The Human-Computer Interaction Spiral

J. Martin, E. McKay and L. Hawkins
RMIT University, Melbourne, Australia

**jenny.martin@rmit.edu.au elspeth.mckay@rmit.edu.au
linette.hawkins@rmit.edu.au**

Abstract

Multidisciplinary collaboration is essential for effective human computer interaction. Historically computer science, psychology and the social sciences have operated as discreet disciplines. However with the increased use of Information communication technologies in everyday life issues of appropriate design, functionality and accessibility assume increased importance. In this paper a model for effective multidisciplinary human-computer interaction (HCI) is presented. This is an interactive spiral that informs science through the integration of observations, reflections, theories and practices across a diverse range of disciplines. Informed multidisciplinary responses increase the likelihood of appropriate design solutions. Case studies in tertiary education and mental health are used to illustrate the application of the HCI spiral for ongoing multidisciplinary collaboration in HCI design.

Keywords: multidisciplinary, collaboration, accessibility, human computer interaction

Introduction

HCI has become an integral part of normal everyday life in the 21st Century. However there is an increased reliance on multimedia technologies that means the applications and usability of HCI are often complex and highly variable. Effective HCI invoke collaboration across traditional disciplinary boundaries. Moreover, these harmonious partnerships require simultaneous engagement with the physical and social sciences. The model for effective HCI presented in this paper transcends interdisciplinary differences and promotes effective multidisciplinary HCI systems' design. An increasing number of practitioners acknowledge that the solutions to complex social problems require multidisciplinary collaboration (Boyer, 1990). Consequently, this requires a sophisticated problem analysis by the system's development team across a normally disparate range of disciplines. Developing multidisciplinary teams across areas that have worked previously in isolation is challenging. We present a model for effective HCI called the "HCI spiral".

The main stages of this spiral include: observations, reflections – both personal and use of a "design-persona", the integration of multidisciplinary knowledge and informing science through design and re-design. This is followed by two case studies applying the HCI spiral. The first is a case study on mental health and employment – e-WRAP. The second case study is on tertiary education incorporating a student empowerment model. The HCI spiral provides an "empowerment architecture" for user participation via active project team

membership as well as representation in a design-persona.

Human-Computer Interaction Spiral

To make the necessary connections between our observations, reflections, theory and practice we need to give them operational meaning. Marion Bogo and Elaine Vayder have adapted the work of Kolb, on experiential learning and applied it to social work education to develop what they call the "integration of theory and practice loop" (1987, p.2), (ITP loop). This loop can be applied to a wide variety of both direct and indirect practice situations. In the words of Bogo and Vayda, "It can be microscopic or macroscopic depending on what facts are retrieved. The choice of a lens and the degree of magnification depends on the practice situation and the specific intent." (1987, p.2).

When applying the ITP loop firstly, the factual elements of a practice situation are "retrieved". Secondly, "reflection" focuses on the effectiveness of the retrieved information combined with identifying personal assumptions, attitudes and values that may impinge upon the practice situation. For instance, class, cultural and gender assumptions and biases must be identified in order to understand and control their power and influence. Thirdly, "linkages" are made with professional knowledge that can account for or explain the previous findings. This in turn leads to an, "informed professional response". This model is further developed in this paper with the development of the HCI spiral, see Figure 1.
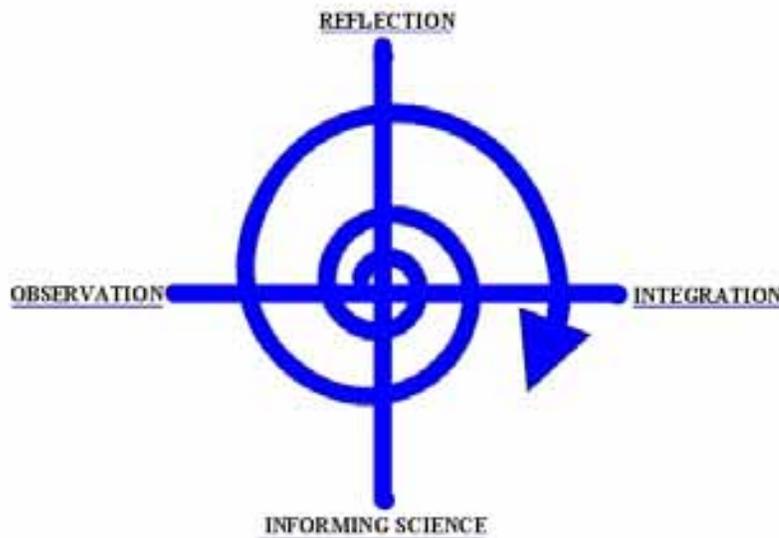
Figure 1: Human-Computer Interaction Spiral

