Internet-Based Education and Training: Using New Technologies to Facilitate Instruction and Enhance Learning

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Introduction: The Promise of Internet-based Education and Training in Aviation

The recent rapid growth of the Internet as a global telecommunications medium has also led to significant innovations in relation to the delivery of education and training. Many aspects of the learning process, from the presentation of information and interpersonal communication, to assessment of learning outcomes and performance, can now be supported using widely accessible Internet-based formats. Within the aviation industry, the Internet has recently been embraced as an innovative means of providing education and training. Stating a common perception of unlimited potential, Wilson (2000, p.22) suggests, that “the Internet is set to revolutionise certain portions of the training curriculum, as distance learning takes more and more pilots out of the classroom and on to the web”. One typical vision of the future of aviation training involves flight-crew members on a long-haul stopover logging into the company's secure web-site from a notebook computer in their hotel room and undertaking an Internet-based module on the A380 field-length requirements as part of conversion training. While this scenario might have been seen as an element of science fiction only a decade ago, today it is much more of a reality.

In an industry where staff who require regular training are frequently travelling across all corners of the globe, the benefits of an instructional delivery mode that transcends both space and time are obvious. Unlike classroom based learning, or traditional Computer-Based Training (CBT), which both require groups of students attending a central training location, the Internet allows the delivery of instruction any time, and in any place (Walters, 1999). The benefits from Internet-based training are typically seen in relation to cost savings and improved training efficiency. As Earp (2000) suggests, the adoption of distance learning in the aviation industry offers savings in relation to travel costs and scheduling flexibility, and considerable improvement in operation performance by allowing people access to instruction on demand.

While prospective gains in efficiency, along with reductions in costs, are certainly attractive to any organisation, the shift to Internet-based education and training must also be driven by reference to the use of the Internet as an instructional medium. From the perspective of instruction, the Internet has a number of potential uses including the delivery of course materials, interpersonal interaction and dialogue between students and teaching staff and the Internet can even be used as a medium for educational evaluation and assessment.
Perhaps the most common instructional use of the Internet currently involves the distributed provision of Internet-based hypermedia and multimedia courseware. Hypermedia and multimedia were developed as new computer-based forms of information representation and have been accepted as alternatives to the use of paper-based instructional materials. The term multimedia describes the storage and presentation of information in a combination of media forms: for instance audio, images, and text (Reushle, 1995). Hypermedia refers to the representation of multimedia in a hypertext system, where pieces of information are stored as nodes in non-linear networks, and connected through links. Together, these new forms of information representation can be used to build complex course materials. In order to understand better the potential of these new Internet-based forms of educational delivery, it is necessary to examine the use of these new information and communications technologies in relation to the principles of adult learning.

New Technologies and the Principles of Adult Learning

For decades computers have been used in instruction, and are now accepted as tools which can promote high quality learning outcomes through the provision of integrated multimedia instructional programmes. Historically, computer-based learning developed from within the highly didactic paradigm of behaviouristic models of learning. The early developments of teaching machines and programmed instruction embodied the very essence of the didactic transfer of knowledge and reinforced an overtly mechanistic and technical perspective of learning (Fry, 1961; Glaser, 1965; Skinner, 1968). In direct contrast to this legacy, Internet-based instruction offers means by which new modes of learning can be realised. In particular, a considerable amount of recent research has focussed on how the principles of adult learning can be realised through the use of new information and communication technologies (Laurillard, 1993).

When thinking about the role of the Internet in relation to adult learning, it is useful to reflect on the principles of andragogy, or adult learning theory. As described by Knowles (1983), andragogy holds that adults learn in a manner quite different from children, and therefore require different modes of instruction. In contrast to the emphasis on the didactic transfer of knowledge which is central to traditional pedagogy (childhood learning), andragogy (adult learning) involves instructional modes and methods that emphasise aspects drawn from our understanding of the cognitive development of adults. Three basic tenets of andragogy are important to the increasing use of the Internet as an instructional medium. Each of these principles of adult learning provides a framework for appropriately embedding Internet-based instruction within a training curriculum and can offer considerable guidance for practice.

