NEW MEDIA COMMUNICATION TECHNOLOGIES FOR FACILITATING ASYNCHRONOUS DELIVERY OF DISTANCE LEARNING FOR DIFFERING LEARNING STYLES: AFFECTIVE PEDAGOGICAL TECHNIQUES FOR MULTIMEDIA INTO THE NEW MILLENNIUM

Robert Fröhlich

Division of Electronic & Broadcase Media, Nanyang Technological University, Singapore.
email: tfrohlich@ntu.edu.sg
http://www.ntu.edu.sg/home/tfrohlich

ABSTRACT

There have been various descriptions of Learning Styles expressed over the years. All are based on how the individual gathers and processes information. From Schmeck's (1983) construct of cognitive complexity and Kolb's (1984) model of information processing, to Gardners (1983, 1993) multiple intelligences, these Learning Styles are all said to influence, if not predetermine, our preferred method of learning particular subjects and thereby predispose us each to only a few ways of learning. The paradigms utilised in Distance Education have evolved over many years, however, it is only relatively recently that Multimedia has been able to fulfil an integral role in facilitating Distance Learning through being able to provide differing instructional techniques to suit these different Learning Styles.

The facilitation of Education must always rely on content rather than the technology of the delivery medium. A well-drawn sketch on a blackboard can convey information much better than a poorly produced slide-show. This paper identifies the emerging New Media Communication Hybrid Technologies and devices, including Wearable Computing and 3D/Omnidirectional Video Imaging, and how they will be effective for facilitating true Flexible Delivery through a combination of Pedagogical Techniques and methods. These Communication Technologies will empower educators to construct asynchronous learning environments where all learners can be actively engaged in their individual learning experience, despite their differing Learning Styles. The paper also describes how the geographical barriers currently limiting the delivery of Distance Education, such as lack of electricity, telephone and broadband infrastructure, can also be broken down so that learners universally can become more actively involved in their own education.

KEYWORDS

Distance education, distance learning, new media technologies, learning styles.

1. INTRODUCTION

As we stand at the doorstep of the new millennium, with the world entering the 'information age' and broadband telecommunications technologies helping to create a global village, one pedagogical question which cries out to be answered is; how will students learn in the next millennium? Will the paradigms of Distance Education and training evolve to a point that all education will be facilitated through these styles of delivery and traditional face-to-face teaching will become obsolete. The answer to these questions largely depends on whether the majority

of the world's population will be able to learn successfully through these new methods of pedagogy. Learners will be best served, with ready cognition of the information being taught, if the delivery is tailored to their preferred learning style and therefore more affective for assimilation and cognition.

There have been various descriptions of Learning styles expressed over the years, all based on how the individual gathers and processes information. From Schmeck's (1983) construct of cognitive complexity and Kolb's (1984) model of information processing, to Gardners (1983, 1993) multiple intelligences, these Learning Styles are all said to influence, if not predetermine, our preferred method of learning particular subjects and thereby predispose us each to only a few ways of learning. Considering the differences in indigenous people of the world, it is highly probable that all the Learning Styles within the global village have not as yet been identified and classified, despite the extensive research that has been undertaken to date.

2. TECHNOLOGY IN DISTANCE EDUCATION

At the beginning of this century Gutenberg's printed word was at the forefront of delivering education and knowledge at a distance, and in fact delivering it asynchronously. Students who were able to read could learn a vast amount of information by reading texts when and where they wanted. If they did not fully comprehend what they had read, they could read it again, and again, and again if desired. If they still did not understand the subject matter they were left with few choices. Either they would have to read on, and hope that it made more sense as they got further into the document, or they could try to find another book, dealing with the necessary topic, that they could understand. Possibly they could consult someone who knew more about the subject than they did. It was rare for isolated individuals to have access to a variety of texts on any individual subject and even rarer for them to be able to find an expert on the subject whom they could consult for enlightenment.

