3D Hologram Technology
in Learning Environment

Husain Ghuloum
University of Salford, Department of Built and Human Environment, Manchester, UK

H.Ghuloum@pgr.salford.ac.uk

Abstract

Major progress has taken place in the field of ICT usage in learning environments. The advantages offered by ICT in this sector have led most educational institutions to integrate ICT services into their departments. Scientists are working very hard to provide an advanced technology, which can benefit them in many areas. 3D Hologram Technology (3DHT) is one of the most creative of these solutions.

In this paper, the researcher presents essential information about 3DHT, in order to understand the importance of this technology in our life, and in the learning environment in particular. He also identifies the strengths and weaknesses of 3DHT as a teaching tool, in order to evaluate its effectiveness as an educational tool.

In order to thoroughly understand the phenomenon, a survey has been carried out on a large sample of teachers in the UK, and therefore the questionnaire has been utilized as a data gathering technique.

Findings show that, 45.5% of respondents confirmed the importance of 3DHT as an effective teaching tool for the future. However, 47, 3% of participants mentioned that this technology could not change the face of education.

Additionally, the results indicate that the main barriers to integrating 3DHT into learning environments are a) the high cost of installation and b) requirement of a high-speed Internet connection.

Keywords: 3D Hologram Technology, Electronic Learning, Electronic Teaching, Learning Environment.

Introduction

In the past, the traditional model of learning is typically characterized as didactic instruction in which information is presented to students with little consideration of how that information is used. Caprio (1994) indicated that, in traditional learning, the teacher is the sole information giver, undertaking lectures for a large group of students and the students sitting in the classroom are passive recipients of information.

The rapid developments in Information Communication Technology (ICT) have made tremendous changes in the many fields of life. Therefore, educational institutions have been quick to take advantage of technological services via integrating ICT into education, which in turn has produced new models of education such as e-learning, distance learning and blended learning. These models have changed the face of learning as well as playing an essential role in the increase of the student population and also providing a good opportunity to learn at any time and/or place.

Recently, technological developments are playing an important role in improving the educational process. For example, we see many educational institutions using sophisticated technological tools such as touch screens, new software and others. However, before using any new tool in education, it must be evaluated to test its ability and effectiveness.

This paper is set in the context of ICT usage in the learning environment. Its key focus is on the level of effectiveness of 3DHT as a new tool which could support teaching and learning in educational institutions. For that, the paper will be directed at achieving the following objectives as well as answering the research paper questions.

Research Paper Objectives:

- To understand the importance of 3DHT in our lives, and in the teaching and learning environment in particular.

- To identify the strengths and weaknesses of 3DHT as a teaching tool.

- To identify the barriers which 3DHT faces as a teaching tool.

Research Paper Questions:

- Will 3DHT be an efficient tool for teachers in the future?

- What difficulties could educational institutions face in engaging with this tool?

The Historical Background of ICT in Education

The technological revolution has contributed to changes in many areas of life. In education, for example, the famous inventor, Thomas Edison, predicted that textbooks would be replaced by motion pictures (Mayer, 2005, p.8). Similar predictions were made with the emergence of the phonograph, radio broadcasting, tape players, TV and video. Despite these attempts were importance in the field of education, many experts argued that these technologies considered as the mass form of one-way information transfer. For example, public broadcasting prevents individual learning, because it does not reflect individual needs. The sequential presentations, such as tapes and videos, do not allow for working with the piece of information actually needed. Therefore these means can only play a role of supplementary specialised material.

