How easy was it for you to grasp the following artistic aspects of Photography?	Very easy	Easy	Not Sure	Difficult	Very difficult
☐ The lens and picture perspective					
☐ The Rule of Thirds					
☐ Freeze and blur motion					

☐ Achieving desired exposure					
☐ Creative use of depth of field					
☐ Framing Techniques					
☐ Lighting Techniques					
☐ Choice of film					
☐ Others: Please state …					

5b- Which artistic aspect was the most difficult to learn and why?

6a-How often do you use the Following media to learn about photography	Always	Usually	Sometimes	Seldom	Never
☐ Books					
☐ Photography Magazine					
☐ Exhibitions					
☐ Photos examples					
☐ Workshops					
☐ Video					
☐ CD-Rom					
☐ Internet					
☐ Other photographers					
☐ Others: Please state …					

6b- Which of these have you found is the most useful, why and how did it help?

7a- How useful do you think the Following advanced media resources could be to help you when studying photography?	Very Useful	Useful	Do not Know	Not Useful	Not Useful at all
☐ Interactive Multimedia CD-Rom.					
☐ Interactive website (Internet).					
☐ 3D Animation.					
☐ Virtual Reality					
☐ Video					
☐ Virtual Camera					
☐ Others: Please state …………					

7b- Which media resource(s) do you think would be the most useful and what aspect of study in Photography do you think they could help you with the most?

Appendix 4-2 Preliminary study Teacher Interview

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Faculty of Art and Design

Interviews

with relevant members of the photographic community

The Development of a Design Model for the Teaching of Photography Using Advanced Multimedia

This Interview is part of a process to determine current' difficulties and problems faced by students on photography courses and identification of suitable areas for the use of advanced multimedia.

Please tick the appropriate response that best describes your opinion

Respondent Details	
Full Name:	Job Title:
Gender : Male ☐ Female ☐	Address :
Age: Less than 30 ☐ 31-40☐ 41-50☐ Over 51☐	
Nationality:	
Telephone Number:	
Email Address:	

I would now like to get some background details from you

- What is your formal photography qualification?
- How many years have you taught photography?
- Which levels of students do you teach?
- What aspects do you teach on your introduction to photography course
- What is your class size?

Interviewer Questions

Q1- What is your preferred class size?

Q2- What kind of problem do you face in teaching large groups?

Q3- How would you solve such problems?

Q4-What media resources do you currently use in teaching Photography?	Frequency of use				
	Always	Usually	Sometimes	Seldom	Never
☐ Books , notes					
☐ Diagrams.					
☐ Photos examples					
☐ Media presentation					
☐ Video					
☐ Internet					
☐ Others: ………………					

Q5- State the type of Problems you face when teaching **<u>technical</u>** aspects of Photography?

Q6- State the type of Problems you face when teaching **<u>artistic</u>** aspects of Photography?

Q7-**Suggest possible solutions for such problems?**						
Q8-What are the main problems and difficulties students experience in learning Photography?						
Q9-How useful do you think the following advanced multimedia could be in teaching photography?	Very Useful	Useful	Do not Know	Not Useful	Not Useful at all	State reasons for your responses (useful or not useful)? Including how they could best help
☐ Interactive Multimedia CD-Rom.						
☐ Interactive website (Internet).						
☐ 3D Animation.						
☐ Virtual Reality						
☐ Streaming video						
☐ Virtual Camera						
☐ Others: Please state ………………						
10. Are there any further comments you would like to make? (Please comment)						

Appendix 5-1 Validity testing panel

No.	**Name**	**Title**	**Institute**
1	Samir Ellia El-Komos	Associate Professor of Curriculum and Instruction	College of Education University of Bahrain – Kingdom of Bahrain
2	Jehan Al-Omran	Associate Professor of Educational Psychology	
3	Muain Al-jamlan	Professor of Educational Technology	
4	Ali Sharaf Musawi	Associate Professor of Educational Technology	Sultan Qaboos University - Oman
5	Naser H. Almosawi	Associate Professor of Curriculum and Instruction	Curriculum Expert / UNESCO

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Faculty of Art and Design

The Development of a Design Model for the Teaching of Photography Using Advanced Multimedia

Critical review of existing e-learning material with an emphasis on photography

Please Rate this website using the following Rating Code:

5= Very Good. 4= Good. 3= Fair. 2= Poor. 1= Very Poor. N/A Not Applicable

1	**General Design Factors**						
	Criteria	**5**	**4**	**3**	**2**	**1**	**N/A**
1.1	Page organization/layout						
1.2	Ease of navigation						
1.3	Organization of information						
1.4	Clarity of instructions						
1.5	Ability to search and find the information						
1.6	Ability to identify the site purpose of from the first page						
1.7	Range of functions and information available						
2	**Pedagogical Design Factors**						
	Criteria	**5**	**4**	**3**	**2**	**1**	**N/A**
2.1	Clarity of objectives (learning outcomes)						
2.2	Extent to which the content reflects the objectives.						
2.3	Extent to which learning activities relate to the objectives.						
2.4	Quality of feedback provided on success in learning activities						

2.5	The website's ability to motivate learners' attention						
2.6	Provision of progressively more difficult tasks						
2.7	Ability to deliver content in multi languages						
2.8	Ability to interrupt application at any stage						
2.9	Extent to which the website provides clear expectations of what the learner is required to do during the study						
2.10	Appropriateness of multimedia components to the learning experience.						
2.11	Effectiveness of sites in meeting learning objectives						
2.12	Ability to work through topics step by step						
2.13	Ability to retrace steps						
2.14	Ability to work through topics in order determined by user						
2.15	Provision of help and guidance on how to use the application						

3	**Type of learning experience and media used (see 2nd form)**					
	Select the learning experience used in the e-learning material and the media used			Rate the media used with the following Rating from 5 = very effective to 1= ineffective		**Comments**
	Learning Experience	Use	**Multimedia Technology used**	**3A- Achieving learning outcome**	**3B- Level of Motivation**	
3.1	Attending, apprehending			Using a rubric form as a scoring guide to describe the levels of learning outcome. Refer to Appendix **5.3.** Section A1	Using a rubric form as a scoring guide to describe the levels of motivation. Refer to Appendix **5.4** Section B1	
3.2	Investigating, exploring			Using a rubric form as a scoring guide to describe the levels of learning outcome. Refer to Appendix **5.3.** Section A2	Using a rubric form as a scoring guide to describe the levels of motivation. Refer to Appendix **5.4** Section B2	
3.3	Discussing, debating					
3.4	Experimenting, Practicing					
3.5	Articulating, expressing					

4	**Effectiveness of Multimedia Components**	Text	Photographic	Illustrations	Sound	Animations	Simulations
4.1	Ease of use						
4.2	Clarity of content						
4.3	Level of engagement						
4.4	Level of enjoyment and fun						
4.5	Level of learning						
Comments							
4.1							
4.2							
4.3							
4.4							

Please rate the following for each question using the following

Rating code: **5= Very Good. 4= Good. 3= Fair. 2= Poor. 1= Very Poor. N/A Not Applicable**

5	**Criteria**	**Rating**					
	Overall rating of the website	**5**	**4**	**3**	**2**	**1**	**N/A**
5.1	Use of advanced multimedia e.g. video, animation and simulation, etc. as a cognitive learning tool.						
5.2	Overall effectiveness of application as learning aid						
	Comments						
5.1							
5.2							

Appendix 5-3 Achieving learning outcome

3A Achieving learning outcome guide				
Type of learning experience and media used				
Rate the media used with the following Rating from 5 = very effective 4= effective 3= fair effective 2= less effective 1= ineffective				
Select the learning experience used in the e-learning material and the multimedia used				
Criteria		**2.1 Attending, apprehending**	**2.2 Investigation / exploring**	**Comments**
		A1	A2	
1-	Facilitating the learning experience.			
2-	Enhance learning.			
3-	Delivering methods according to content and target group.			
4-	Ensuring the positive role of learner			
5-	Developing learner attitude to word self study			
6-	Reinforcing the content objective			
7-	Showing awareness of the impact of learning style			
8-	Providing feedback			
	Average rate			