Sound recording technology was one of the first medium to allow repeated access to individual segments of a non-textual presentation on demand. Recordings did not have to be listened to from start to finish, but could be listened to when and where, in the recording, the listener wanted. The advent of telephony, firstly with Morse-code and then later with two-way voice communication, meant that information could be distributed in almost real-time. However, the technology only allowed communication between a limited number of people at any one time. Users had to be connected to the telephone system, and once many parties were connected to the one line the quality of the transmission suffered dramatically. Then came the introduction of radio. This technology provided a realistic means of delivering Distance Education to many people, over a vast area, in real-time. Although only one person was able to speak at any given time, it allowed the educators to converse with their students through a two-way form of conversation. This synchronous style of Distance Education, or open learning, has been utilised by 'School of the Air', in combination with written texts and work-books, to educate children in outback Australia and other isolated areas for many years. Another form of technology which facilitated Distance Learning (DL) was motion picture. Documentary and training films have been utilised to educate many people in a form of quasi-asynchronous delivery, however, it was rare for the learners to be able to view the films on demand, and rarer still, to view individual segments of the films.

With the introduction of television in the 1950's, another possible medium was added for distance delivery but it didn't provide any facility for asynchronous learning. Also, due to the large distances involved in communicating with isolated communities and the reality that television broadcasting was only reliable over relatively short distances, this technology was not embraced by distance educators for many years. Terrestrial landlines were too costly to connect all of the isolated communities to the television broadcasts, which originated from the major population hubs, and so the technology was only embraced by mainstream educators to augment face-to-face delivery. It was not until satellite broadcasts were introduced in the early 1980's that television reception became available to many of these isolated communities. It was also not until the mid 1970's that video-recorders gained popularity and became common for delivering educational and training programmes in educational environments.

3. NEW MEDIA TECHNOLOGIES

We are now standing at the doorstep of the new millennium. With the emergence of New Media Technologies we may finally be taking our first steps towards allowing learners' preferred learning styles to prevail in the acquisition of knowledge. These technologies, in particular the New Media Communication Hybrid Technologies, may allow learning to take place at any time and in any location. They may also enable the delivery of intelligent multi-layered interactive multimedia solutions which will help ensure that learners are absorbing the desired information whilst not having to traverse subject matter for which they are already fully conversant. Although my crystal ball is no clearer than anyone else's, some of the New Media Technologies, innovations, and devices which I believe may shape DL paradigms and Distance Educational pedagogy in the new millennium are detailed below:

3.1 BROADBAND CABLE DATA NETWORKS

Broadband Cable Data Networks have been installed in many of the affluent urban areas of the world. Current technologies such as Asymmetrical Digital Subscriber Line (ADSL) operate at data transfer rates of up to 5.5 megabits per second (MBps). This is almost 100 times faster than the current Integrated System Digital Network (ISDN) connections. Asynchronous Transfer Mode (ATM) is another technology which utilises optical fiber to achieve transfer rates of up to 622 MBps, almost 1000 times faster than ISDN. These networks function in a two-way mode, meaning that data can be sent in both directions. The implications for the delivery of asynchronous DL are immense, with learners being able to download courseware and upload responses quickly and conveniently. One limitation, however, is that learners have to be connected to the cable.

3.2 SATELLITE DATA TRANSMISSION

Satellites are currently being utilised to download Internet data in various population centres of the USA. Through the use of low-Earth-orbit satellites (less than a thousand miles above Earth), Internet access is provided which is about four times faster than current ISDN connections. Presently users require a terrestrial connection for requesting information from the Internet or the uplinking of data. However, it is envisaged that in the future data from the user will be able to be transmitted directly to the satellite. Once this broadband technology is widespread and satellites are available to be accessed in all countries, future learners will not need to be 'plugged-in' and should be able to participate in DL from wherever they are on the planet, and whenever they want.

In order to facilitate this 'anywhere/anytime' learning, new forms of batteries and sustainable electric generation technology will be needed. These must be cost effective, in order for them to be affordable and become widely accepted. Storable Solar energy (CSIRO, 1995) may be an ecological solution to this issue.

3.3 HIGH DEFINITION TELEVISION AND DIGITAL TELEVISION

High Definition Television (HDTV) has approximately six times the information which is contained in traditional television formats. The resolution of HDTV is 1080 lines by 1920 pixels wide. Because of the large bandwidth required to transmit HDTV using conventional broadcasting technology, the analogue signal is digitised and compressed using algorithms to reduce the quantity of data involved. The transmitted signal is converted back to an analogue signal within the receiver. Digital Television (DTV) allows for the transmission of multiple channels, and when a return link is provided, either through modem or when delivered through broadband cable networks, allows the medium to be truly interactive. Depending on the effective authoring of the content and the client/browser used to receive it, Digital Television offers a valuable medium for the delivery of high quality DL.