A primary principle of andragogy is that adults have considerable autonomy as learners. This is to say that adults in general have the ability to engage in self-directed learning, through evaluating their own knowledge deficiencies, identifying their own learning objectives and assuming certain responsibly for their own learning outcomes (Rowntree, 1992). To a large degree this means a shift away from overly
Internet-Based Education and Training Matthew J W Thomas

prescriptive approaches to instruction typified by the traditional “chalk and talk” model. From the perspective of andragogy the role of the instructor, and thus by default the instructional medium, is to assist adults to learn in a way that enhances their capabilities to function as self-directed learners (Mezirow, 1981). The use of the Internet as an instructional medium has been shown to promote these important aspects of adult learning. Park (1991) discusses a number of research studies which have shown that hypermedia is ideal for adaptive student-centred instruction and increases learner control. Although using computer-based platforms that predate the Internet proper, these studies utilised a hypermedia format almost identical to that of the World Wide Web. In one such study it was argued that the potential of hypermedia systems lies in the provision of a non-constrictive information environment, where students choose the paths through information, and are engaged in a constant process of decision-making and evaluation through navigation (Roselli, 1991). More recent research has reinforced these findings through the use of Internet-based instructional materials and suggest that the information structures in Internet-based materials can mirror the development of students’ own knowledge structures (Barnard, 1997; Starr, 1997).

A second, and allied principle of andragogy, relates to the need for a practical and problem-based curriculum. Adult learners already have considerable experience and knowledge, and are most frequently engaged in learning tasks with practical implications for their everyday work tasks. Accordingly, the learning outcomes of adult learners can be greatly enhanced by promoting the integration of new knowledge within a framework of past experience and future practice. As Knowles (1983) suggests, andragogy involves a distinct shift away from techniques that involve the transmission of information, towards modes of instruction that are participatory and experiential. Moreover, it has been argued that in the aviation training environment a problem-based approach is essential to the development of more complex forms of knowledge and skills whereby a student is able to use acquired knowledge in a practical context (Henley, Anderson, & Wiggins, 1999). By constructing interactive learning environments in which students engage in the development of solutions to various problems, Internet-based learning can be enhanced. As recent research has shown, educational uses of hypermedia and can support various forms of problem-based and exploratory learning (Jacobs, 1992). Furthermore, the development of Internet-based simulation and part-task training by major equipment manufacturers illustrates the potential for these types of Internet-based learning in the aviation context.

A third and final aspect of andragogy that relates particularly to the use of the Internet in instruction is the role of interaction and dialogue in the adult learning process. Laurillard (1988; 1999) has developed a “conversational” model of adult learning, in which the processes of internal and interactive dialogue are seen as essential to the formulation of new knowledge and abilities. In turn, this naturalistic view of the learning process highlights several other important aspects of adult learning, including critical reflection, learner engagement and the socialisation processes inherent in knowledge-construction. As Laurillard states:
Essentially, a learning process complex enough to achieve the aims of academic learning must involve at least two participants, operating iteratively and interactively on two levels - practice and discussion - and connecting those two levels by the activities of adaptation and reflection (Laurillard, 1999, p.114).

According to this theory of adult learning, new knowledge is not merely acquired through passively receiving transmitted information. Rather, adults integrate new information into increasingly complex knowledge structures through a dialectic process in which dialogue is crucial. Through the provision of asynchronous, non-hierarchical and reciprocal communication environments, computer-supported collaborative work has been shown to increase participation, interaction and collaborative thinking (Boshier, 1990; Ruberg, Moore, & Taylor, 1996). Furthermore, Internet-based learning environments appear to provide a perfect forum for an academic discourse that promotes increased student engagement, critical analysis and reflection, and the social construction of knowledge. As Warschauer (1997) argues, computer-mediated communication forums allow for learning which integrates student interaction and critical reflection.

Each of these three aspects of andragogy, learner autonomy, practical and problem-based approaches, and the role of dialogue, are important to the development of Internet-based instruction. Moreover, the forms of non-linear information representation in hypermedia have been shown to create qualitative improvements in the construction of knowledge and understanding (Burbules & Callister, 1996). Recently, the engagement theory of information and communication technology use has been used to describe the potential benefits of Internet-based teaching and learning. By way of bringing together a number of different potential benefits, engagement theory encapsulates the means by which technology can provide student-centred learning. As Kearsley and Shneiderman (1998) describe:

The fundamental idea underlying engagement theory is that students must be meaningfully engaged in learning activities through interaction with others and worthwhile tasks...we believe that technology can facilitate engagement in ways which are difficult to achieve otherwise (p.20).