(adapted from Bogo and Vayda (1987) Integration of Theory and Practice - ITP Loop)

As can be seen the looping process is maintained as an important element of this design however this is considered as an upward spiral to reflect the progress achieved through design, re-design and continual improvement processes based on observations, reflections and theories that inform integrated responses. However the spiral may go up or down rapidly or slowly depending upon the responsiveness of the project team. In the HCI spiral reflections include the personal with this expanded to include "the design-persona" discussed further below. Another development of this

model, in its application to HCI, is the inclusion of "multidisciplinary" knowledge rather than application to one particular discipline. This is particularly important when considering the interacting relationships of HCI in computer systems designed to address complex problems or issues. Systems which implement sound HCI practice combine a human-dimension that is represented by the social organization and work, to engage the human-machine aspect of the technical requirements, see Figure 2.
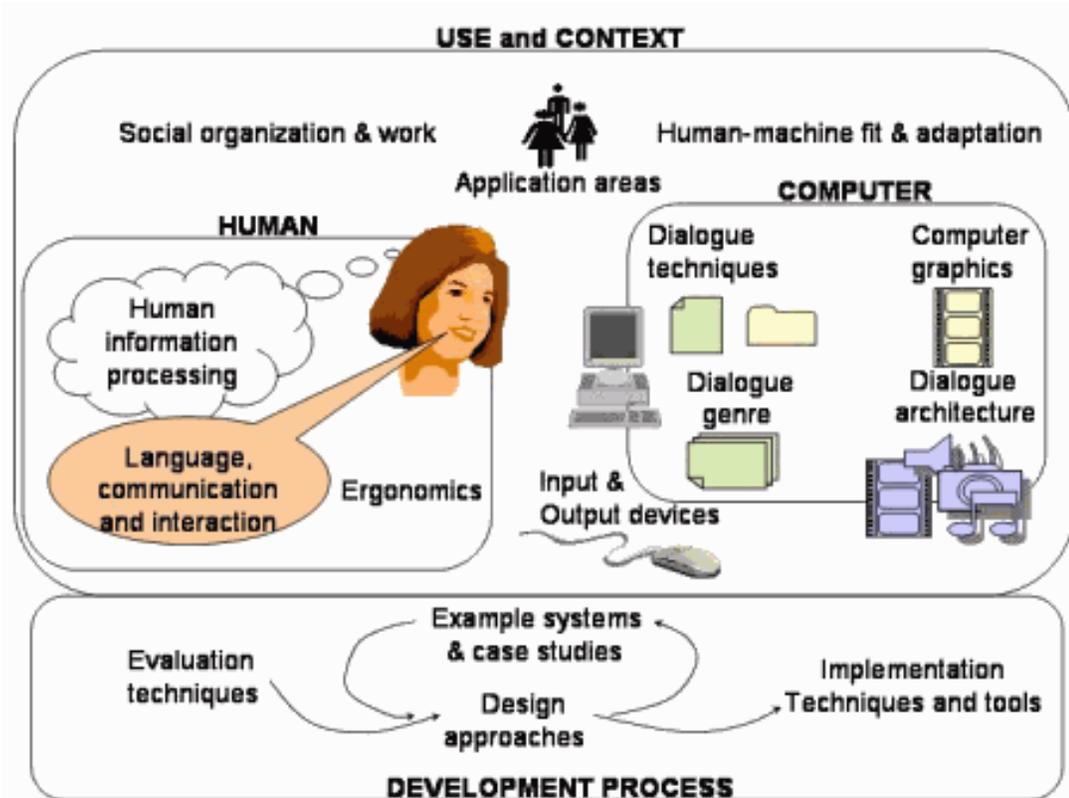

Figure 2: Human-computer interaction

(adapted from Preece, 1994, p.16)

Observations

A well founded HCI architecture therefore aims to address questions or issues of significance relating to the human-dimension, with the ultimate aim of social and technical advancement. Typically problem-solving approaches are used to define a particular problem and then to set about devising ways and means of addressing them. However for complex social problems, sophisticated problem analysis is required for the design of effective solutions. Observations take on a variety of forms. Typically they will be direct or indirect. Direct observations include first hand experiences whereas indirect observations include observations provided by third party sources. What a person observes will be influenced by her or his background and particular areas of interest. So in this sense observations are selective and often subjective unless derived from a controlled experimental design. Even controlled observations of people will still be variable. This will also be influenced by the lens of the discipline the observer is a member of. Thus selective information will be retrieved from observations. This information requires reflection from a personal perspective and from that of a "persona".