Appendix 5-4 Level of Motivation

<table>
<tr><th colspan="5">3B Level of Motivation guide</th></tr>
<tr><th colspan="5">Type of learning experience and media used</th></tr>
<tr><th colspan="5">Rate the media used with the following Rating from
5 = very effective 4= effective 3= fair effective 2= less effective 1= ineffective</th></tr>
<tr><th colspan="5">Select the learning experience used in the e-learning material and the multimedia used</th></tr>
<tr><th colspan="2" rowspan="2">Criteria</th><th>2.1 Attending, apprehending</th><th>2.2 Investigation / exploring</th><th rowspan="2">Comments</th></tr>
<tr><th>B1</th><th>B2</th></tr>
<tr><td>1-</td><td>Level of attention</td><td></td><td></td><td></td></tr>
<tr><td>2-</td><td>Interaction</td><td></td><td></td><td></td></tr>
<tr><td>3-</td><td>Time of involvement</td><td></td><td></td><td></td></tr>
<tr><td>4-</td><td>Number of media technology used in the resource</td><td></td><td></td><td></td></tr>
<tr><td>5-</td><td>Feedback</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Average rate</td><td></td><td></td><td></td></tr>
</table>

Appendix 6-1 Analysis of Students' Comments

	The major strengths of learning resources:	The resource	**Percentage of Students**
1	Good interaction and feedback with the content.	Kodak	42 %
2	Interaction with learning activity of the website in an attractive way.	Kodak	47%
3	Excellent usage of multimedia components such as sound and simulation.	Kodak	42%
4	Engaging with interactive learning activity	Kodak	55%
		Photonhead	53%
5	Learning some difficult aspects of photography in an excellent way.	Kodak	51%
		Photonhead	57%
		Virtual Studio	42%
6	Interaction with the virtual camera gives the learner a feeling that they are present at that event when they are taking the picture.	Kodak	62 %
		Photonhead	42 %
7	Virtual environment of the learning activity gives the user a feeling of reality.	Virtual studio	54 %
8	Reliance on training and experiment in the learning process	Virtual studio	53%
9	The website is good for the experienced but not so good for beginners because of its limited imagination.	Liquid Sculpture	42 %
10	Presence of several educational links.	Normankoren	63%
	The major weaknesses of learning resources:		
1	Managing the headings and subheadings in order.	Virtual studio	19%
		Normankoren	21%
2	Limitation of usage of rich multimedia	Normankoren	21%
		Liquid Sculpture	19 %

3	It does not contain sufficient learning activities.	Normankoren	37 %
4	Lack of interaction and feedback.	Normankoren	33 %
	To improve the learning resources		
1	Gives the virtual studio more reality by using real pictures	Virtual Studio	33 %
2	Increase the interactive learning activities	Photonhead	22 %
3	Increase the use of an interactive multimedia such as simulation, VR Camera.	Photonhead	23 %
4	More reliance on using real pictures rather than wire frame objects (polygon), due to lack of vividness	Liquid Sculpture	35 %

Appendix 6-2 Informal Observation Form

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Faculty of Art and Design

Informal Observation Form

on e-learning resources for photography

The Development of a Design Model for the Teaching of Photography using Advanced Multimedia

Name:	
Course Name:	
Subject:	**Gender: Male ☐ Female ☐**

Resource Title:	
Resource Type:	**website ☐ CD-Rom ☐**
Subject Area:	
URL:	

Task 1: Ease of use and getting started with website / CD-Rom

5	4	3	2	1
Ease				Difficult
Comments:				

Task 2: Level of student interaction with the content

5	4	3	2	1
High				Low

Comments:

Task 3: Level of engaging with learning activity

5	4	3	2	1
High				Low

Comments:

Task 4: Length of time involvement

5	4	3	2	1
5 Hours				15 minutes

Comments:

Appendix 6-3 Student Feedback on E-learning resources

Faculty of Art and Design

The Development of a Design Model for the Teaching of Photography

Using Advanced Multimedia

Student Feedback on e-learning materials for photography

Course Name:	**Nationality:**
Subject:	**Gender: Male** ☐ **Female** ☐

Site Title:	**1-Tutorials on photography by Normankoren** **2- Photonhead** **3- Kodak** **4- Liquid Sculpture** **5- Virtual studio**
Subject Area:	
CD name or URL:	

Please Rate this website using the following Rating Code:

5= Very Good. 4= Good. 3= Fair. 2= Poor. 1= Very Poor. N/A Not Applicable

	Criteria	**Rating**					
1	**How the main page looks and functions**	**5**	**4**	**3**	**2**	**1**	**N/A**
1.1	Ease of getting started						
1.2	Ease of navigation						
1.3	Range of functions and information available						

1.4	User instructions						
1.5	Page organization/layout						
2	**General design of the Website**	**5**	**4**	**3**	**2**	**1**	**N/A**
2.1	Ease of reading text						
2.2	Layout of screen						
2.3	Clarity of icons						
2.4	Use of text to present information						
2.5	Use of sound to present information.						
2.6	Use of video to present information.						
2.7	Use of illustrations to present information						
2.8	Use of animations to present information.						
2.9	Use of interactivity to present information.						
2.10	Use of color to present information.						
2.11	Use of headings and subheadings to organize the information						
2.12	Multimedia download speed						
3	**Navigation of the Website**	**5**	**4**	**3**	**2**	**1**	**N/A**
3.1	Ease of use of website						
3.2	Clarity of where to go next						
3.3	Clarity of labeled Links						
3.4	Ability to retrace your steps						
3.5	Organization of the website						
3.6	Intuitiveness of interface (ease of interacting with interface)						
3.7	Ease of finding information						
3.8	Ability to work through topics step by step						
3.9	Ability to jump straight to a chosen section.						
3.10	Help provided						
4	**Learning from the Website**	**5**	**4**	**3**	**2**	**1**	**N/A**
4.1	Interest level of content						
4.2	Feedback provided on success in learning activities						

4.3	Step by step Guidance to learning activities						
4.4	Degree to which website helped you learn						

Please rate the following multimedia components for each question using the following Rating code: **5= Very Good. 4= Good. 3= Fair. 2= Poor. 1= Very Poor. N/A Not Applicable**

5	**Multimedia content of the Website**	**Text**	**Photographic images**	**Illustrations**	**Sound**	**Video**	**Graphics e.g. Chart**	**Animation**	**Simulations**
5.1	Ease of use								
5.2	Clarity of content								
5.3	Level of learning								
5.4	Level of engagement								
5.5	Level of enjoyment and fun								

6- No activity available for ''**Tutorials on photography by Normankoren'' but for others see below**

Please rate this website using the following rating code:
5=Strongly agree 4=Agree 3= Not sure 2=Disagree 1=Strongly Disagree N/A=Not Applicable

7	**Overall rating of web site**	**5**	**4**	**3**	**2**	**1**	**N/A**
7.1	I would use this website to help with my studies.						
7.2	This is an excellent learning resource.						
7.3	I would still need help from staff to learn this topic						
7.4	The use advanced multimedia is very helpful learning tool e.g. video, animation and simulations etc.						

What are the major strengths of this website as a learning aid?

1	
2	
3	

4	
5	

What are the major weaknesses of this website as a learning aid?

1	
2	
3	
4	
5	

How would you improve the website as a learning aid?

1	
2	
3	
4	
5	

Any other comments?