Emerging from the theories of qualitatively improved learning, research studies have shown that the use of information and communication technologies can lead to increased levels of cognitive engagement with the learning task, increased motivation, deeper levels of processing, and the construction of personal meaning (Burbules & Callister, 1996; Land & Hannafin, 1996). However, while much of the recent research has focused on the role of new technologies in facilitating qualitatively enhanced forms of student learning, a considerable amount of practice in the area still fixates on the possible increases to productivity, efficiency and cost-effectiveness. This focus on the "bottom-line" has the potential to detract from the production of effective instruction within the aviation industry.
Current Examples of Internet-Based Education and Training

Currently, there are considerable moves throughout the aviation industry towards the development of Internet-based training programmes. In all areas of the industry, from university-based ab-initio flight training, through to airline-based recurrency training, the Internet is being used to facilitate the delivery of distance education and training. To better understand both the diversity and potential of current practice, two innovative programmes will be explored in detail. While these programmes differ in educational objectives, curriculum development and instructional design, both use the Internet as an essential mode of delivery. Furthermore, through the provision of flexible learner-centred education, both programmes embody the major principles of adult learning.

Case Study One: Air New Zealand Internet-based Airport Familiarisation Briefings

Project Context: Training Requirements and Instructional Objectives

The Air New Zealand Internet-based Airport Familiarisation Briefings project was undertaken to facilitate the process of flight-crew acquiring and maintaining route and aerodrome proficiency qualifications. As a regulatory requirement under international air-transport regulations all flight-crew must undergo regular training and evaluation in relation to the routes and aerodromes they use. For instance, under JAR-OPS1.975:

(a) An operator shall ensure that, prior to being assigned as commander or as pilot to whom the conduct of the flight may be delegated by the commander, the pilot has obtained adequate knowledge of the route to be flown and of the aerodromes (including alternates), facilities and procedures to be used.

Similar regulatory requirements exist world-wide and ensure that all flight-crew are familiar with the particular characteristics and operational requirements of all airports serviced on specific routes, as well as the alternate airports that crews might be required to be familiar with given the need for diversion. Proficiency in relation to the specific requirements of a variety of unique airports requires flight-crew to develop a significant body of knowledge relating to local conditions, airport layout and airspace. Traditionally, this knowledge has been acquired by flight-crew during ground and simulator training and from personal study of the company's operations manuals. Flight-crew are then required to demonstrate their acquisition and effective use of this knowledge through adequate performance during recurrent route checks. While this process establishes a measure of operational proficiency, the overall training approach does little to assist flight-crew in developing an integrated body of knowledge nor does it employ the principles of adult learning.

To create a more effective training system, Air New Zealand has recently undertaken a major project to develop Internet-based airport briefings for their international flight crew. This project involved the development of individual modules of study constituting a detailed briefing for each of the airports Air
New Zealand service on their international routes. The overall objectives of this project were twofold. Firstly, the project sought to enhance the learning process in relation to flight-crew route and aerodrome proficiency by taking advantage of both the multimedia capabilities of CBT combined with the flexibility offered by Internet-based delivery. Secondly, the project sought to reduce training costs by removing the requirement to roster pilots to come to base specifically to complete the airport briefings.

**Technical Details and Instructional Processes**

The training programme was constructed using Macromedia Authorware, a well-known industry standard software application used for the development of computer-based training (CBT) packages. This software allows for the inclusion of multimedia content, and facilitates the development of an integrated learning package including elements such as the structured delivery of content and automated on-line assessment. Although used primarily for the development of stand-alone CBT packages, the software also allows for the development of Internet-based packages. Using a standard Web browser and a common software "plugin", users are able to login to a secure web-site from any computer with Internet access and work through the CBT package when required.