3.4 VIDEO ON DEMAND

Video on Demand (VoD) is where the DTV data is stored on a central server and accessed by the client when required. There are many different technologies involved in delivery and there appear to be few standards to date. Limited implementations of this hybrid technology have been undertaken, but to date a major limiting factor has been the relative lack of true interactive programming available.

3.5 DIGITAL VERSATILE DISC

Digital versatile discs (DVD's) are also referred to as digital video discs (Internet.com., 1998). They are the same size as CD-ROM's and employ similar technology, but can hold up to 17GB of data. That is over 25 times the amount of data which can be stored on a CD-ROM. They utilise MPEG-2 to compress video data and have high data access rates, currently of up to 1.3 MBps. They are envisaged to have rates of up to 9.6 MBps in the future. DVD's provide random access to the data they contained and are also backward-compatible with CD-ROMs. Because of the huge amounts of data that can be stored they are a perfect medium for augmenting on-line delivery of DL. Large files which are unlikely to require change in the short-term can be distributed via this medium and combined with content distributed on-line. Re-writable DVD's (DVD-RW) have recently been released. Although they currently can not store as much data as pre-recorded DVD's (presently only 5.2 GB), it is likely that they will have the same high storage capacities in the future. Through the use of 'push' technology for on-line delivery of data combined with DVD-RW technology, it may be possible for learners to download entire courses and not require connection to either cable or satellite for the actual delivery of asynchronous DL.

3.6 MACHINE TRANSLATION

Machine Translation is technology which facilitates the translation of text from one language to another. Although it is still in it's formative stage, limited translation is available on the WWW (Digital, 1998). Currently translation is only available between English, French, German, Italian, Portuguese and Spanish. Once this technology is refined, and is available in all languages, many of the geographical barriers to globalised DL may be broken down.

3.7 BODY WEARABLE COMPUTERS

Body Wearable Computers (BWC's) are battery-powered computer systems worn on the user's body with a belt, backpack or vest. They are designed for mobile and predominantly hands-free operation, often incorporating head-mounted displays and speech input. Body wearable computers have been described as a means for personal empowerment and their attributes have been defined as; unrestrictive to the user; unmonopolizing of the user's attention; observable by the user; controllable by the user; attentive to the environment; communicative to others; constant: always ready; and personal: human and computer are inextricably intertwined (Mann, 1998). This style of computer is just starting to be used for various applications by NASA (Bentley, 1998), and will probably one day incorporate Human/Brain-Computer Interfaces (Carder-Russell, 1996) through the use neural implants.

3.8 3D/OMNIDIRECTIONAL VIDEO IMAGING

3D/Omnidirectional Video Imaging is made possible through a combination of two Omnicamera's. The Omnicamera has recently been developed at Columbia University. Essentially it is a video camera that can view all directions at the same time. Through the use of parabolic optics, the camera provides a 360° x 180° image which when decoded through the Omnivideo software produces images of normal perspective at full frame video rate. Users can selected any viewing direction and magnification from the video signal which contains the full 360° x 180° image. This technology can allow learners to navigate (pan, tilt and zoom) within both live video-conference environments and asynchronous deliveries of pre-recorded video footage.

3.9 INTELLIGENT AGENTS

Intelligent Agents are software entities utilising Artificial Intelligence which assist people and act on their behalf (Woodnorth, 1998). They are able to help us because they learn our preferences and are therefore able to know what information we want, or need, at a given time. They will certainly be of great assistance to us in the new millenium as our world becomes more and more complex and we have to sift through more and more information in the 'information age'. They are currently being used in business applications for manufacturing, health, finance, travel, retailing and many other industries including the internet. Currently IBM™ has a commercial multi-platform Java™ agent which is said to be able to:

- Learn a user's preferences, and predict a user's behavior based on personal history or on similar individuals' histories
- Learn about a sequence of steps, and predict steps to achieve the best result
- Learn to classify information, and assist in the classification decision
- Handle new cases and figure out what to do based on past experience
- Find the nearest match for a complex set of inputs (for instance, find the closest user like you)
- Give a confidence rating for predictions or conclusions
- Learn from other agents and promote knowledge sharing
- Do all these things with ambiguous or incomplete input

  (Woodnorth, 1998).

Through the use of these and other future attributes of intelligent agents, it is more than likely that they are going to provide a quantum leap in the delivery of DL through helping to tailor course delivery to suit learner's preferred learning style.

