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Learners as actors: strategies for computer-enhanced learning encounters

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LEARNERS AS ACTORS:
STRATEGIES FOR COMPUTER-ENHANCED LEARNING ENCOUNTERS

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SUMMARY

The extent to which interactivity represents an implicit characteristic of computer-based learning environments has been increasingly scrutinised. Investigating the question as to which aspects of interactivity contribute to the engagement and focus of the learner during such encounters, a research study was devised to examine the ways in which learners both perceive and work with interactive constructs. Working with a total group of 70 participants from an undergraduate program in multimedia studies, a qualitative methodology was employed to examine, through survey and observation, those elements of computer-based interactive environments that impact on the overall effectiveness of, and subsequent engagement with, content material.

Considering the array of approaches to computer-based learning, such as instructivist and constructivist, the theoretical paradigms contributing to design and implementation and the contemporary proposals advocating metaphors of theatre and narrative, the outcomes of the research supported an extended focus for design. Whereas learners appear to have clear expectations of what an interactive learning environment will provide, the actual experience of that environment can appear confused through conflicting messages and missing information. Conceptualising the learner-computer relationship as a series of encounters, and positioning the learner as an integral character or actor within that encounter, can enhance the user-centred design approach and extend the design focus beyond that of content and interface.

Adopting such an approach will potentially assist in making computer-based educational technology work more consistently and result in even more effective and engaging encounters.

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INTRODUCTION

This thesis is about computers and learners, about the use of software to enhance learning and about the ways learners and computers interact. Producing this thesis has not simply been a matter of completing a rigorous, academic research process, but is better seen as a product of a journey that began in my childhood and has yet to end. From my first encounters with computers, my experience in developing and teaching computer-based learning and my research focus on computer-based interactive learning, I have maintained a belief and optimism in the value learners can gain from educational material delivered by and accessed from computer-based applications. This brief introduction expresses how that optimism has been maintained, why the research is important for our field and the direction I, and others, might take from here.

FROM POMPEII TO PLATO

As a young child in the early 1960s I emigrated from Great Britain to Australia. As we sailed from Southampton on a cold night in late November, I began a journey that was to expose me to new and different places. I can still recall the rough voyage through the Bay of Biscay and our first port of call at Gibraltar, where I watched monkeys scrambling up the famous rock, not cowering behind bars. Then the smooth blue of the Mediterranean and our journey from Naples to the silent homes and temples of Pompeii - where small figures were captured in their final attempt for escape, encased in stone forever - with a smoking Vesuvius towering above.

But it was in Port Said where I first encountered a glimpse of the magic our world can offer. On a balmy evening, strolling through the sandy grey-brown streets, our family was confronted by two men in long flowing robes, one of whom proceeded to pull an egg out of my ear! The magic fascinated me, but as he tried the same trick with my more conservative father, he was given a few pieces of change and we moved on.

Over the ensuing years, my wonder at the magic open to us has not diminished. Towards the end of high school, I can vividly recall the amazing sights of inland Australia and an emu-dance performed by a local Aborigine. Here was a man in old baggy pants, a jacket festooned in badges, a tilted army hat and a weathered, bristly face who transformed almost instantly into a desert bird hunting and pecking through the scrub. Not long after, as an undergraduate in the early 1970s, I encountered my first computer. While writing a Computerised Crook Catching program, a simulated exercise to compare witness descriptions with the characteristics of known criminals to identify likely suspects, I learned much about both the power and simplicity of this technology. In the same way that a person could, from my cultural perspective, almost magically transform into a bird, so too the computer could transform data into valuable information.

Then after working as both a teacher and computer programmer, I was fortunate to view a presentation by the designer of PLATO (Programmed Learning for Automated Teaching Operations) to the 1976 Australian Computer Society conference in Perth. Of particular fascination was the moment when Dr Bitzer was, by touching the display, moving bees from one screen location to another. During this demonstration he paused to make observations to the audience but was interrupted by the computer saying "Dr Bitzer - you still have a bee on your finger"! This was a defining moment for me, as I perceived a potential for communication and interaction between computer and human that could engage, humour and educate.