Reflections: Personal and Persona

Personal reflections are valued differently according to professional background. In the human services domain, personal reflection is seen as an integral part of practice. However in more scientific disciplines they can be less valued and associated with qualitative rather than more scientific and rigorous quantitative paradigms. Personal reflection validates use of self and acknowledges the impact that observations and information retrieved have on the observer, and how this in turn influences responses. Personal reflection requires acknowledging how you think and feel about a given situation. Thinking will be influenced by a range of factors including past personal and professional experiences, disciplinary background, political and social views and demographic factors such as age, class, cultural background, gender and ability. A main factor that will influence reflections is the level of commitment and motivation of the person regarding the information observed. Whilst one worker may view a situation as intolerable and one that must be addressed immediately another may not see it as particularly significant.

Personal reflections guard against the practice of "professional distancing" that occurs in the human services (Martin, 2003). It fosters a humane approach and a commitment to values of social justice by promoting empathy between workers and service users. Reflection moves beyond,

> "What do I think and feel in response to this situation?"

to

> "What would it be like if it was me or a loved one in this situation?"

to

> "How would I like to be treated?"

and

> "What type of assistance would be of most benefit to me?

and

> "Who is best to provide this assistance?"

The use of the "design-persona" adds a further dimension to reflection in HCI. The persona assists in understanding user information needs informing design and accessibility and ultimately suitability (Sinha, 2003, p.1). The persona is a hypothetical construct that embodies the main features of the population that the project is endeavoring to address. This provides a reference point for all aspects of project design and provides a safeguard against design elements that are inappropriate or not suited to the intended user population. User profiles have been used for some time in marketing (Moore, 1991) with the persona introduced in marketing and project design by Alan Cooper (2004) in the late 1990s. Personas supersede the so-called 'elastic users' by replacing them with a real identity that becomes an integral part of the project design process. Cooper argued that designing a persona is better than designing for a vaguely defined user group or for the designer. The persona provides a conduit for transmitting a wide range of information about design and use. Whilst Cooper was not particularly concerned with the persona being representative of the user group, Grundin and Pruitt (2002) argue that representation of the user group is crucial and that this is the main advantage of using a design-persona. This is also the experience of the authors of this paper. A design-persona provides a lens that includes the socio-political context and addresses issues around quality of life and difference. By focusing attention on a particular user group, personas assist in identifying different kinds of users as well as those who are not being designed for (Pruitt & Grundin, 2003, p.11). Designing the right persona or set of personas can be challenging. A common mistake to avoid include; choosing 'flashy' technology over accessibility. Hourihan warns against the project team designing for themselves and losing sight of the intended user group. She comments, 'We thought we were the primary persona. Like a recovering substance abuser, it's a constant challenge for me to refrain – I can always imagine that I'm the user' (2002, p.3).

The persona is developed through a number of quantitative and qualitative processes including interviews, observations, ethnographies, focus groups, brainstorming, market research and usability studies (Sinha, 2003, p.1). Members of the project team ultimately direct any changes and modifications required to the persona throughout the project to ensure relevance and responsiveness to enact required changes (Sinha, 2003, p.2). An essential feature of the HCI Spiral is the inclusion of user groups in all aspects of project design including the development of the persona. The persona must not be seen as a replacement for active user involvement. The persona comes to life as a "real person" who the project is being designed for. The persona is given a name and it is in the naming process that the persona is brought to life. Planning and decision-making is done thinking about what this person's experience will be like. Giving the persona a name is a further element in the process that creates empathy. Rather than, "How would people use this?" questions are personalized to for instance "How would Alex use this?" Alex or whatever name is chosen is the representative of the intended user group and embodies all of the personal features of the intended user group (Martin, McKay, & Hawkins, 2005; McKay, 2005). These features might include age, gender, educational background, class, health, ability/disability, race, ethnicity and culture, sexuality and spirituality (Giroux & Shannon, 1997). Cooper comments, 'All things being equal I will use people of different races, genders, nationalities and colors' (2004, p.3).