Each airport briefing covers a variety of topics including general details concerning the geographic location of the airport and its surroundings as well as issues relating to terrain and local weather patterns. The briefings also include operational information and cover details of long finals, short finals and take-offs, along with any operational restrictions relevant to particular airports. As an employee works through each module, they are required to demonstrate adequate development of knowledge by successfully completing a series of multiple-choice assessment questions that are strategically placed throughout the module.

**Figure One: Examples of Internet-based Airport Familiarisation Briefings**

From the perspective of instructional design and adult learning theory, each module is constructed to take advantage of the non-linear capabilities of Internet-based multimedia delivery and provide for instruction that is to some degree individualised. If the assessment procedure identifies learning deficiencies - by the student providing an incorrect answer - the student is taken back to the relevant section of the module for further study. This process is similar to "mastery" approach, whereby students are allowed a reasonable number of attempts at the assessment procedure until they meet the required standard (Keller, 1968). However, due to the nature of the multiple choice assessment task, if a student provides a second incorrect response they are told the correct answer and not allowed further attempts on the relevant section.
As discussed previously, an important aspect of adult education and training is learner autonomy. The Internet-based airport briefings developed by Air New Zealand provide a good example of how the Internet can be used to enhance learner autonomy in the aviation training environment. Although not fully implemented at this stage, the ultimate aim is to give flight crew more responsibility for their own learning by providing access to the required aspects of the instructional programme. Using the Internet as an instructional medium in this way allows flight-crew to undertake their study in their own time and at their own pace.

**Issues and Areas for Consideration**

An important issue highlighted by the Air New Zealand project, and one which is common to many forms of Internet-based training, is that of user-support. In this case, flight-crew are provided with the opportunity to study from home as an alternative to access to the Internet-based modules from the Air New Zealand "Standard Client Architecture" computer terminals located at Air New Zealand bases. However, if future moves were made towards a complete shift to Internet-based training, the issue of user-support would become more critical. Even within a large organisation, only limited technical support can be provided for the flight crew who chose to undertake their airport procedures training using the Internet from their home computers. If users have difficulty with the configuration of software or the installation of a necessary plugin on their home computers most organisations are unable to provide detailed support. One possible step towards a solution to this ongoing problem might be through standardisation, whereby a training provider will specify the required hardware, operating system and software necessary for successful operation of the Internet-based instructional materials (Jones, Kirkup, & Kirkwood, 1993). Air New Zealand make recommendations for the minimum requirements in relation to the computer specifications for running the Internet-based instructional modules. However, an on-going issue for any training provider relates to the responsibility for purchasing and maintaining 'personal' equipment used for what is essentially the maintenance of work-related competencies.

Another issue that is highlighted by this case study is the need to clearly define the instructional purpose served by Internet-based instruction within the context of an integrated training programme. It is apparent that internet-based instruction has certain strengths and weaknesses that must be taken into account in the overall instructional design. For instance, while a practical and problem-based approach has been stressed as a key concept in adult learning the common predilection towards the use of multiple-choice testing in the Internet-based training environment has the tendency to promote learning more aligned with the passive transfer of knowledge. While multiple-choice testing is a particularly robust means of assessing knowledge-related learning outcomes, it is not always an effective technique for assessing skill-based behaviours such as problem solving (Gronlund & Linn, 2000). Furthermore, with the expectation of multiple-choice testing, students can commonly develop only declarative forms of knowledge whereby they are able to accurately replicate the information presented in the instructional material, but lack a sufficiently complex understanding of the material to effectively use it in the operational environment.
Within the context of flight-crew acquiring and maintaining route and aerodrome proficiency qualifications, Air New Zealand use Internet-based instruction specifically to streamline the process of preliminary knowledge acquisition. The Internet-based modules are therefore seen as a small element of a larger programme in which the simulator and line training syllabus is designed to build the operational competencies for effective crew performance. This approach clearly defines the role of the Internet-based instructional materials, and uses the medium in a way that takes advantage of its strengths as an effective means of presenting information in a multimedia format.