In the same way that these images of entombed figures, street magician and desert impersonator have engaged my senses, so has that initial magic of PLATO provided me with a context to understand computers as a learning tool. This is the magic of surprise, like an egg appearing from nowhere, or the magic of awareness when links between people and the land emerge, or the magic of delight seeing animals in their natural habitat. Perhaps more accurately, it is simply the magic of our dynamic, living planet. However it is this magic which we have the capability to harness and expose through computer-based learning experiences.

Over the past twenty years I have endeavoured to apply this analogy of magic through my work as a computer-based learning analyst, courseware developer and teacher of educational technology. However, as the challenge to make educational technology

work better remains (Reeves, 1999), I wonder whether the potential of computer-based learning technology has in some way been constrained - has its *magic* been compromised?

PROMISES - PRACTICES - REALITIES

Over much the same period as I was discovering this form of magic, so computers and Computer-Based Learning (CBL) were emerging and evolving. When first conceived, computer-based learning was manifested as a teletypewriter terminal linked to a mainframe computer - input was by keyboard and output through printed responses. Since then computer technology has changed remarkably - from the introduction of stand-alone personal computers to the development and rise of the internet and world-wide web, and from monochrome displays to high-resolution colour images enhanced with audio, video, graphics and animation. Likewise, CBL has evolved from question and answer tutorials to exciting micro-worlds and information landscapes. Learners from pre-school to the workplace have been confronted with a vast array of tutorials, drills, simulations, tests, games and performance-support systems. As the technology developed, so did the complexity of the displays and the activities and choices made available to the learner.

Nevertheless, while many CBL developments were presented to demonstrate the effectiveness of the technology, research studies and reports have continued to debate the overall efficacy of the technology in terms of adding value to the learning process (Kulik, Bangert & Williams 1983; Juchau, 1999). This on-going debate has been paralleled with new releases of computer hardware and software, frequently promoted as providing the necessary enhancements to add such value to computer-based learning. In the past four decades this technological imperative has seen coloured displays, hypertext, multimedia and the world wide web boldly paraded as solutions for effective education. Not so long ago it was the multimedia CD-ROM that was touted as being able to truly enhance the learning process, now it is the internet and web-based learning. However, it is my perception that it will only be through the endeavours of specialised development teams with expertise in education and technology that consistently effective computer-based learning will be achieved. Computer technology will enable the implementation of applications designed to represent contemporary approaches to teaching and learning.

The **promise** of computer-based learning was of one where the individual learner could access educationally structured content, control the pace and sequence of its presentation and, through this interaction, learn from questions, answers and manipulation of objects. This individualised and adaptive environment, it was predicted, would change the traditional teacher-learner relationship to a learner-centred and teacher-facilitated environment. Learning would not only be faster, but better.

The interactive nature of computer-based environments – that is one in which the computer could respond to a user's input – was perceived as integral to the learning process (Alessi & Trollip, 1991). It was assumed that in the same way a teacher responded to and communicated with students, so too the computer could provide individual responses and feedback. The interaction embedded within this human-computer encounter was promoted as comparable to the teacher-learner interaction.

In order to achieve this promise, a range of **practices** designed to support the implementation of effective educational software applications have also evolved. These embrace a combination of contemporary software development methodologies (ranging from systems analysis to rapid prototyping), instructional systems development techniques and learning or instructional theories (spanning behavioural, instructional, cognitive and constructive approaches). One's philosophical approach to learning and training influence the way in which content is presented to the learner and the opportunities provided to the learner to interact during that presentation.

The software tools created specifically to support the development of computer-based learning resources have ranged from complex programming languages to fill-in-the-box templates; the former often too complex for educators, the latter too rigidly structured to take advantage of the power of computer technology. Having worked as a developer of educational software, it is my experience that implementing interactivity is especially difficult if one does not have a comprehensive understanding of both the computer and pedagogy. It is my perception that the recurrent criticisms of this technology may partly be due to developing educational software without an appropriate skill combination, as the level of computer programming skills will to some extent determine the effectiveness of the presentation and interactions (Sims, 1997a). As we stand today, this is the role of a development team with complementary knowledge and skills.