A common vision and commitment to the persona is essential for successful design and implementation. This will be influenced by communication processes and how the persona is included in the project team at all stages of design. Effective communication is important particularly with those who may be absent from meetings where the persona is discussed. Creative strategies are required to keep the persona relevant and the focus of activity. Detailed written documentation that succinctly describes the main features of each persona is essential. Decisions are now being made about a person with a name and identity-albeit hypothetical. The level of detail suggested by Freydenson (2002) for a persona includes; 'at least a first and last name, age, goals, background story, a telling quote, e-mail address, job title and a photograph', (p.1). He recommends the development of multiple personas with each given a status according to primary, secondary, supplemental and negative status. These personas extend beyond the user to include others such as line workers and management. This assists in prioritizing by identifying and keeping the focus on the primary persona, while also keeping in mind the needs of secondary personas. Ultimately the primary persona must be satisfied with the system you deliver (Hourihan, 2002, p.1). The same questions mentioned above for personal reflection are also applied to the persona. The persona will change and develop with the project and at times more than one persona may be required, particularly in instances of extreme diversity amongst potential user groups.

Mapping requires identifying the needs, interests and concerns of the "persona" around main issues in her or his life. Favored options are those that meet most or many, of the persona's needs of and takes account of many or most of their concerns (Martin, McKay & Hawkins, 2005). "Task analysis" is useful in identifying the processes and tasks associated with project design to achieve the desired outcomes for the persona (Pruitt & Grundin, 2003, p.12). In effect the personal now becomes a member of the project team. It is useful to have something to signify this. This may simply be an empty chair at meetings that represents the presence of the persona in discussions and decision-making.

Integration of Multidisciplinary Knowledge

As mentioned earlier the integration of multidisciplinary knowledge is an essential feature of the HCI spiral. This is a complex process as people generally have "expert knowledge" in their own particular disciplines that is not always easily understood or transferable across disciplines. Multidisciplinary collaboration requires skilful communication between partners that transcends disciplinary boundaries. Potential users of the project design are important members of the multidis-

ciplinary team as is "the persona". It is important that supports are provided and language is used that makes participation meaningful and worthwhile. Effective communication and participation requires clear communication in shared language. Skilful communication requires quality relationships with people that take account of personal and professional values and beliefs and identify areas of possible conflict.

Often timelines are developed that have disciplines providing expertise at different times depending on the expertise required at a particular stage of the project. Whilst on the one hand this seems like a sensible way to proceed, it results in disciplines meeting at the crossroads to hand over and exchange information. This is not multidisciplinary collaboration in a true sense as disciplines are still predominantly working in isolation albeit on different component parts of the same project. Effective multidisciplinary communication moves beyond this approach to a model of active collaboration by members of different disciplines throughout the project. This provides continuity across all disciplines and provides opportunities for joint learning and teamwork. A free-flow exchange of information occurs across disciplines thereby enhancing communication and increasing the likelihood of creative solutions that integrate knowledge from a variety of disciplines. This is particularly important for complex problem-solving as answers generally do not sit within discreet disciplines. Views can vary significantly within disciplines according to the different theoretical orientations adopted by individual members. Thus shared meanings and understandings on one project involving the same multidisciplinary make-up are not necessarily transferable to other teams or projects. The avoidance of stereotypes is important – particularly negative stereotypes if conflict does arise (Conflict Resolution Network 2000). At such times the persona is useful to keep the project team focused and on-track.

Informing Science: Design and Re-design

Science is informed by creative solutions that are informed by the combination of personal and persona reflections and multidisciplinary knowledge and perspectives. Quality improvement is an inbuilt design feature of the HCI spiral as the spiral is continuous. Design outcomes are monitored and evaluated according to new observations following application. The cycle of improvement continues with every new observation, reflection and integration of multidisciplinary knowledge. The HCI spiral is similar to a barometer that will go up and down according to its suitability and relevance at any given time. If the spiral goes down this is an indicator that perhaps the needs and concerns of the persona are not being addressed by the project design and that re-design features are required. Observations of the application of the project will provide increased information about the "actual user group" that may not always be the same as the "intended user group". Reflection on these observations may result in changes to the persona more in accordance with the actual user group.