In the 1960s, computers were used in education for computer-assisted instruction. "From 1978 to about 1982, the inclusion of computers in schools was primarily a grass-roots movement, often led by a single teacher… this usually resulted in only one teacher in a building using computers" (Roberts et al, 1988, p. 1). However, not all teachers were enamored of computing. They were not user-friendly and there were little to no options for application to the curriculum. But some experts confirmed that the computer was the future of learning. According to Setzer:

> "Increasingly, the computers of the very near future will be the private property of individuals, and this will gradually return to the individual the power to determine patterns of education. Education will become more of a private act ... There will be new opportunities for imagination and originality." (Setzer, 1997, p.37)

Sir Tim Berners-Lee, working at the European Laboratory for Particle Physics (CERN) in Geneva, created the World Wide Web (WWW) in 1989. However, the coming of age of the Web in the educational sector was during 1990s, when Berners-Lee had built all the tools necessary for a working Web. These tools included the first Web browser, which was also a Web editor, the first Web server (info.cern.ch), and the first Web pages, which described the project itself. The browser could access Usenet newsgroups and FTP files as well. Almost immediately after Berners-Lee completed the World Wide Web browser for the NeXT platform, Nicola Pellow created a simple text browser that could run on almost any computer to encourage use within CERN (Gillies & Cailliau, 2000). However, Nielsen (1995) confirmed that, the real breakthrough for the Web in the context of the learning environment was in 1993 when the easy-to-use point and click Web client Mosaic was released by NCSA (the National Centre for Super computing Applications). Since then the Web has been growing at an unbelievable speed and has become a system that has not only completely changed the importance of hypertext and hypermedia but has also had a strong influence on many fields of computing and information technology as a whole.

Today, the Internet and virtual world support active, hands-on learning which can provide students with practical, real-life experience. According to Sandra Andrews, an educational researcher at Arizona State University College of Education, "The virtual world gives a greater sense of presence than discussion boards... [so] the students get a better feel for the teacher, and it is more fun" (Harrison, 2009, p.2). Hence, many studies have shown that this style of learning results in better retention and understanding of a given topic.

3D Hologram Technology (3DHT)

The word, hologram is composed of the Greek terms, "holos" for "whole view"; and gram meaning "written". A hologram is a three-dimensional record of the positive interference of laser light waves. A technical term for holography is wave front reconstruction (Universal-Hologram, 2009). Dennis Gabor, the Hungarian physicist working on advancement research for electron microscopes, discovered the basic technology of holography in 1947. However, the technique was not fully utilised until the 1960s, when laser technology was perfected. 3D Holographic Technology (3DHT) created in 1962 by scientists in both the United States and the Soviet Union. However, 3DHT has advanced notably since the 1980s owing to low-cost solid-state lasers that became easily accessible for consumers in devices such as DVD players (Chavis, 2009).

The way 3DHT operates is by creating the illusion of three-dimensional imagery. A light source is projected onto the surface of an object and scattered. A second light illuminates the object to create interference between both sources. Essentially, the two light sources interact with each other and cause diffraction, which appears as a 3D image.

Through the enormous development of technology, many scientists began to make greater use of 3DHT. Indeed, scientists managed transfer of individuals from one place to another without the need to travel. This sounds like something from a science fiction movie or T.V show. But this phenomenon has already taken place in American elections in 2008, when Jessica Yellin, in Chicago, was `beamed up` into Wolf Blitzer's studio in New York with a very realistic display (Figure1). This event attracted millions viewers to watch the hologram effect via a YouTube clip. In fact, "CNN Hologram" was the 22nd most searched term on Google shortly following the coverage (Welch, 2008).
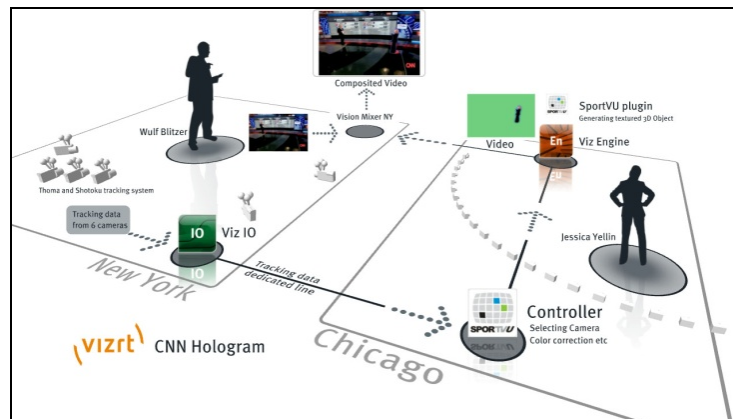
Figure1: A diagram of the CNN Hologram (Serrao, 2008)

Musion System Company seamlessly integrated their 3D holographic display technology with Cisco's TelePresence's system to create the world's first real time virtual presentation (Musion System, 2009). Hence, 3D Holograms have broken out of the world of science fiction and fantasy and are about to become common currency between many countries around the world. Live and life-size 3D TelePresence holograms can now interact with their remote audiences whether they are a band performing on stage, a politician delivering a keynote speech, or a CEO holding an interactive meeting with colleagues around the world.