1	
2	
3	
4	

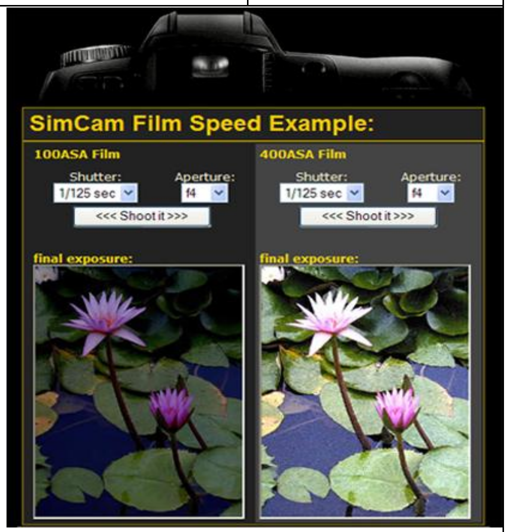
2- Photonhead (Activity)

The following is a list of activities and items within the product. To what extent did these features help you learn from the website? Rating Code System:

5 = Very big help 4= Big help 3= Some help 2=Little help 1= No help

6	The Sim Cam is an interactive camera simulation designed to help photographic concepts. Change the camera settings and see the results on-screen. The Sim Cam is a tool for learning about exposure.

6.1 <u>Shutter and Aperture</u>	**Rate** **1 2 3 4 5** □□□□□	**6.2 <u>Film Speed</u>**	**Rate** **1 2 3 4 5** □□□□□



6.3 <u>Camera Shake</u>	**Rate** **1 2 3 4 5** □□□□□	

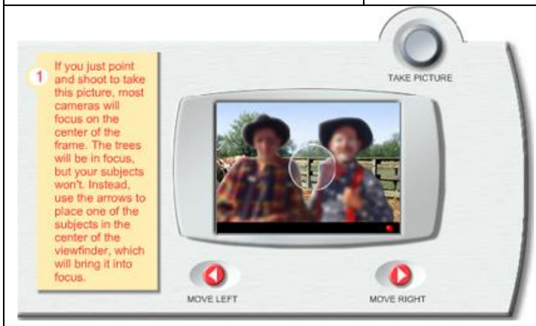
3- Kodak (Activity)

The following is a list of activities and items within the product. To what extent did these features help you learn from the website? Rating Code System:

5 = Very big help 4= Big help 3= Some help 2=Little help 1= No help

6. The interactive camera simulators help to practice some photography tips to improve your picture taking!

6.1 Locking the Focus — **Rate 1 2 3 4 5** □□□□□

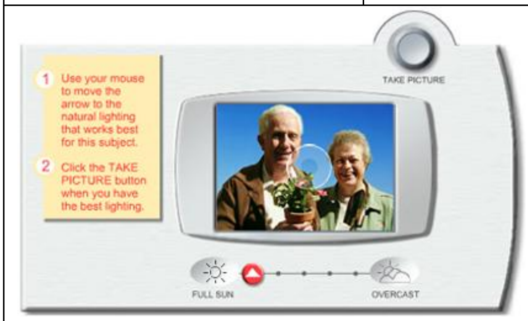


6.2 Using a Plain Background — **Rate 1 2 3 4 5** □□□□□

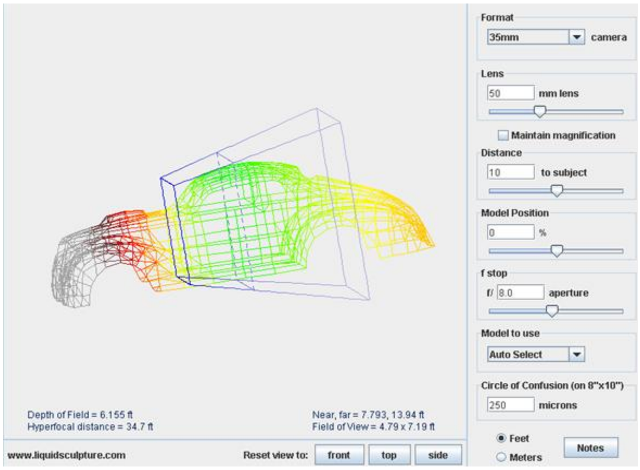
6.3 Moving It from the Middle — **Rate 1 2 3 4 5** □□□□□

6.4 Knowing Your Flash's Range — **Rate 1 2 3 4 5** □□□□□

6.5 Watching the Light — **Rate 1 2 3 4 5** □□□□□



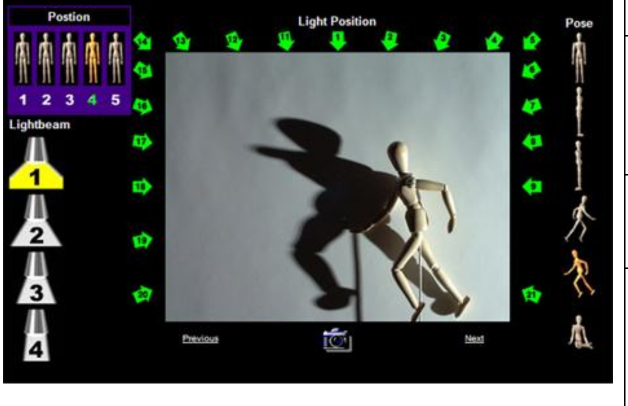
6.6 Troubleshooting Your Pictures — **Rate 1 2 3 4 5** □□□□□

<table>
<tr><td colspan="4">4-Liquid Sculpture (Activity)</td></tr>
<tr><td colspan="4">The following is a list of activities and items within the product. To what extent did these features help you learn from the website? Rating Code System:
5 = Very big help 4= Big help 3= Some help 2=Little help 1= No help</td></tr>
<tr><td>6 -</td><td colspan="3">Drag the wire-frame model on the left to inspect the effects from various angles. Green portions of the wire-frame lie within the depth of field; the portions that are yellow, red, and eventually gray, are increasingly out of focus</td></tr>
<tr><td colspan="3">Examine the depth of field by changing the camera controls and the effects they have on the resulting picture by using :</td><td>Rate from 5 to 1</td></tr>
<tr><td rowspan="6">
</td><td>6.1</td><td>Aperture</td><td></td></tr>
<tr><td>6.2</td><td>lens focal length</td><td></td></tr>
<tr><td>6.3</td><td>distance to subject</td><td></td></tr>
<tr><td>6.4</td><td>film format</td><td></td></tr>
<tr><td>6.5</td><td>Changing the model</td><td></td></tr>
<tr><td>6.6</td><td>Easy to interact with model</td><td></td></tr>
</table>