**Case Study Two: Massey University School of Aviation Internet-Based University Study**

*Project Context: Training Requirements and Instructional Objectives*

The delivery of flexible and distance learning within the higher education sector has been a focus of considerable recent growth. Most universities now offer some portions of their degrees through a distance learning option, and the Internet has become a common medium used to expand the range of educational delivery (Bates, 1995). The School of Aviation at Massey University has been a pioneer in the development of Internet-based aviation distance learning within their Bachelor of Aviation degree. As part of a University that has a long history of traditional paper-based distance learning programmes, the School of Aviation has recently led the shift towards utilising Internet-based delivery as a core element of their distance education programmes.

The aim of the Bachelor of Aviation degree is to assist students with the development of a wide range of knowledge and skills relating to professional practice in the international aviation industry. Not only concerned with the development of the operational competencies, the degree programme is designed to provide students with integrated academic, technical and practical knowledge, along with generic skills such as high-level problem solving and decision-making (Hunt, 2000). Accordingly, the choice to include elements of Internet-based delivery in this academic environment has been driven by the need to explore alternative delivery modes that can be used to achieve these enhanced learning outcomes. Furthermore, using Internet-based delivery, in conjunction with more traditional delivery modes, also provides a mechanism for the globalisation of the Bachelor of Aviation degree programme. As a global telecommunications network, the Internet allows for access to study materials at any time and any place. Therefore, with the use of appropriate instructional design, students are able to engage in academic studies whether they are located on campus or overseas.

*Technical Details and Instructional Processes*

The Internet-based course materials are developed using Macromedia Dreamweaver and Macromedia Flash software packages. These packages enable both the development and integration of multimedia content into individual modules of study. Once the course materials are developed, they are placed within the framework of a WebCT database. WebCT provides a flexible Internet-based learning environment which facilitates the organisation of multimedia course materials, enables the
integration of on-line discussion and collaboration into the Internet-based courses, and also provides a number of tools for assessment, evaluation and student management. The use of this purpose-built software packages enables the creation of learning environments in which a number of different forms of Internet-based learning can be integrated as elements of an overall instructional design.

The typical format adopted by the School of Aviation in the development of their distance learning curricula is that of multi-modal delivery. Multi-modal delivery involves the use of a variety of media as elements of an overall educational programme. Furthermore, as a framework for instructional design, multi-modal delivery uses what can be termed a "complimentary approach" to information technology use in higher education. The complementary approach seeks to take advantage of the particular strengths of different instructional delivery modes in creating an enhanced educational programme (Thomas, 2000). For instance, a print-based resource or perhaps a face-to-face practical session might be used to complement Internet-based course materials. The underlying assumption that drives the complementary approach is that the learning environment is a powerful mediator of the approaches to learning that students adopt, and the outcomes that they achieve. Accordingly, this approach to instructional design involves not using technologies for types of learning activities they cannot yet adequately support, and seeks to promote balance and diversity throughout the curriculum. The diagram in Figure Two illustrates how both innovative Internet-based and more traditional face-to-face instructional elements can be integrated to produce an effective instructional design.

**Figure Two: An Example of a Complementary Approach to Internet-based Instructional Design**

One of the major objectives of the complementary approach to Internet-based instructional design is the development of frameworks for students' knowledge construction and skill development. To achieve this objective, instructional materials are created such that the learner is guided through a developmental progression that begins with the introduction of pre-requisite knowledge. Subsequent instructional materials and activities then assist students to progressively build on this foundation knowledge and create increasingly complex knowledge structures and skills. Another essential element of this approach is the alignment of appropriate learning activities with the desired learning outcomes. As Biggs (1999) argues, the learning activities and assessment tasks embedded within a curriculum are powerful determinants of student learning outcomes. Therefore, by aligning the desired learning outcome with appropriate instructional processes, the resulting curriculum can be both effective and authentic. Figure Three shows two screens from a typical Internet-based course.
From the perspective of adult learning theory, the Internet-based distance learning programmes at Massey University are designed to promote the three major aspects of andragogy. Firstly, learner autonomy is supported through the provision of learning self-paced learning materials. The students are provided with some structure to guide their studies, such as a scheduled lecture series or assessment due date. However, these events are used only as indicators to ensure progression through the materials and students are otherwise able to progress through the course of study at their own pace. Secondly, the alignment of learning and assessment tasks ensures the development of a practical and problem-based curriculum. Throughout the course of study students engage in activities that requires the use of newly acquired knowledge in solving authentic problems. Finally, the use of complementary face-to-face sessions and Internet-based communication tools are used to promote the ongoing use of internal and interactive dialogue in the learning process. Through the process of dialogue, students are encouraged to articulate their emergent understanding. Accordingly, they must engage with the academic subject matter at a deeper level. However, the use of Internet-based tools for on-line student interaction presents an area in need of further consideration.