The Importance of 3DHT

We can see the importance of 3DHT in many areas, such as marketing and advertising, society, environment and education.

The Importance of 3DHT on marketing and advertising:

3DHT clearly has a powerful future. James (2009) pointed out that, "As this audiovisual display continues to get high profile credibility, we are likely to see more companies advertising their products or marketing business in this way". As examples of marketing using 3D holograms, we could mention Lexus in NYC in 2005, fashion designers like Alexander McQueen and his holographic Kate Moss advertisement in 2006 or Diesel in 2007 (Adverblog, 2008). In July 2009, marketing statistics show that using 3DHT contributed significantly to increasing the number of the UK customers (Emarketer, 2009).

The importance of 3DHT on society

The importance of 3DHT on the society lies in the interdependence of human relations. For instance, the Pentagon wants to create computerized hologram-like moms and dads that can talk with the kids when their parents are deployed far from home. Navy commander Russell Shilling, the experimental psychologist overseeing the program, said "a child may get a response from saying 'I love you,' or 'I miss you' or 'Good night`... the goal: reassuring little ones whose parent has suddenly disappeared" (Thompson, 2009). Another example on this issue is the virtual assistant. For instance, the virtual holographic assistant can help you to prepare a meal in the kitchen, or stand beside you and talk about different topics. Although this may sound like pure fiction, there is reason to believe that it could become reality in just a few years' time.

The importance of 3DHT on the environment

The importance of 3DHT on the environment lies in reducing the air pollution caused by aircraft, which burn hydrocarbon fuels, something which is considered one of main reasons for global

warming. Prince Charles confirmed this fact in a green energy conference in Abu Dhabi, as shown in Figure2. He was keen to prove his green credentials by noting that if he had chosen to appear in person, his long-haul flight would have emitted around 15 tons of carbon dioxide, the greenhouse gas which is causing global warming. Hence, he appeared as a hologram to congratulate Abu Dhabi for its plans to harness the power of natural resources to create a new zero carbon city called "Masdar". As the 3DHT, Prince Charles left the audience with the words: "I am now going to vanish into thin air, leaving not a carbon footprint behind!" (Jacob, 2008, p.2).

Trewin Restorick, of the energy saving charity Global Action Plan, told Sky News: "It's been estimated it contributes to 3.5% of the world's green house gases we're pumping into the atmosphere so businesses need to follow Prince Charles' example" (Jacob, 2008).
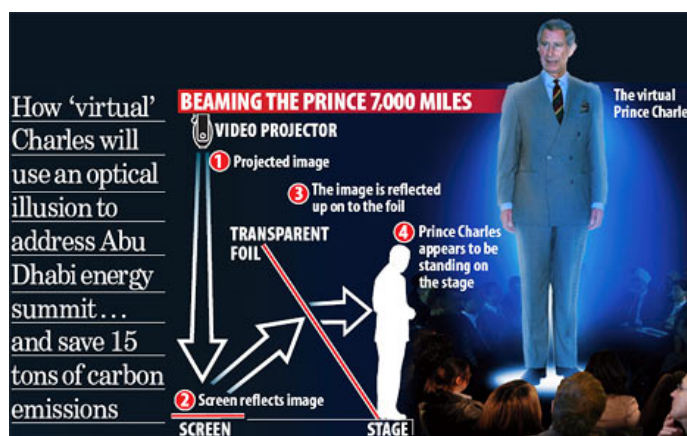

Figure 2: Prince Charles appear in Abu Dhabi as a hologram (Mail News, 2007)