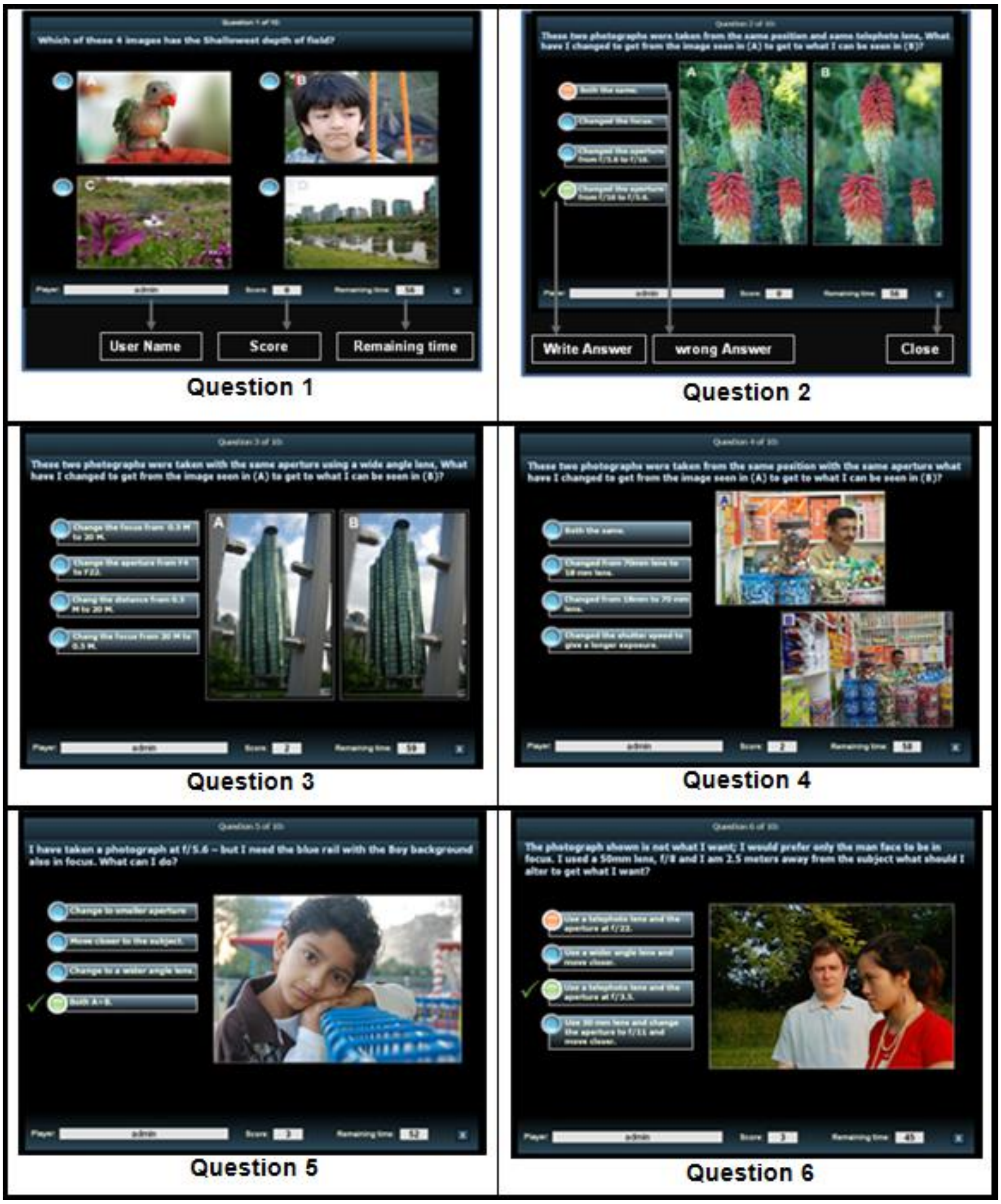
5-Virtual studio

The following is a list of activities and items within the product. To what extent did these features help you learn from the CD-Rom software? Rating Code System:

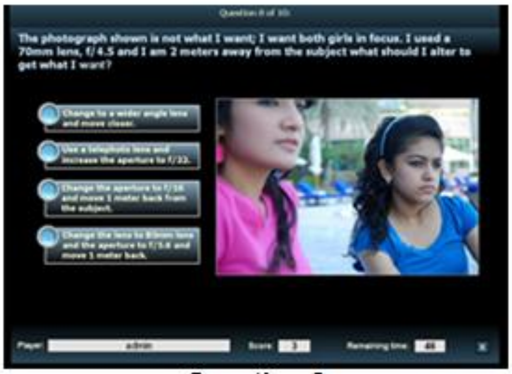
5 = Very big help 4= Big help 3= Some help 2=Little help 1= No help

<table>
<tr><td>6.</td><td colspan="3">Having decided which photograph lighting techniques you wish to practice you need to choose down the details of the icons you have to use. An example might be as follows,
Position 3 Light Beam 4
Pose Run Right Light Position 10</td><td>Rate from 5 to 1</td></tr>
<tr><td colspan="2" rowspan="5">
</td><td>6.1</td><td>Understanding the effect of the light on the model position</td><td></td></tr>
<tr><td>6.2</td><td>Understanding the effect of the light on the pose position</td><td></td></tr>
<tr><td>6.3</td><td>Understanding the effect of the type of light beam</td><td></td></tr>
<tr><td>6.4</td><td>Understanding the direction of the light position</td><td></td></tr>
<tr><td>6.5</td><td>Understanding concept of shadow</td><td></td></tr>
</table>

Appendix 8-1 Questions 1 – 10 Final Evaluation

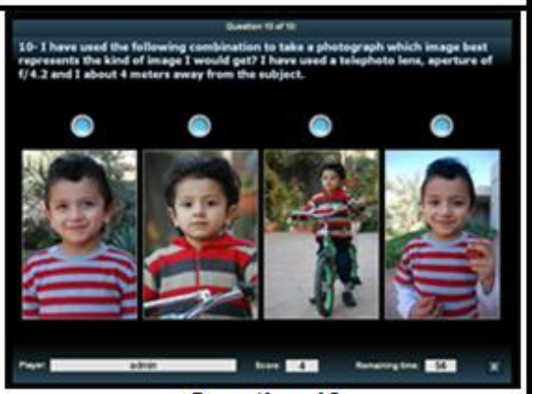


Question 7



Question 8

Question 9



Question 10

Appendix 9-1 Test 1: Pedagogic design questionnaire

Feedback Questionnaire for Photography experts to validate the content and the Pedagogic design of a new Photography (Depth of Field) e-learning application

I am a PhD researcher in Multimedia Design at De Montfort University, UK.
I would like to have your opinion regarding the content and the Pedagogic design of a new Photography (Depth of Field) e-learning application which should only take you not more than 45 minutes.
Please be assured that the information you provide will be kept strictly confidential.
Thank You.

The learning goals:

1. Demonstrate an understanding of the concept of depth of field and its uses.
2. Demonstrate an understanding of how the individual elements affect depth of field in a photograph, i.e. A) aperture, B) focal lens length C) camera-to-subject distance.
3. Apply the knowledge gained from understanding how the individual elements affect a photograph by combining these elements. That is,
   A) aperture + focal length lens,
   B) Aperture + camera-to-subject distance.
   C) Focal length lens + camera-to-subject distance.
   D) Aperture + focal length lens + camera-to-subject distance.

Level of the Target Audience: First year under graduate students of Photography course.

Please rate the following factors for each question using the following **Rating Scale Key: (5=Very Good, 4=Good, 3=Fair, 2=Poor, 1= Very Poor)**

Participant Name:

Institute Name:

No	Pedagogic design Factors:	Rating	Comments
1	Are there clear learning goals and outcomes for this e-learning resource?		

2	Is the language used suitable for the level of the user?		
3	Does the content support the achievement of the learning outcomes?		
4	Is the content accurate, relevant and current?		
5	Is the content suitably organized and structured to support the learner?		
6	Is there anything you think should be added to achieve the learning outcomes and support learners?		
7	Is there a clear relationship between different parts of the lesson?		
8	Are the all the individual learning activities appropriate?		
9	Do these learning activities support the achievement of the learning outcomes?		
10	Does the order that the materials are presented in support learning? (e.g. sequentially in order of difficulty		
11	Does the feedback support the learner?		
12	Is the feedback appropriate to the learner's responses?		
13	Does the resource support a range of learning styles		
14	Will the resource be attractive to and engage the students		

Extra comments or suggestions for improvements :

Kindly send the filled in questionnaire by mail to:
falbayat@dmu.ac.uk
Fareed Albayat
Faculty of Art and Design