Outputs from these development practices have been manifested through a diverse range of computer-based learning applications, from the commercial educational games directed primarily at the schools' market, to those produced in-house for the workplace. The school environment has generally seen an emphasis on constructivist aspects of learning, with the computer used as a tool, whereas the work environments have evolved a more traditional instructivist approach, with the computer more frequently taking the role of trainer. Recently however, applications embodying performance support systems and just-in-time training have become more widespread. In the university sector, developments have evolved from those of individual enthusiasts and student-driven applications to one where centralised management of educational technology initiatives is more commonplace.

The practice of computer-based learning has also been influenced by the research culture, focusing on issues such as learning outcomes, individual differences, learning styles and learner control. The operation of learner control has been one of the more frequent objects of research, and while findings have been ambivalent, the overall quality of the research has also been criticised (Reeves, 1993). Other research efforts have focused on the achievement of desired learning from specific applications. However, in a field with learners ranging from pre-school to adults, topics as diverse as elementary mathematics and theatre and outcomes varying from knowledge to skills to attitudes, it is not feasible to generalise when specific operational attributes of the technology will work effectively. However, as computer technology has an increasing impact on our day-to-day environment, the challenge remains to maintain a research agenda to focus on making computer-based learning work better (Reeves, 1999).

The field of educational technology has also been subjected to rigorous and contentious debate. From the design perspective, the argument has focused on the means by which material should be structured to maximise instructional or educational effectiveness, typified by the instructivist-constructivist arguments (Merrill, Drake & Pratt, 1996). The alternatives described by Taylor (1980), where the computer can be either tutor (doing the teaching), tool (helping the learner) or tutee (learning from the learner), also reflect the complexity of applying computer technology to the educational context. The extent to which the media itself impacts learning outcomes has also received considerable attention (Clarke, 1983; Kozma, 1991), challenging the assumption that new computer technology will *de facto* provide enhanced learning opportunities.

The notion of interactivity, considered an implicit attribute of the technology, has also undergone analysis and critique. Early analyses of interactivity (Rhodes & Azbell, 1985; Hannafin, 1989) proposed a hierarchical structure in which more interactivity was considered more desirable. Taxonomies constructed by Jonassen (1985), Schwier & Misanchuk (1993) and Borsook & Higginbotham-Wheat (1991) extended the complexity of interactivity, although focusing on more being better. Sims (1997a) described interactivity from a development perspective, suggesting the different types of learner-computer interaction would enable more engaged learning and Aldrich, Rogers & Scaife (1998) introduced the cognitive aspects of the interactive process. Nevertheless, over this period the concept of interactivity has been regarded as difficult to define to the extent that Rose (1999) queried its role in the computer-based learning process. As the field evolves and changes, so must our interpretation of what constitutes an interactive learning environment.

One of the intriguing aspects about this evolutionary process is that it in some ways represents an attempt to use the computer to support a range of learning experiences by imposing existing educational artefacts, such as a classroom, book or teacher. But is the computer merely a mirror for our existing artefacts, or is it in some way an independent different device that we must understand better in order to maximise its effectiveness and application within educational environments? Rather than trying to model the computer after existing artefacts, constructing totally new models on which to base applications for education and learning may enhance the structure and effectiveness of computer-based interactivity.

FROM CLASSROOM TO THEATRE

From the more formal prescriptions of instructional design and behaviourism have emerged new expectations of computer-based learning that address this issue of how the computer should best be used. Jonassen (1996) emphasises the importance of the computer as a tool, introducing the concept of Mind Tools as a means to express the relationship between learner and computer. Work has also been undertaken to assess the extent to which computer-based applications might be compared to theatre (Laurel, 1991) and the role narrative plays in supporting understanding and engagement (Plowman, 1996a). What these analyses suggest is that computer-based technology, especially in the learning environment, is not simply an animated, multimedia text, but a

complex and intricate relationship between the learner and those responsible for creating the application itself. Using the theatre analogy, we can imagine the learner as actor and the developer as author and director; the actor interprets their role, but under the guidance of the director and with give and take from both. With the narrative analogy, the learner is best served when they become part of the story and take on the role of a lead character in that narrative.

The importance of these approaches is that communication between learner and computer is not simply one of transmission, but one that should be dynamic, adaptive and individual. How this can be achieved using computer technology is not necessarily a technical issue, but rather one where developers are challenged to establish with the learner the roles they can adopt and the possibilities available to them within the particular application.