The importance of 3DHT on education

In this area we can take advantage of 3DHT in different forms. For example, holograms now allow students to be taught by a "virtual teacher" who could be many kilometers away. The process goes a step beyond video conferencing in that the hologram teacher appears to be in the classroom, and can see and speak to the pupils as if they were all in the same room. The system used by Edex, the largest supplier of Internet connections to the UK education market, at the BETT2000 educational technology show in London (BBC News, 2000). Moreover, 3DHT can enhance the educational process by bringing famous characters to life again from the past, and they speak about themselves and/or explain something as an assistant teacher. For instance, there have certainly been many worthy philosophers and learned men in world history perhaps none more celebrated that the Greek Philosopher Plato. Unfortunately we are unable to talk with Plato as he is from a past period, while we are in the present period moving into the future period by hologram. In Seoul's Alive Gallery Project, holograms and 3-D animation technology bring 62 world-renowned masterpieces of Western art to life again. In this project we can see the Mona Lisa answering questions from students, such as "Why don't you have any eyebrows?" she is answering, "When I was alive, a woman who had big forehead was considered a beauty … so most women had their eyebrows taken off for beauty". Or, Michelangelo explains the fresco technique he is using to paint "The Last Judgment". He explains the work of another masterpiece he had completed earlier on the ceiling of the Sistine Chapel. A pop-up screen shows a close-up of the famous "Creation of Adam" (Cho, 2008, p.1).

However, 3DHT, as does any technology, has some disadvantages. Firstly, there is the problem of price. Secondly, 3DHT needs to be connected to a fast Internet, next-generation broadband Inter-

net network with a minimum guaranteed constant speed of 20 megabits per second. Finally, to use this technology perfectly, we will need a screening room with compatible lighting and video technology, which costs around 150,000 US dollars to install, as well as a display screen for viewing the holograms on, priced at around 215,000 US dollars (Bobolicu, 2009).

Nevertheless, Ian O'Connell, director of Musion, a company that is pioneering the use of live hologram technology, believes that this sort of fixture will be a mainstay in many sectors in the future, perhaps even within the next five years. "It's going to necessitate a change in architectural design for residential homes for it to be embraced fully," he said. "It's going to need a room that can accommodate the screening and delivery technology. But I think we're five years away from holograms being a ubiquitous, affordable tool" (Bobolicu, 2009, p.2).

The Methodology and Data Analysis

Data Collection Methods

Hurt (2005) states that the survey is often used to describe frequencies of behaviours and attitudes and sometimes to recognize relationships between variables, correlations which we want to emphasis on. Hence, on order to answer the paper questions as well as achieving the objectives, a survey has been carried out on a large sample of teachers in the UK, and therefore the questionnaire has been utilized as a data gathering technique. According to Oates (2006, p.219) the questionnaire is a set of pre-defined questions to be answered by a number of respondents in order to provide specific data. Hence, a questionnaire was distributed to 400 teachers working in various levels of education in the UK, thus constituting a random sample (Figure3).

Stage of education	Type of institution		Year/grade key	Typical age	Study sample
Higher and *further education*	Further education institutions (*further education colleges, tertiary colleges, specialist colleges, and adult education centres*)	Higher education institutions (*universities* and other higher education institutions)		18 +	**100 lecturers**
Upper secondary education	*Further education institutions*	School *sixth forms* or *sixth form colleges*		17 - 18	**100 teachers**
				16 - 17	
	Secondary schools		Year 11 (Y11)	15 - 16	
			Y10	14 - 15	
Lower secondary education			Y9	13 - 14	**100 teachers**
			Y8	12 - 13	
			Y7	11 - 12	
Primary education	Primary schools		Y6	10 - 11	**100 teachers**
			Y5	9 - 10	
			Y4	8 - 9	
			Y3	7 - 8	
			Y2	6 - 7	
			Y1	5 - 6	
		Reception classes	R	4 - 5	

Figure 3: The Study Sample (Diagram of the Education system in England and Wales, 2009)

In order to maximize validity by standardizing the sample, the researcher explained the purpose of the study and gave an introduction to the 3DHT of all respondents to know what the meaning of this technology. Moreover, he clarified concisely all questions of the questionnaire before each teacher and lecturer started filling it out. The researcher carried out follow-ups with the participants according to what participants identified as areas in which they needed help and once teachers complete the questionnaires, the researcher has collected them straight away.