Appendix 9-2 Test 2: Multimedia design questionnaire

Multimedia Design on Photography – Design Factors Questionnaire (User experience testing)
I am a PhD research student De Montfort University, UK doing research on Multimedia Design. The aim of this questionnaire is to get feedback on the general multimedia design factors of the Photography multimedia e-learning application. Please take a few minutes to complete the questionnaire. All the data collected will be kept strictly confidential. Thank you for your help!
Please rate the following factors for each question using the following **Rating Scale Key: (5=Very Good, 4=Good, 3=Fair, 2=Poor, 1= Very Poor)**
Name: **Institute Name:** **The Participants : Student ☐ Designer ☐**

General design Factors :	**5**	**4**	**3**	**2**	**1**
Ease of navigation	☐	☐	☐	☐	☐
Clarity of content	☐	☐	☐	☐	☐
Ease of reading text	☐	☐	☐	☐	☐
Clarity of Icons	☐	☐	☐	☐	☐
Clarity of directions given	☐	☐	☐	☐	☐
Use the color to present information	☐	☐	☐	☐	☐
Clarity of indication of the current location	☐	☐	☐	☐	☐
Clarity of route to a starting point or main menu	☐	☐	☐	☐	☐
Use of multimedia components to present information	☐	☐	☐	☐	☐
Use the headings and subheadings to organize the information	☐	☐	☐	☐	☐
Level of attractiveness	☐	☐	☐	☐	☐
Level of engagement of screen and contents	☐	☐	☐	☐	☐
Consistency and adherence to navigation standards and conventions	☐	☐	☐	☐	☐
Flexibility and ease of use	☐	☐	☐	☐	☐
Level of fun or enjoyment	☐	☐	☐	☐	☐
Comments and suggestions for improvement:					

Kindly send the filled in questionnaire by mail to: falbayat@dmu.ac.uk
Fareed Albayat
Faculty of Art and Design

Appendix 9-3 Pre-test in Depth of Field answering sheet

Pre-test in Depth of Field
Group (   )

Dear Students,

This exam aims to determine the degree of your interaction with the subject "depth of field" in photography during learning, and detect the theoretical and practical knowledge and skills acquired during your studies to the subject.

To this end, please consider honesty and objectivity in your answers to achieve the objectives of the present study, the certainty that your answers will be treated confidentially and will not be used for other purposes of scientific research.
This test is comprised of two parts:
Part 1: 10 multiple choice questions.
Part 2: 10 slides of PowerPoint text and images used to evaluate Part 1 of the multiple choice questions.

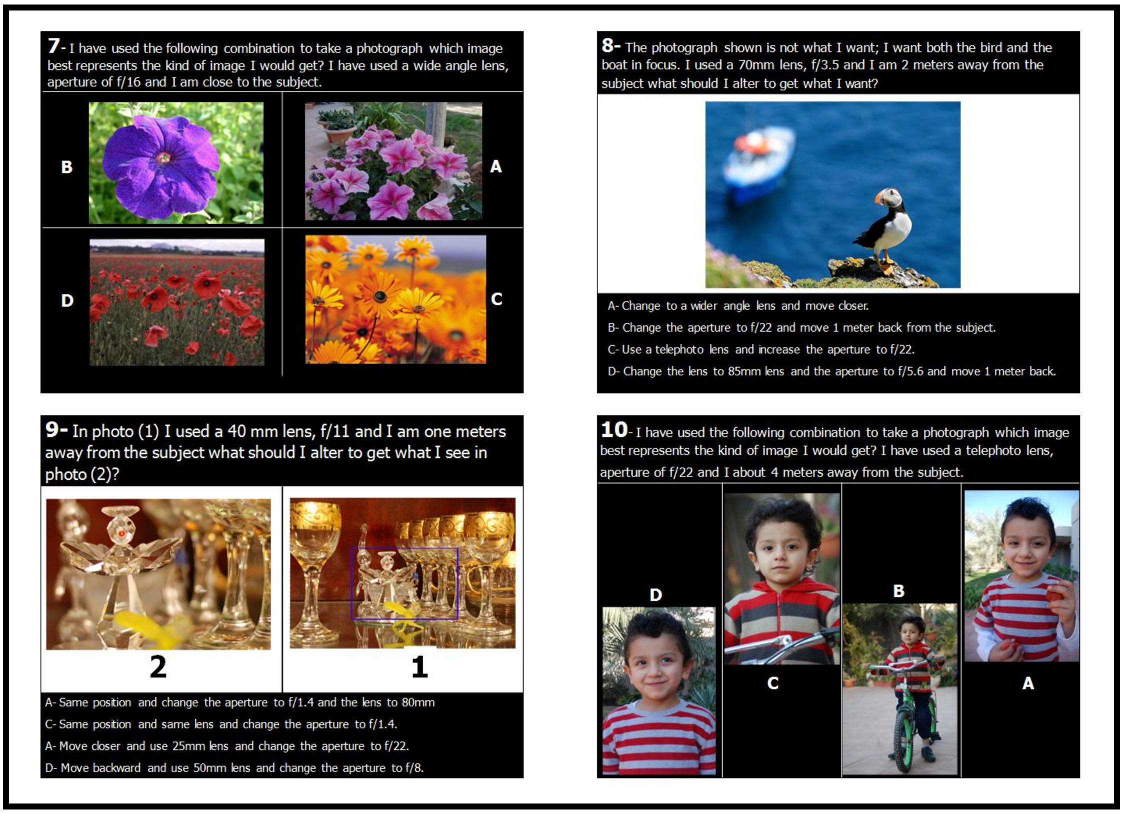
Thanking you in advance your research objectives achievement.
General instructions:

1. Write your personal data in the answer sheet.
2. See your images displayed on the white screen.
3. Read each question carefully and precisely, and then circle the correct answer to the question during the allotted time.
4. If you don't know the correct answer, place make circle on the "don't know".
5. Please answer all questions.

Name(Optional)	**Date:**
University Name:	**Gender: Male ☐ Female ☐**
Study Field:	**Year of study:**

The Course is : Elective ☐ Compulsory ☐						GPA:
No	**Questions**	**Select the right answer**				
1	Which of these 4 images has the Shallowest depth of field?	**A**	**B**	**C**	**D**	I don't Know
2	These two photographs were taken from the same position and same telephoto lens, What have I changed to get from the image seen in (1) to get to what I can be seen in (2)?	**A**	**B**	**C**	**D**	I don't Know
3	These two photographs were taken with the same aperture using a wide angle lens, What have I changed to get from the image seen in (1) to get to what I can be seen in (2)?	**A**	**B**	**C**	**D**	I don't Know
4	These two photographs were taken from the same position with the same aperture what have I changed to get from the image seen in (1) to get to what I can be seen in (2)?	**A**	**B**	**C**	**D**	I don't Know
5	I have taken a photograph at f/5.6 – but I need the blue rail to also be in focus. What can I do?	**A**	**B**	**C**	**D**	I don't Know
6	The photograph shown is not what I want; I would prefer only the man face to be in focus. I used a 50mm lens, f/8 and I am 2.5 meters away from the subject what should I alter to get what I want?	**A**	**B**	**C**	**D**	I don't Know
7	I have used the following combination to take a photograph which image best represents the kind of image I would get? I have used a wide angle lens, aperture of f/16 and I am close to the subject.	**A**	**B**	**C**	**D**	I don't Know
8	The photograph shown is not what I want; I want both girls in focus. I used a 70mm lens, f/4.5 and I am 2 meters away from the subject what should I alter to get what I want?	**A**	**B**	**C**	**D**	I don't Know
9	In photo (1) I used a 18mm lens, f/8 and I am 1.2 meters away from the subject what should I alter to get what I see in photo (2)?	**A**	**B**	**C**	**D**	I don't Know
10	I have used the following combination to take a photograph which image best represents the kind of image I would get? I have used a telephoto lens, aperture of f/4.2 and I about 4 meters away from the subject.	**A**	**B**	**C**	**D**	I don't Know