3.10 VIRTUAL DISPLAYS

Virtual Displays (VD's) have been around for some time, but the next generation of VD's bear little resemblance to the heavy cumbersome helmet style displays which are currently used. Human Interface Technology Labs, at the University of Washington, appear to be at the cutting edge of this new technology with their Virtual Retinal Display (VRD) project. In a conventional VD, an image is produced which is either viewed directly or projected through an optical system so that a virtual image can be viewed. With VRD technology the image is produced on the retina of the users eye. It is proposed that VRD's can be built with the following attributes:

- Very small and lightweight, glasses mountable
- Large field of view, greater than 120 degrees
- High resolution, approaching that of human vision
- Full colour with better colour resolution than standard displays
- Brightness sufficient for outdoor use
- Very low power consumption
- True stereo display with depth modulation
- Capable of fully inclusive or see through display modes

  (HITL, 1998)

In the future, this style of visual display when combined with motion sensors or trackers (ATC, 1997) and possibly satellite positioning using Global Positioning Satellites (GPS) (Trimble, 1996-1997), will allow for visual information to be superimposed over learners real-life vision. When VRD's are combined with headphones, utilising VR Audio (Lake DSP, 1998), they will allow learners to be fully immersed within virtual worlds, through both auditory and visual stimulus.

3.11 MULTIMODAL INTERFACES

Multimodal Interfaces are a form of Artificial Intelligence which will introduce many new elements into how human-computer interaction takes place. Multimodal Interfaces incorporate such features as computerised voice (text-to-speech), facial gesture recognition, speech recognition, as well as gaze and body motion recognition (HITL, 1998). By being able to recognise these different gestures and also able to converse directly with students via speech, future DL courseware may be able to identify learners preferences and address problems quickly. It should not require the completion and submission of assessment tasks in order to identify that the learner is having problems.

Through the use of Multimodal Interfaces, high level security features can also be incorporated. These may well utilise biometric linking techniques including; finger printing, face feature mapping, and voice printing (ImagineNation, 1997). Iris recognition is another technique which may also be included (IriScan, 1998) to give an even higher level of security. Such techniques, when combined with 3D/Omnidirectional Video Imaging, may prove invaluable for the invigilation of assessment tasks and exams for DL courses offering university credits. If we want to be 'over the top' about the validity of assessments, invasive Identification Microchips (Kac, 1997) could be used as well!

4. IMPLEMENTATION OF NEW MEDIA TECHNOLOGIES

The facilitation of Education must always rely on content rather than the technology of the delivery medium. A well-drawn sketch on a blackboard can convey information much better than a poorly produced slide-show. The paradigms utilised in Distance Education have evolved over many years, however, it is only relatively recently that Multimedia has been able to fulfil an integral role in facilitating DL through being able to provide differing instructional techniques to suit these different Learning styles. How will the emerging New Media Communication Hybrid Technologies and devices be effective for facilitating true Flexible Delivery through a combination of Pedagogical Techniques and methods?

Technology can be of great benefit in the delivery of Distance Education and DL, or it can become a barrier as well. Different people assimilate information through different cognitive paths and processes. We all are familiar with the "Chinese Whisper" situation, where a piece of information is told to one person, who tells it to someone else, who in turn tells it to someone else. This re-transmission of information continues, along with the addition of 'noise' and 'distortion', for a number of steps until the information transmitted bears little resemblance to the original information. This particular form of degradation of information rarely applies in Distance Education situations, because it is usually a single stepped process of dissemination of information which occurs. However, the information may still not have been correctly understood by the learner. This may be through the addition of noise into the learner's cognitive process because the delivery of the information did not align with their preferred learning style. The best way to be sure that the information has indeed been understood by the learners, is for them to have to put it into their own words or images, and transmit it back to the educator. This is usually achieved through the learners being subjected to answering questionnaires, completing exams and undertaking other assessment tasks.

In face-to-face delivery by a 'sage on the stage', the teacher usually has the benefit of having visual contact with the students and can gain some feedback as to whether 'the lights are on' and thereby whether the topic is being comprehended by the students. However, as people rarely want to 'lose face' and appear ignorant by asking questions in front of their peers, students are often inhibited in revealing that they are unable to follow the subject matter in front of the whole class. They may also be reluctant to make suggestions which may be perceived as incorrect (Koschmann *et al* 1995). Even experienced teachers are often unable to gain the required feedback as to whether they are attempting to teach the students topics which they are already fully conversant with. Because of this the teacher is often unable to move on to another topic without boring and alienating some students by regurgitating information that they already know. Students will usually respond to social pressure and stay until the end of class even if

they find the content boring and uninteresting. If the learning style of the student does not align with the manner in which the information is presented in the classroom or lecture theatre, the student may often leave at the end of a class or lecture with little more knowledge than when they entered. Students may have been presented with the required information, however, information is not knowledge. The cognitive transfer of information to knowledge may not have been facilitated through the style of delivery being mismatched with the students learning style.