Each question in the questionnaire has been evaluated by using a pilot study or must be pilot tested before the final administration. This procedure is vital for any questionnaire in order to evaluate how respondents interpret the question's meaning and also to check if the range of response alternatives is sufficient. Furthermore, it is also important to evaluate how to phrase each question, layout, check the wording in the questions to avoid potential confusion (De Vaus, 2002). The pilot study suggested that the questionnaires appeared to be an effective method of collecting a large amount of relatively basic information in a short space of time.

Data Analysis and Findings

The survey was conducted during the period of the 4th to 31st of October 2009. The researcher sent out the questionnaires to the 400 teachers who were chosen randomly from different levels of education in the UK. All questionnaires were returned, this meaning all the population had participated (Table 1).

Table 1: The response of questionnaire

Response rate				
Population	**Research**	**Sample**	**Response**	
Category	Instrument	Size	No.	%
Teachers	Questionnaire	400	400	100

First of all, the researcher wants to know the relationship between the teachers from different levels of education and their thoughts on whether 3DHT will enhance learning (Table 2). The table shows that, 228 (57%) of respondents said "*Yes*", whereas 61 (15.3%) said "*No*". While, 111 (27.8%) said "*Don't know*". These proportions clarified that there is a large percentage of respondents believe that, the hologram technology will support the learning process. However, if we break down their responses by educational phase, we will find different views. For instance, 46 teachers in primary stage said "yes", whereas just 2 said "no" and 51 said "don't know". That is the stage with the highest percentage of teachers who are not sure if this technology will enhance the educational process or not. On the other hand, the situation was different in other stages of education because most of the teachers especially in higher education (73 teachers) emphasized the importance of the hologram in supporting the educational process.

Table 2: Relationship between the 3DHT and enhance learning

Table 2		Primary education	Lower secondary education	Upper secondary education	Higher and further education	Total
Do you think the 3DHT will enhance the learning?	Yes	47	56	52	73	228
	No	2	19	31	9	61
	Don't know	51	25	17	18	111
Total		100	100	100	100	400

Table 3 clarifies the relationship between the teachers and their thoughts on whether 3DHT will change the face of learning. The table shows that, 92 (23%) of respondents said "*Yes*", whereas 189 (47,3%) said "*No*". While, 119 (29.8%) said "*Don't know*". These ratios indicate that there is a large percentage of respondents who believe that hologram technology will not change the face of education, especially in primary education.

Table 3: Relationship between the 3DHT and change the face of learning

Table 3		Primary education	Lower secondary education	Upper secondary education	Higher and further education	Total
Do you think the 3DHT will change the face of learning?	Yes	16	17	21	38	92
	No	63	57	42	27	189
	Don't know	21	26	37	35	119
Total		100	100	100	100	400

In table 4, the researcher wants to explore the relationship between teachers from different stages of education and their thoughts on whether 3DHT will be a tool for the teacher. The table shows that 243 (60.8%) of respondents said "*Yes*", whereas 59 (14.8%) said "*No*" and 98 (24.5%) said "*Don't know*". According to these percentages, there is a large ratio of respondents who believe that hologram technology will be a tool for the teacher. However, if we analyse this question in each educational phase, we will find 77 teachers in higher education stage said "yes". That is mean hologram technology could be a future tool for teachers in the phase of higher education in many majors.

Table 4: Does the 3DHT will be a tool of teacher?