Appendic 9-4 Pre-test Depth of Field PPT presentation


7- I have used the following combination to take a photograph which image best represents the kind of image I would get? I have used a wide angle lens, aperture of f/16 and I am close to the subject.
B
A
D
C
8- The photograph shown is not what I want; I want both the bird and the boat in focus. I used a 70mm lens, f/3.5 and I am 2 meters away from the subject what should I alter to get what I want?
A- Change to a wider angle lens and move closer.
B- Change the aperture to f/22 and move 1 meter back from the subject.
C- Use a telephoto lens and increase the aperture to f/22.
D- Change the lens to 85mm lens and the aperture to f/5.6 and move 1 meter back.
9- In photo (1) I used a 40 mm lens, f/11 and I am one meters away from the subject what should I alter to get what I see in photo (2)?
2
1
A- Same position and change the aperture to f/1.4 and the lens to 80mm
C- Same position and same lens and change the aperture to f/1.4.
A- Move closer and use 25mm lens and change the aperture to f/22.
D- Move backward and use 50mm lens and change the aperture to f/8.
10- I have used the following combination to take a photograph which image best represents the kind of image I would get? I have used a telephoto lens, aperture of f/22 and I about 4 meters away from the subject.
D
C
B
A

Appendix 9-5 Pre-test in Depth of Field answering sheet

Post-test in Depth of Field
Group ( )

Dear Students,

This exam aims to determine the degree of your interaction with the subject "depth of field" in photography during learning, and detect the theoretical and practical knowledge and skills acquired during your studies to the subject.

To this end, please consider honesty and objectivity in your answers to achieve the objectives of the present study, the certainty that your answers will be treated confidentially and will not be used for other purposes of scientific research.

Thanking you in advance your research objectives achievement.

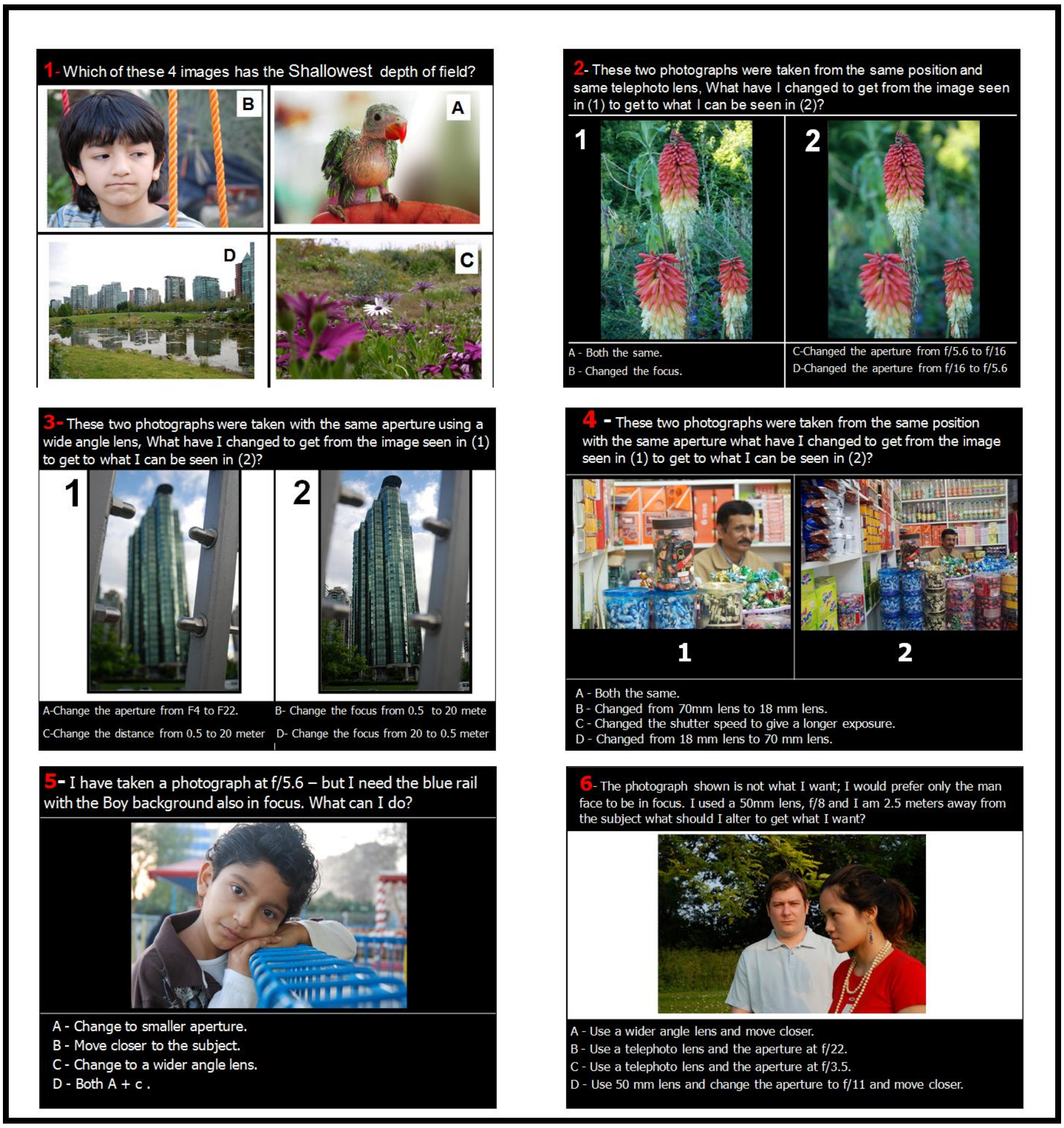
General instructions:

1. Write your personal data in the answer sheet.
2. See your images displayed on the white screen.
3. Read each question carefully and precisely, and then circle the correct answer to the question during the allotted time.
4. If you don't know the correct answer, place make circle on the "don't know".
5. Please answer all questions.

Name(Optional)	**Date:**
University Name:	**Gender: Male ☐ Female ☐**

Study Field:						**Year of study:**
The Course is : Elective ☐ Compulsory ☐						**GPA:**
No	**Questions**	**Select the right answer**				
1	Which of these 4 images has the largest depth of field?	A	B	C	D	I don't Know
2	These two photographs were taken from the same position and same telephoto lens, What have I changed to get from the image seen in (1) to get to what I can be seen in (2)?	A	B	C	D	I don't Know
3	3- These two photographs were taken with the same aperture using a wide angle lens, What have I changed to get from the image seen in (1) to get to what I can be seen in (2)?	A	B	C	D	I don't Know
4	These two photographs were taken from the same position with the same aperture what have I changed to get from the image seen in (1) to get to what I can be seen in (2)?	A	B	C	D	I don't Know
5	I have taken a photograph at f/5.6 – but I need the blue rail to also be in focus. What can I do?	A	B	C	D	I don't Know
6	The photograph shown is not what I want; I would prefer only the boy face to be in focus. I used a 40mm lens, f/11 and I am 2 meters away from the subject what should I alter to get what I want?	A	B	C	D	I don't Know
7	I have used the following combination to take a photograph which image best represents the kind of image I would get? I have used a wide angle lens, aperture of f/16 and I am close to the subject.	A	B	C	D	I don't Know
8	The photograph shown is not what I want; I want both the bird and the boat in focus. I used a 70mm lens, f/3.5 and I am 2 meters away from the subject what should I alter to get what I want?	A	B	C	D	I don't Know
9	In photo (1) I used a 40 mm lens, f/11 and I am one meters away from the subject what should I alter to get what I see in photo (2)?	A	B	C	D	I don't Know
10	I have used the following combination to take a photograph which image best represents the kind of image I would get? I have used a telephoto lens, aperture of f/22 and I about 4 meters away from the subject.	A	B	C	D	I don't Know

Appendix 9-6 Post-test Depth of Field PPT presentation



7- I have used the following combination to take a photograph which image best represents the kind of image I would get? I have used a wide angle lens, aperture of f/16 and I am close to the subject.