In asynchronous DL there is often no social pressure to stay and complete the class. Masie *et al* (1998) asserts that when students are on-line they are usually merely one click away from exiting the programme. Learners switch-off and leave for a number of factors, some of which are:

1. "Been there, done that!" – Learners depart as soon as they feel the content is something they already know.
2. "I'll never use that knowledge!" – Learners depart as soon as they sense the content is not applicable to their situation.
3. "This site is SO slow!" – Learners depart as soon as the site, or their web connection, slows down to a crawl.
4. "I can't figure out what to do!" – Learners depart as soon as they get confused by the navigational commands or the technical aspects of the learning site.

   (Masie, 1998)

These factors need to be eliminated in order to keep learners motivated so they stay and complete the course. Learners find it greatly frustrating to wait for a long period of time to pass while data loads, when they may intuitively know what is contained. They need to be presented with a control to skip forward in the programme. One way of keeping the learners interested in their current learning process may be to utilise user-model based interfaces of the future. A prototype form of user-model based interface, utilising adaptive link annotation, has already been implemented on the WWW in the form of Adaptive Navigation Support (ANS). This has proved to be beneficial to student's learning as long as they accepted and followed the navigational advice provided (Eklund *et al*, 1998).

In the future, more advanced user-model based interfaces should allow us to make use of styles of delivery which appear to the learner as being less didactic, but facilitate the absorption of information and the cognitive transfer of information to knowledge more readily. The subject information needs to be designed for delivery in numerous ways to provide for different learning styles. These different styles of delivering information concordant with Learning styles, at a minimum may include for example, a written model for Assimilators and Convergers, whilst providing a constructive simulation for Accomodators and Divergers. These differing styles of delivery must be envisaged and planned for at the authoring stage of the courseware, and the delivery interface must also provide for this flexibility in delivery.

An intelligent agent (Woodnorth, 1998) client interface may provide the learner with their prescribed topics in a controlled navigational environment. The learner may unknowingly be restricted from travelling to wherever they want, but would transparently be directed in their travels by the client. They may only be offered a limited choice of navigational paths and would be gently steered throughout the learning experience. The intelligent agent would constantly update a profile of the learners knowledge and preferred learning style through the use of audit trails and constructive evaluative exercises and tests. The pedagogical preference for Problem Based Learning (Camp, 1996) could be facilitated through the student being given problems and then interacting with the intelligent agent to find a solution.

5. CONCLUSION

These Communication Technologies, if employed carefully, will empower educators to construct asynchronous learning environments where all learners can be actively engaged in their individual learning experience, despite their differing learning styles. Through the hybridisation of these new technologies we can also see how the geographical barriers currently limiting the delivery of Distance Education, such as lack of electricity, telephone and broadband infrastructure, can also be broken down so that learners universally can become more actively involved in their own education. It would appear that during the initial years of the new millennium DL will finally come to the forefront of educational delivery and gain the status it deserves.

6. REFERENCES

Ascension Technology Corporation (ATC). 1997. Ascention – Motion Trackers/Sensors, [HTML-WWW], Ascension Technology Corporation, http://www.ascension-tech.com/. 14/8/98.

Bentley, T. 1998. Body Wearable Computer Applications, [HTML-WWW], NASA, http://www.ksc.nasa.gov/payload/projects/borg/. 14/8/98.

Camp, G. 1996. Problem-Based Learning: A Paradigm Shift or a Passing Fad?, [HTML-WWW], Medical Education Online, http://www.utmb.edu/meo/f0000003.htm. 14/8/98.

Carder-Russell, R. A. 1996. Human/Brain-Computer Interface, [HTML-WWW], Carder-Russell, R. A., http://www1.shore.net/~rodc/hcibci.html. 14/8/98.

Columbia University. 1997. Omnicamera: Omnidirectional Video Camera, [HTML-WWW], Columbia University, http://www.cs.columbia.edu/CAVE/omnicam/. 14/8/98.