Table 4		Primary education	Lower secondary education	Upper secondary education	Higher and further education	Total
Do you think the 3DHT will be a tool of teacher?	Yes	46	57	63	77	243
	No	21	19	11	8	59
	Don't know	33	24	26	15	98
Total		100	100	100	100	400

Table 5 shows the relationship between the teachers and their thoughts on whether 3DHT would be an effective teaching tool in the future. The ratios show that 182 (45.5%) of respondents said "*Yes*", whereas 63 (15.8%) said "*No*"and 155 (38.8%) said "*Don't know*". Overall, the percentages emphasise the perceived importance of the hologram as an effective teaching tool in the future. However, both teachers in primary schools and lower secondary schools were not sure if this technology will be an efficient instrument for teaching in the future or not. However, teachers in upper secondary schools and higher education asserted the importance of the 3DHT as an effective tool for the teacher in the future.

Table 5: Does the 3DHT will be an effective teaching tool in the future?

Table 5		Primary education	Lower secondary education	Upper secondary education	Higher and further education	Total
Do you think the Hologram will be an effective teaching tool in the future?	Yes	31	43	47	61	182
	No	26	13	15	9	63
	Don't know	43	44	38	30	155
Total		100	100	100	100	400

Table 6 seeks to identify the obstacles that may face the integration of holograms into the learning environment. This table shows that 380 (95%) of all participants confirmed that the main barriers that could hinder integrate of the 3DHT into education is "*the high cost of installation*", whereas 315 (78.8%) of all teachers in different stages said that 3DHT "*needs high speed Internet*" and that could be an obstacle. 41 (10.3%) of all respondents mentioned that, "*it is not easy to use*" the hologram technology in a learning environment while 77 (19.3%) of all participants indicated that there are "*other reasons*" which could prevent the merger of the hologram into education. For instance, most of them don't like to deal with this technology, because it is vulnerable to interruption at any moment which may disrupt the smooth flow of the learning process.

Table 6: Possible barriers which 3DHT when integration into the learning environment

What are possible obstacles that holograms may face in terms of integration into the learning environment?	Table 3.6					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
It needs high cost of installation	380	95%	20	5%	400	100.0%
It needs high speed Internet	315	78.8%	85	21.3%	400	100.0%
It is difficult to use	41	10.3%	359	89.8%	400	100.0%
Other	77	19.3%	323	80.8%	400	100.0%

Overall, the results showed some interesting points related to the use of 3DHT as a teaching tool as well as the reasons that hinder its integration into the UK learning environment. For example, the majority of respondents confirmed that 3DHT reinforces the learning process, as well as potentially being an effective teaching tool for the future. However, most participants mentioned that this technology does not change the face of education. Moreover, the main barriers that may hinder the integration of 3DHT into the learning environment are the high cost of installation and requirement of a high-speed Internet connection.

Conclusion

Teachers replaced by holograms. It sounds like something from a science fiction movie or T.V show. What would happen if holographic teachers could be sent to you? The reality is the technology has recently been created to bring live holograms from one location and beam them into any location in the world.

This phenomenon led the researcher to investigate whether 3DHT will be an effective tool for the teachers in the future. Furthermore, the researchers wished o explore the main barriers that might prevent 3DHT being integrated into a learning environment. In order to move towards an answer in this issue, the researcher posed the following questions;

1.   Will 3DHT be an efficient tool for teachers in the future?

The researcher noted that, 60.8% of respondents have confirmed the importance of 3DHT as an efficient tool for teachers while 45.5% believed that 3DHT will be an effective teaching tool for the future. However, 47.3% of teacher in all stages mentioned that this technology could not change the face of education, but it could help them to some extent in their teaching.

2.   What are the difficulties, which educational institutions could face in engaging with this tool?

According to the study findings, the main barriers that may hinder the integration of 3DHT into learning environments are 'needing a high cost of installation' and 'needing high speed Internet'. Although 95% of all participants indicated that 3DHT is very expensive and difficult to integrate it with the learning environment, the researcher believes that it is very interesting to use this technology in the teaching process even if it is very expensive to implement at present.

References

Adverblog. (2008). *Hologram of French goalkeeper by Adidas.* Retrieved November 11, 2009, from http://www.aderblog.com/archives/oo3655.htm

BBC News. (2000, January 13). Meet the hologram teacher. *BBC News.* Retrieved November 21, 2009 http://news.bbc.co.uk/1/hi/in_depth/education/2000/bett2000/600667.stm

Bobolicu, G. (2009). *"Live" hologram communication to become reality within five years*. Retrieved October 25, 2009, from http://gadgets.softpedia.com/news/Live-Hologram-Communication-to-Become-Reality-within-5-Years-1233-01.html

Caprio, W. (1994). Easing into constructivism: connecting meaningful learning with student experience. *Journal of College Science Teaching*, *23*(4), 210-212.