In the following discussion the HCI spiral is applied to two case studies. The first case study applies the HCI spiral to mental health and employment and the second is applies it to tertiary education. The headings used above to describe the spiral are used in the case studies to illustrate each distinct stage in the process.

Case Study 1: Mental Health and Employment: E-Wrap

Observations

An academic specialist in HCI observed that there was that there was no electronic work finding program that was suitable for people recovering from mental illness. She also observed that the World Wide Web Consortium (W3C) Standards for web-design and accessibility did not provide

for the human-dimension that implement design features and recommendations tailored to meet the needs of people recovering from mental illness. Instead, these standards concentrate on the machine-dimension of HCI. As such, they mainly represent Web-access protocol development and browser privacy issues.

Reflections

Personal reflections revealed that this was an important social and design issue that needed specialist input from other areas including psychology and the social sciences. She then set about forming a multidisciplinary team to work on this project.

Integration of Multidisciplinary Knowledge

A project team was formed across the disciplines of business, social work and psychology and research funding was sought and granted to develop a proto-type for an electronic work requirement awareness program (e-WRAP).

Reflections: Personal and Persona

Personal reflections from each project team member revealed divergent interests and priorities ranging from a focus on mental health and employment to consideration of broader political and social factors that impact upon a person's ability or desire to gain and maintain employment. A design-persona was developed to assist in providing a focus for the design. A brainstorming process was conducted by the project team to develop the main features of the persona. The persona was given a name that was gender neutral –Chris, so as to avoid gender bias in the design. The design-persona was used as the reference point for all further discussions about the project design and implementation.

Chris came to life with not only a name but also in terms of age, family education, health and mental health, employment history, housing and socio-economic status. This was done in a manner that was respectful in the realization that Chris could not possible represent the diversity of people recovering from mental illness who might be looking at returning to work. However by including several features of disadvantage that are not uncommon to people recovering from mental illness the team was able to cater for a wider range of contingency factors. For instance Chris was limited in ability to present adequately for interview due to not having the clothes required. This led to additional design features including information on clothing banks. There was a commitment from the project team to do the right thing and get the best possible outcomes for "Chris" in ways that were respectful of where Chris was at in terms of looking for work. Questions were asked, "What if Chris does not want to get a job but is simply complying with Social Security requirements so that s/he did not lose income benefits?" Questions were also asked around voluntary work vis-à-vis paid employment.

Integration of Multidisciplinary Knowledge

Reflections on the experience of Chris were combined with research and expertise from the team. Whilst all project team members had specialist expertise in a particular area of the project they were involved in all stages of planning and implementation. Technical aspects were designed so as to be responsive to Chris' mental health and issues of motivation and level of perceptual comfort using e-WRAP. This led to design features that meant Chris could log in and out without losing any data stored as well as addressing issues of privacy. Ease of use was a prime consideration utilising touch screen technology. The stigma and discrimination Chris experienced when seeking employment and generally, as well as already lowered of self-esteem, led to the inclusion of de-

sign features on dealing with knock backs, general health and well-being and self-care and building self-esteem. Low-cost leisure activities were built into the design in recognition

of the loneliness and boredom that Chris experienced and difficulty managing on a low income. So what initially began as an employment focused project broadened into quality of life.

Informing Science: Design and Re-design

The e-WRAP prototype was produced in accordance with the research funding timeline and requirements. Touch screen technology was used to design a computer system that was tailored to the needs of people recovering from mental illness considering employment. Main features of e-WRAP were the design features that were cognizant of the difficulties people using the system may experience in relation to motivation and also perceptual difficulties as well as the inclusion of relevant information for return to work, health and lifestyle for people recovering from mental illness.