8- The photograph shown is not what I want; I want both girls in focus. I used a 70mm lens, f/4.5 and I am 2 meters away from the subject what should I alter to get what I want?

A- Change to a wider angle lens and move closer.
B- Use a telephoto lens and increase the aperture to f/22.
C- Change the aperture to f/16 and move 1 meter back from the subject.
D- Change the lens to 85mm lens and the aperture to f/5.6 and move 1 meter back.

9- In photo (1) I used a 18 mm lens, f/8 and I am 1.2 meters away from the subject what should I alter to get what I see in photo (2)?

A- Move closer and use 25mm lens and change the aperture to f/22.
B- Same position and same lens and change the aperture to f/1.8
C- Same position and same aperture f/1.4 and change the lens to 70 mm
D- Move backward and use 50mm lens and change the aperture to f/8.

10- I have used the following combination to take a photograph which image best represents the kind of image I would get? I have used a telephoto lens, aperture of f/4.2 and I about 4 meters away from the subject.

Appendix 9.7 Validity testing panel

	Name	Title	Institute
1	Noaman M. Almusawi	Associate Professor of Education Measurement and Evaluation	College of Education University of Bahrain – Kingdom of Bahrain
2	Jehan Al-Omran	Associate Professor of Educational Psychology	
3	Mohammed J. Al_Mosawi	Assistant Professor of Educational Technology	
4	Naser H. Almosawi	Associate Professor of Curriculum and Instruction	Curriculum Expert / UNESCO
5	Ziyad Hadad	Associate Professor of Design	Dean of Faculty of art and Design / Royal University - Bahrain

Appendix 9-8 Test 3: Learning & Enjoyment Questionnaire

Questionnaire in measure the perceptions of effectiveness in learning and degree of engagements and enjoyments in learning

Dear Students,

The aim of this questionnaire is to measure 3 key factors;

A. Effectiveness of learning Depth of field in photography subject.
B. Level of student Engagement in this subject.
C. Level of student Enjoyment in this subject.

To explore the knowledge the practical skill and the techniques that you gained while studying this subject.
To achieve this purpose, please read these questions carefully. Put tick **(√)** in the space which determines the level of your performance.

All the data collected will be kept strictly confidential. Thank you for your help!

The Researcher
Fareed Albayat
falbayat@yahoo.com

Name(Optional)	**Date:**
University Name:	**Gender: Male ☐ Female ☐**
Study Field:	**Year of study:**
The Course is : Elective ☐ Compulsory ☐	**GPA:**

No	**1- The perceptions Effectiveness Learning**	**Always**	**Rarely**	**Often**	**Rarely**	**Never**
1	This way of presenting the subject and the techniques used enabled me to understand the subject of photography better.					
2	I became more competent in the skills of technical and creative analyses through this way of presenting the subject.					
3	I mastered the creative and artistic analysis skills of “Depth of Field” through this way of presenting the subject and the techniques used in teaching it					
4	The variety of the techniques used in the depth of the field have helped me gain knowledge and skills that are applicable in other situations and subjects.					
5	The techniques used in the depth of field topic triggered my curiosity for knowledge and enhanced my desire to explore and create					
6	The way I studied the topic enabled me to evaluate the photograph using clear and defined criteria.					
7	The way I studied the "Depth of Field" topic enabled me to master new and advanced skills and abilities in photography field.					
8	I can now apply necessary technical skills in photography better than before.					
9	The techniques used in this way of learning helped me organize my information and ideas through the integration of the elements of learning materials in my mind					
10	The media used in this way of learning enabled me to find solutions to technical problems of photography.					

	2- The perceptions Engagement in Learning	Always	Rarely	Often	Rarely	Never
11	Learning “Depth of Field” helped me discover new hidden techniques in photography.					
12	The way of learning gave me the opportunity to discuss with my colleagues gained ideas and information about photography.					
13	The way of learning allowed me to access new sources and gain more information about the subject.					
14	While performing the activities, I acquired several skills, such as being more disciplined, and confident.					
15	This way of learning encouraged me to study the subject in depth.					
16	This way of learning created a motivating environment for active learning and cooperation with student.					
17	This way of learning allowed me to develop new strategies and methods to study the subject.					
18	My apprehension of the functions of “Depth of Field” and its technical features encouraged me to practice more supportive activities with the subject.					

N0	**3- The perceptions Enjoyment Learning**	**Always**	**Rarely**	**Often**	**Rarely**	**Never**
19	Using this way of learning, I enjoy learning the subject.					
20	I like to apply this way of learning in other subjects.					
21	I found the photography topics are really interesting.					
22	I wish my classroom colleagues could study photography as it is enjoyable.					
23	Conversations and discussions with colleagues about "Depth of the Field" activity made the learning process more interesting and intriguing.					
24	The way of learning this topic was more enjoyable and exciting then other ways of learning.					
25	I felt happy when I could see the effects of the "Depth of Field" on the picture.					
26	This way of learning showed me the impotence of concentrating in order to understand the subject more deeply					
27	My continuous interaction in this learning situation made it more enjoyable, which encouraged me to gain more photography experience.					
28	I enjoyed dealing with the new knowledge and skills I have discovered through this activity.					

Answer these fallowing questions:

1. Identify the technical skills in photography that you have acquired through the study of “Depth of Field” subject.

----

2. What is your opinion of the way of studying this subject with regard to the following? :

(a) Number and type of activities applied in the subject.

____

____

(b) Encouraging students to engage with the subject of “Depth of Field” during the learning process.

____

____

(c) Making the learning process more enjoyable and entertaining?

____

____

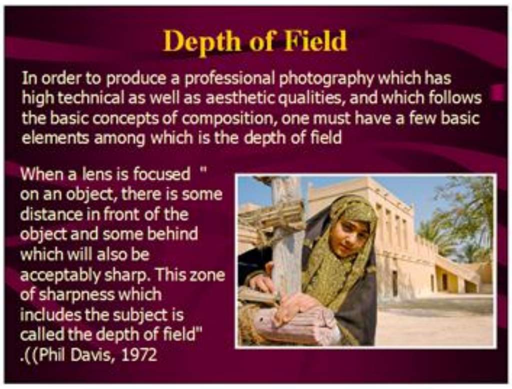
3. What recommendations do you have for improving the learning of “Depth of Field” subject by student of photography?