Chavis, J. (2009). *3D holographic technology*. Retrieved October 17, 2009, from http://www.ehow.co.uk/about_5448579_holographic-technology.html

Cho, J. (2008, June 13). Talking to Mona Lisa & Michelangelo. *ABC News*. Retrieved October 19, 2009, from http://abcnews.go.com/International/Travel/story?id=5060941&page=1

De Vaus, D. (2002). *Surveys in social research* (5th ed.). London: Routledge Publications

E-Marketer. (2009). UK online advertising: Spending and trends. Retrieved November 14, 2009, from http://www.marketresearch.com/vendors/sampleviewer/default.asp?SID=74063740-471111915-410945431&VendorID=1282.

Gillies, J., & Cailliau, R. (2000). *How the web was born: The story of the world wide web*. Oxford: University Press.

Harrison, D. (2009, Febuary 18) Real-Life teaching in a virtual world. *Campus Technology*. Retrieved February 14, 20101, from http://www.marketresearch.com/vendors/sampleviewer/default.asp?SID=74063740-471111915-410945431&VendorID=1282

Hurt, C. (2005). *Doing your masters dissertation: Realizing your potential as a social scientist*. London: Sage.

Jacob, C. (2008, April 7). Prince Charles delivers virtual speech as hologram. *Sky News*. Retrieved October 21, 2009, from http://news.sky.com/skynews/Home/Sky-News-Archive/Article/20080641301500

James, R. (2009). *3D holographic projection - The future of advertising*. Retrieved November 10, 2009, from http://www.articlecity.com/articles/gadgets_and_gizmos/article_1509.shtml

Mail Online. (2007, December 13). Prince Charles will appear at conference as a hologram. *Mail News*. Retrieved February 12, 2010, from http://www.telepresenceoptions.com/2008/11/holographic_presenters_jessica/

Mayer, R. E. (2005). *The Cambridge handbook of multimedia learning*. Cambridge University Press, p.8.

Musion System. (2009). *Musion on-stage holographic telepresence*. Retrieved October 21, 2009, from http://www.musion.co.uk/musion_telepresence.html

Nielsen, J. (1995). *Multimedia and hypertext: The internet and beyond*. Boston: Morgan Kaufmann.

Oates, B. J. (2006) *Researching information systems and computing*. London: Sage Publications.

Roberts, N., Carter, R. C., Friel, S. N., & Miller, M.S. (1988). *Integrating computers into the elementary and middle school*. Englewood Cliffs, NJ: Prentice Hall.

Serrao, J. (2008, November 6). Holobama: 'Holograms' greet election 2008. *Teleprence Options News*. Retrieved February 10, 2010, from http://www.telepresenceoptions.com/2008/11/holographic_presenters_jessica/

Setzer, V.W. (1997). Computers as instruments of counter-art. *8th Brazilian Conference on Computers in Education,* Brazilian Computer Society, 6-9 November.

Thompson, M. (2009, January 9). When daddy is off at war: A hologram home? *The Time*.

Universal-Hologram. (2009). *What is holography?* and, *How to light a hologram.* Retrieved October 17, 2009, from http://universalhologram.com/what_is_holography.htm

Welch, C. (2008, November 6). *Beam me up, wolf! CNN debuts election-night 'hologram'. CNN News.* Retrieved October 19, 2009, from http://www.cnn.com/2008/TECH/11/06/hologram.yellin/index.html

Biography

Husain Ghuloum is a researcher in Information Systems at Salford University. He worked lecturer at the Public Authority for Applied and Education (PAAET) in the State of Kuwait for around four years ago. Ghuloum got Master Information Science at Leeds Metropolitan University and currently working on research relating to ICT in Kuwaiti Higher Education at Salford University.