Issues and Areas for Consideration

The social dynamics of computer-mediated communication presents an area for careful consideration, and the existing research presents some contradictory evidence in relation to the use of Internet-based communication tools in the educational setting. Linda Harasim (1990), a pioneer of new information and communication technology use in education, introduced the educational world to the potential of Internet-based communication tools. She suggested that the new technologies would provide powerful new environments for learning which could enhance social and intellectual connections. She states:

Like face-to-face education, online education supports interactive group communication. Historically, the social, affective, and cognitive benefits of peer interaction and collaboration have been available only in face-to-face learning. The introduction of online education opens unprecedented opportunities for educational interactivity (p.42).

During the last decade it has become widely accepted that information and communication technologies promote the development of communities of learning, which in turn promote learning characterised by student interaction, reflection, collaboration and co-operation towards the social construction of knowledge. However, there is little empirical support for these assumptions and even though the use of Internet-based communication tools has been increasing exponentially over the last decade, there is a considerable amount of contradictory evidence as to its potential in the educational setting and (Walther, 1992).

As early as the mid-1970s it was hypothesised that new forms of telecommunications media vary in their degree of social presence, and therefore have affects on group interaction (Short, Williams, & Christie, 1976). In relation to Internet-based communication tools, the asynchronous, text-based, and
remote nature of computer-mediated communication strips communication to its very basis, and removes many supposedly extraneous elements. Further, it is often suggested that the lack of non-verbal cues produces a depersonalised form of interaction (Ruberg et al., 1996). As Taylor (1998) has also found, introverted students are more likely to benefit from computer-mediated communication than extroverted students, as introverted students find it easier to express themselves in the depersonalised forum. Recent studies have suggested that Internet-based communication tools may be limited in their ability to support the rich forms of student interaction that are essential predicates to enhanced academic learning (Thomas, 2000). Accordingly, this remains an area where further empirical investigation is required.

Another issue raised by the Massey University School of Aviation case study relates to the control and validation of qualifications within a strict regulatory environment. For university aviation programmes, in which both academic and practical elements of the curriculum contribute to the issue of qualifications and licences, it is essential that strict control be kept in relation to the authentication of student work. To this end, students’ access to course materials and assessment is restricted with usernames and passwords and student access is logged to ensure they are covering the required syllabus. However, even by restricting access and monitoring use of Internet-based materials the university has no means of unconditionally verifying the identity of students who participate in Internet-based instruction. Accordingly, it remains necessary to have in place assessment techniques in which the students’ identity can be verified without question.

Conclusion: Promoting Enhanced Learning through Internet-Based Delivery

While the Internet obviously holds great potential to enhance education and training, there is also the need for caution as we move swiftly to adopt what are essentially radically new forms of computer-based learning. The Internet, like any other instructional medium, has unique characteristics, and its own set of strengths and weaknesses. From the preceding examination of the current research and practice in the field of Internet-based education and training, it is apparent that the Internet offers a great deal in relation to the presentation of multimedia course materials. Unfortunately, there is a trend to focus on the innovation involved in Internet-based delivery at the expense of achieving enhanced learning outcomes for the participants involved (Windschitl, 1998).

An important principle which must guide our adoption of Internet-based instruction is that the Internet is not a true educational technology. Indeed, at this point in the development of Internet-based educational delivery it is timely to be reminded of the origins of educational technology. As what was essentially an approach to instructional design, educational technology was first defined as a well disciplined and systematic approach to education and training, characterised by explicitness, sophisticated analysis, synthesis and the utilisation of optimal decision-making procedures (Davies, 1972). Unfortunately, this perspective of educational technology is not almost completely lost, and
current definitions of educational technology focus on the use of computer software and hardware in the learning process.