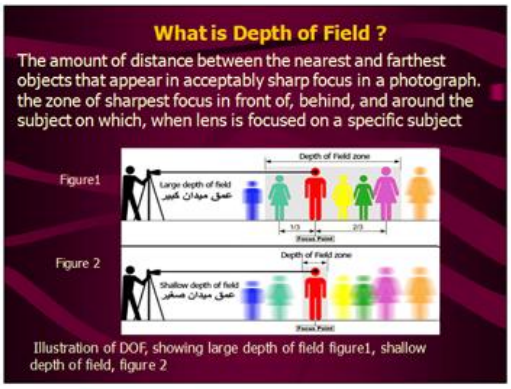
____

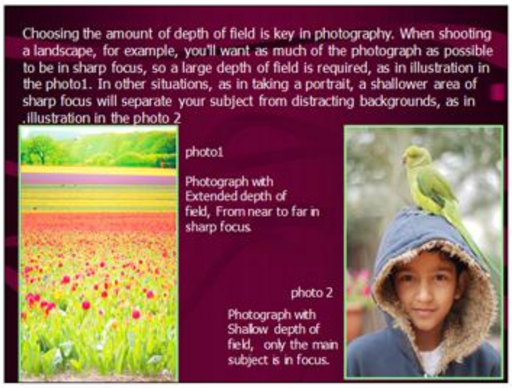
____

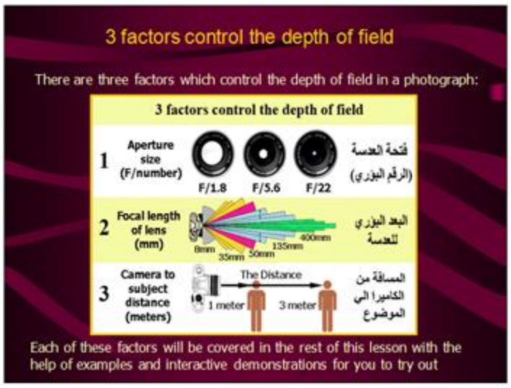
____

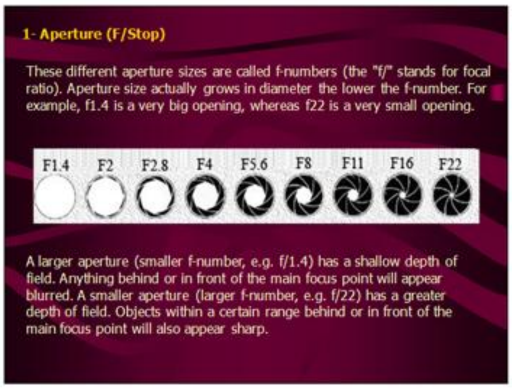
Appendix 9-9 Controlled group (basic multimedia) material for DOF

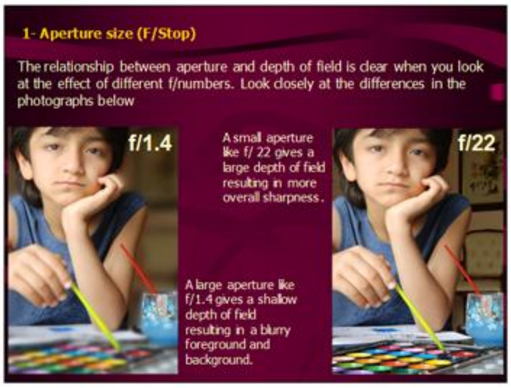


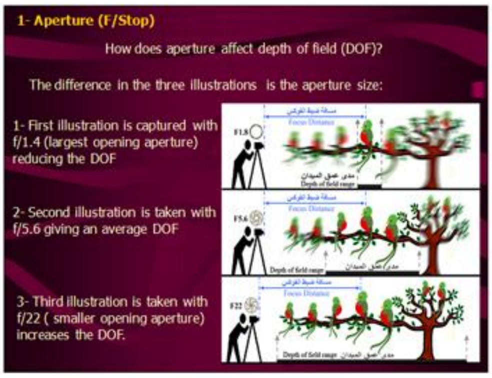




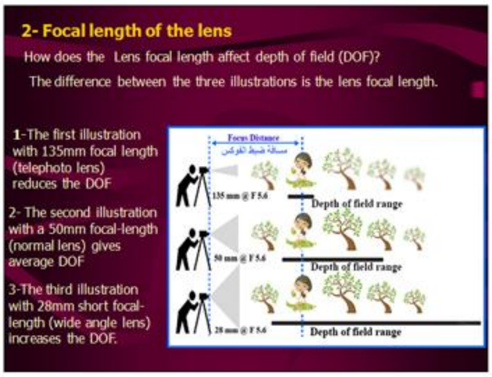


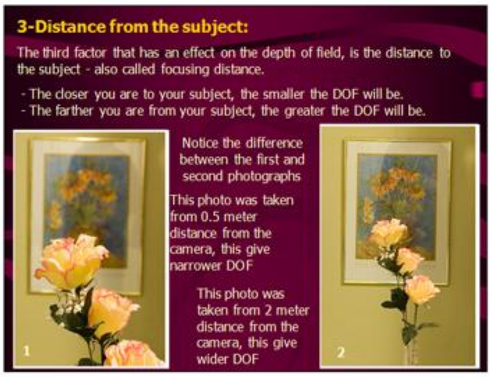


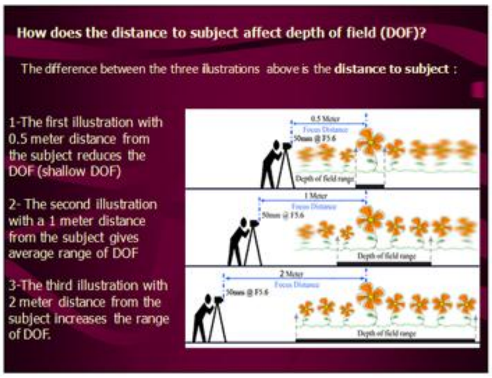


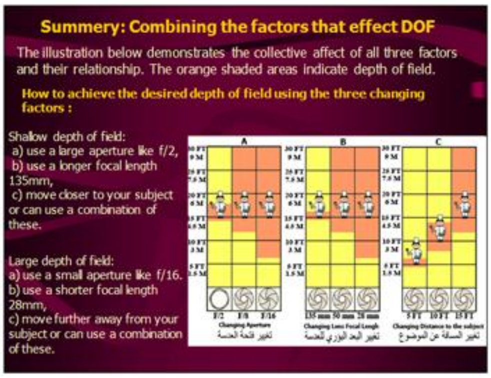

1- Aperture (F/Stop)
How does aperture affect depth of field (DOF)?
The difference in the three illustrations is the aperture size:
1- First illustration is captured with f/1.4 (largest opening aperture) reducing the DOF
2- Second illustration is taken with f/5.6 giving an average DOF
3- Third illustration is taken with f/22 (smaller opening aperture) increases the DOF.


2- Focal length of the lens
The second factor that effect the depth of field of a photography is the focal length of the lens you are using. The shorter the lens focal length, the greater the depth of field for a given aperture. In other words, a wide-angle lens provides more depth of field at f/5.6 than a normal lens, and a normal lens provides more depth of field at f/5.6 than a telephoto lens
35 mm
Using a wider angle lens increases the depth of field.
105 mm
Using a longer lens decreases the depth of field


2- Focal length of the lens
How does the Lens focal length affect depth of field (DOF)?
The difference between the three illustrations is the lens focal length.
1-The first illustration with 135mm focal length (telephoto lens) reduces the DOF
2- The second illustration with a 50mm focal-length (normal lens) gives average DOF
3-The third illustration with 28mm short focal-length (wide angle lens) increases the DOF.
Focus Distance
135 mm @ F5.6
Depth of field range
50 mm @ F5.6
Depth of field range
28 mm @ F5.6
Depth of field range


3-Distance from the subject:
The third factor that has an effect on the depth of field, is the distance to the subject - also called focusing distance.
- The closer you are to your subject, the smaller the DOF will be.
- The farther you are from your subject, the greater the DOF will be.
Notice the difference between the first and second photographs
This photo was taken from 0.5 meter distance from the camera, this give narrower DOF
This photo was taken from 2 meter distance from the camera, this give wider DOF
1
2


How does the distance to subject affect depth of field (DOF)?
The difference between the three illustrations above is the distance to subject :
1-The first illustration with 0.5 meter distance from the subject reduces the DOF (shallow DOF)
2- The second illustration with a 1 meter distance from the subject gives average range of DOF
3-The third illustration with 2 meter distance from the subject increases the range of DOF.


Summery: Combining the factors that effect DOF
The illustration below demonstrates the collective affect of all three factors and their relationship. The orange shaded areas indicate depth of field.
How to achieve the desired depth of field using the three changing factors :
Shallow depth of field:
a) use a large aperture like f/2,
b) use a longer focal length 135mm,
c) move closer to your subject or can use a combination of these.
Large depth of field:
a) use a small aperture like f/16.
b) use a shorter focal length 28mm,
c) move further away from your subject or can use a combination of these.
A
B
C