CSIRO. 1995, 1998. Storing Solar Power, [HTML-WWW], CSIRO Australia, http://www.det.csiro.au/Jun95-a.html. 14/8/98.

Digital Equipment Corporation. 1995-1998, AltaVista: Translations, [HTML-WWW], Digital Equipment Corporation, http://babelfish.altavista.digital.com/. 14/8/98.

Eklund, J., Brusilovsky, P., Schwarz, E. (1997). Adaptive Textbooks on the World Wide Web. *(AusWeb97 Third Australian World Wide Web Conference)*, [HTML-WWW], http://ausweb.scu.edu.au/proceedings/eklund/paper.html. 14/8/98.

Eklund, J., Brusilovsky, P., Schwarz, E. (1998). A Study of Adaptive Annotation in Educational Hypermedia: EdMedia Paper. [HTML-WWW], *(University of Technology, Sydney) http://ausweb.scu.edu.au/proceedings/eklund/paper.html.* 14/8/98.

Gardner, H. (1983, 1993). *Frames of Mind: The Theory of Multiple Intelligences.* Orig. pub. 1983 Heineman, reprinted 1993 Fontana

Human Interface Technology Laboratory. 1998. Human Interface Technology Lab – Virtual Retinal Display - VRD, [HTML-WWW], University of Washington, http://www.hitl.washington.edu/projects/vrd/project.html. 14/8/98.

Human Interface Technology Laboratory (HITL). 1998. Human Interface Technology Lab – Research, [HTML-WWW], University of Washington, http://www.hitl.washington.edu/research/advanced/multimodal/ 14/8/98.

ImagineNation. 1997. Biometrics - VAULT, ImagineNation [HTML-WWW], http://www.ImagineNation.com/Pavilion/Vault/Vault.htm. 14/8/98.

Internet.com. PC Webopaedia, [HTML-WWW], Mecklermedia Corporation, http://webopedia.internet.com/TERM/D/DVD.html. 14/8/98. http://webopedia.internet.com/TERM/D/VoD.html. 14/8/98.

IriScan, Inc. 1998. Iris Recognition Technology, [HTML-WWW], IriScan, Inc., http://www.iriscan.com/technology.htm

Kac, E. 1997. Time Capsule, [HTML-WWW], Eduardo Kac, http://www.ekac.org/timec.html. 14/8/98.

Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development.* Prentice-Hall

Koschmann, T.D., Feltovich, P.J., Myers, A.C., Barrows, H.S. (1995). Implications of CSCL for Problem-Based Learning. *(Computer Supported Collaborative Learning '95)*. [HTML-WWW] http://www-cscl95.indiana.edu/cscl95/outlook/32_Koschman.html. 14/8/98.

Lake DSP, 1998. Lake DSP VR Audio Solutions - All About Audio VR, [HTML-WWW], Lake DSP Pty. Ltd., http://www.lakedsp.com/vrweb/audiovr/index.html. 21/8/98.

Mann, S. (1998). WEARABLE COMPUTING as means for PERSONAL EMPOWERMENT - *Keynote speech of 1998 International Conference of Wearable Computing*, [HTML-WWW], http://wearcam.org/icwc/empowerment.html. 14/8/98.

Microsoft Corporation. 1998. Microsoft Personal Computing-Internet: Easily Access the Internet from Practically Anywhere, Microsoft Corporation, [HTML-WWW], http://www.microsoft.com/magazine/feature/tomorrow/access2.htm. 14/8/98.

Masie, E. (Ed). (1998). Learners Are One Click Away From Leaving! *(TechLearn Trends)*. [HTML-WWW], 62. http://www.techlearn.com/trends/trends62.htm. 17/8/98.

Schmeck, R. R. (1983). Learning styles of college students. *Dillon. R., Schmeck. R. (Eds.), Individual differences in cognition*, Academic Press. 233 – 279

Trimble Navigation Limited. 1996-1997. Trimble - GPS, Trimble Navigation Limited, [HTML-WWW], http://www.trimble.com/gps/howgps/gpsfram1.htm. 14/8/98.

Woodnorth, T. 1998. IBM Intelligent Agents Home Page, [HTML-WWW], IBM Corporation, http://www.networking.ibm.com/iag/iaghome.html#details. 14/8/98.

Woodnorth, T. 1998. IBM Intelligent Agents – MemoryAgent ™, [HTML-WWW], IBM Corporation, http://www.networking.ibm.com/iag/iaginkgo.htm. 14/8/98.