The essence of this shift from classroom to theatre can be expressed as an attempt to redefine the relationship between computer and learner. The analogy of computer as teacher has not produced the hoped-for results and the instructional design and software development procedures have failed to generate consistently good material. In contrast, the positioning of the learner as actor and character is a relatively new concept in the area of computer-based learning. This then suggests that computer technology is in need of its own set of design and development structures, rather than adapting to those originally designed for other media or environments.

OVERVIEW OF THE STUDY

Despite the research, the technology and the applications, the promise of computer based learning technology has not been consistently realised. I maintain my belief in the power and potential of this technology as a learning resource and consider it timely to examine the field from a different perspective. Rather than assess a single application on its ability to impact learning outcomes, this study was designed to focus on the very aspect that defines the field - **interactivity**. If we can better understand the ways in which learners communicate and interact with computer-based learning applications, then we should be able to provide a more flexible and comfortable environment in which to undertake that learning. More importantly, if we can better understand the way learners wish to communicate and learn with computer-based material, then

developments in both computer technology and learning practice may also be accommodated through enhanced learner-inclusive design strategies.

This study examines the interactive nature of computers in the context of applications where the user is working independently with content material structured to support a learning process or training function. While the technology has been demonstrated with all levels of learner – from pre-school to adult – the prime focus group for this study is the adult learner. And while there are many ways in which interaction and interactivity might be considered (for example learner-content, learner-instructor, learner-learner and learner-interface), the study is specifically interested in the interactions and associated interactivity that take place with the independent learner. In brief, the study is focusing on the ways in which individuals, in a learning context, process and understand material presented by the computer.

Computer-based learning has experienced promises of its value as a learning resource, debates on its educational effectiveness, variations in how people learn and an almost diffuse understanding of the nature of interactivity. Given this environment, this study explores the extent to which a deeper understanding of the interactive process might better enable the success of computer-based learning applications.

The following summary of the chapters describes how these questions were derived, the methods used to collect data and respond to these questions and the implications for the ongoing development of effective computer-based learning applications.

Chapter 1 explores the **promises** of educational technology and the elements within the field that have prescribed the importance of interactivity in this form of learning environment. From this, the first major research question is posed:

> ***What expectations do people have from interactive learning environments?***

Chapter 2 examines in detail the relevant theories and research that describe the **conditions** of computer-based learning. These include Human-Computer Interaction, Individual Differences, Learner Control, Learning Theory, Instructional Design, Courseware Development, Communication and contemporary approaches. From this analysis the second research question is derived:

In what ways are interactive elements considered to impact on the learning process?

Chapter 3 focuses on the **practice** of interactivity and the various ways in which it has been understood in the context of computer-based learning. This focus provides a context for the third research question:

In what ways do elements of interactivity affect product useability and effectiveness?

Chapter 4, covering the **research methodology**, provides a context for employing an essentially qualitative approach to the collection and analysis of the data. The chapter also introduces the participants involved in the study and the importance of their characteristics and experience.

Chapter 5 details the methodology and results associated with the **expectations of interactivity** as described by the participants, providing a context from which to assess the perceived impact of an interactive application on learning.

Chapter 6 describes the methodology and results in terms of the way in which participants identified the relationship between a set of examples of interactivity and the extent to which they are considered to **support or hinder the learning process**. The analysis provides a framework to reassess the links between interactivity and learning.

Chapter 7 provides an extensive analysis of seven separate CD-ROM titles and documents the methodology and results in terms of the way in which participants responded to the design, interface and interactive elements embedded in those products. The data analysis provides input on the way people interact and the subsequent **success and effectiveness of those interactions**.

Chapter 8 details the **outcomes of the research** with respect to directions in which the design and development of computer-based learning applications might be enhanced, including directions for future research.

THE JOURNEY CONTINUES

This however is by no means an end point. How we learn within our particular environment will continue to be a dynamic process because our environments are continually changing and the performance demands placed on individuals within those environments will also change. The technology, which even now plays such a critical role in our social infrastructure, will continue to develop and change. How we access learning resources through that technology will also change.

Whatever the learning paradigm or technology, interaction of some form will take place between the learner and the computer. Developing an understanding of the processes taking place during these interactions will ultimately assist the development of more consistently effective learning resources. More importantly, it may help release that certain magic which has often been missing from computer-based learning resources.