By definition, the Internet is an information and communication technology, designed specifically for the efficient global transfer of information stored in a digital format. To this end, the use of Internet-based applications for the purposes of instruction can easily take for granted the need to adopt the appropriate principles of effective instruction design. Recent research has highlighted the failure of many Internet-based instructional materials to promote effective learning outcomes. As Landa (1998, p.55) suggests, Internet-based materials have the propensity to actually inhibit the development of higher-order transferable cognitive skills. This is largely because the medium lends itself to the presentation of information in a highly structured and condensed format. Accordingly, instructional materials can adopt an overtly didactic mode, teaching the solutions to problems rather than promoting the use of students’ skills in problem-solving, or promoting the development of socially negotiated structures of personal meaning. Further, Internet-based instruction frequently rewards the reproduction of information rather than deeper levels of cognitive engagement through the promotion of analysis, evaluation and personal reflection. This sentiment has been echoed by Doherty (1998, p.61), who states:

We are in danger of forcing the Internet into becoming a passive surfing technology. Instructors are presenting more and more traditional educational material on the Internet, with little consideration of the Internet's unique features. These features, if properly identified and utilised, can make learning an active experience.

High quality instructional design and the use of a complementary approach to Internet-based instruction are important strategies that can be used to avoid the promotion of poor learning outcomes. Indeed, perhaps one of the most valuable benefits of shifting aviation education and training programmes to Internet-based delivery will be a renewed focus on the fundamental principles of good instructional design. Through a process of needs-analysis, instructional programme review and curriculum redevelopment, the integration of Internet-based instruction has the potential to enhance both teaching and learning.

Although the last decade has been a period of radical change in relation to the instructional use of computers, there remains a considerable deficit in our understanding of the most effective use of Internet-based instruction. Particular focal points for future research include the analysis of the social dynamics of Internet-based communication, the further development of Internet-based assessment techniques along with the creation of instructional design tools to aid the development of Internet-based instruction that embodies the major principles of andragogy.
Recommended Readings


References


Figure One: Examples of Internet-based Airport Familiarisation Briefings

Hong Kong Airport (Jul 2000)

Note how close the island of Lantau is to the airport. The terrain rapidly rises, reaching 3068ft within 3 miles of the airport’s Southerly boundary.

Significant low level windshear and moderate to severe turbulence can be expected when prevailing winds in excess of 15kts are from the direction of Lantau Island, i.e., from NE through SW. When windspeed exceeds 30kts severe turbulence can be anticipated. The surface wind at the airport is not a good indication of the prevailing wind on approach due to the terrain and land-sea effects. Pilots should use the wind conditions at 2000ft on approach to assess the likelihood of significant local effects further down the approach. With strong winds (25kts plus) from the NW to NE, significant low level windshear and moderate turbulence should be expected.
Figure Two: An Example of a Complementary Approach to Internet-based Instructional Design
PCATDs offer aviation training many benefits due to their low cost and high accessibility. Furthermore, a good deal of research has been undertaken to examine the effects of PCATDs on flight training performance. Studies have found that every day with PCATDs can offer a reduction in actual flight training time in the aircraft. Others studies have shown that there is no difference exists between training on a PCATD and training in a full-scale simulator.

The reading below highlights some of this research, and also discusses at length the the interplay between fidelity and transfer of learning.

**Activity:**

*Reading: Personal Computer-Based Flight Training Devices*


Simulation is a means of "learning by doing," or what is often termed active or experiential learning. These types of learning enable the student to learn through actual experience of the tasks and competencies required for operational performance. The objective of experiential learning is to promote the transfer of what they have learnt in the simulation to the real-life situation. In order for learning through simulation to be effective, and to enable such transfer of learning, the simulation must have a high level of fidelity.

**Fidelity**

The concept of fidelity refers to the degree to which the simulation represents reality, or in other terms, the realism of the simulation. Two types of fidelity are important to simulations in aviation. Firstly, task fidelity refers to the degree to which the simulation represents the actual flight mission as a whole. Secondly, instructional fidelity refers to the degree to which the simulation enables the learning of new skills by the pilot.

Figure Three: Examples of Internet-based Course Delivery at Massey University