A brainstorming process was used with all members of the project team to look at all of the possibilities that might be relevant in designing the e-Wrap menus and the information to be included that would be suitable for Chris. A mapping process assisted in identifying the needs, interests and concerns of Chris in relation to technical functionality as well as around main issues in her/his life that might impact upon her/his ability to look for work. A brainstorming process was used to assist in identifying the five main areas of; looking, applying, getting, keeping and surviving employment (Figure 3).
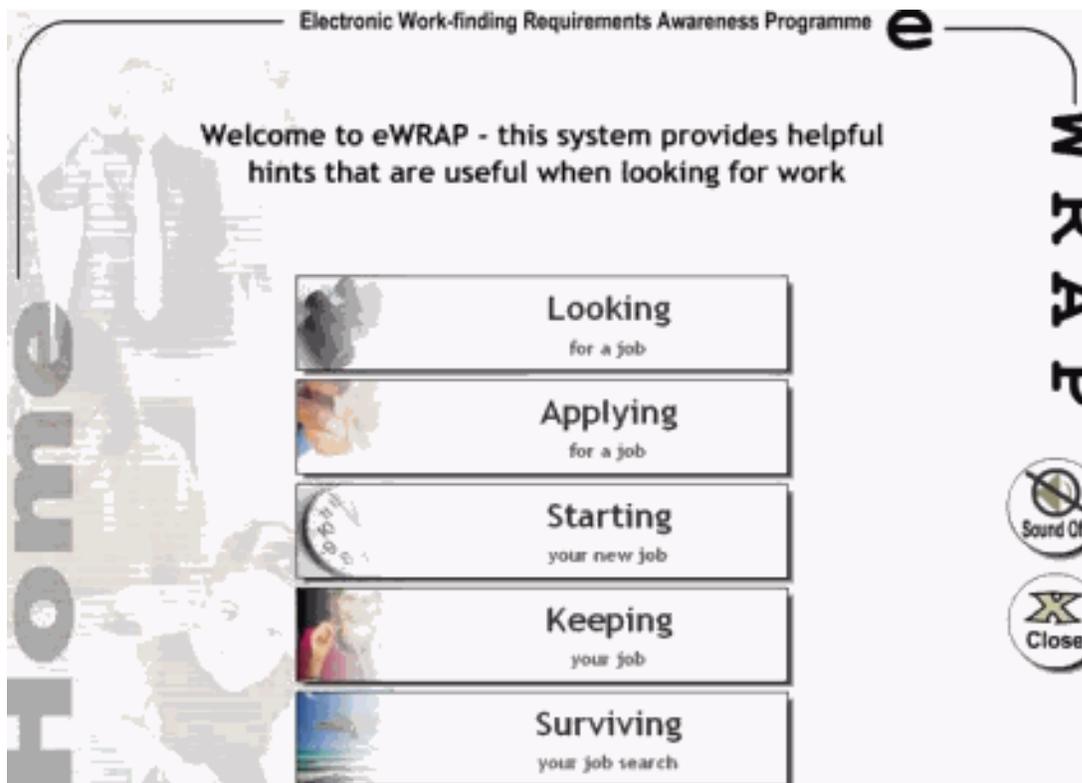

Figure 3: e-WRAP – Main Menu

Task analysis was conducted for each of these processes with Chris in mind at all times. This led to the development of the e-WRAP main menu. What became very apparent in this process was the care taken to look at all of the possible scenarios that Chris may encounter. Questions invaria-

bly started with "What if?" What if Chris did not want to return to work but simply needed to comply with government requirements to keep her social security benefits? What if she wanted to pursue a career or perhaps a change of career or maybe she just wanted an adequate income. With each "What if…?" an additional item was added to the menu hierarchy. An important feature was health and lifestyle and the inclusion of low-cost leisure activities to alleviate the loneliness and boredom and frustration Chris experienced living on social security and the poor self esteem she had as a result of mental illness and unemployment. Pictures, photos, graphics, video streaming and quizzes were used to add variety and make the design both interesting and relevant. The graphics and images were designed mindful of Chris' mental state.

Observations

The prototype was executed over a four month period. The project did not require a sample group of users as this is to be the focus of the research team's longer-term plans to fully Web-enable the system. Arrangements were made with appropriate people, already known to the team, to test the system during 2003, as components were progressively finished. Preliminary feedback, including that of several non-computer users, was very positive. The users found the system easy to use, informative, and could relate to the characters in the various Video on Demand vignettes. This was part of the original research design funded for the development of the prototype. A further trial was conducted at a Conference for people recovering from mental illness and workers in psychiatric disability support services. Observations at the trials and Conference feedback indicated that e-WRAP was a much needed resource. It was acknowledged that whilst there are numerous work search systems available none of these are tailored specifically to the needs of people recovering from mental illness.

Reflections: Personal and Persona

All members of the project team learnt a lot through the multidisciplinary collaboration and were committed to the value of the project and the need for e-WRAP. The value of the project for Chris as the "design-persona' was borne out in the positive feedback received from people recovering from mental illness who were part of the user trial. All people commented favorable about e-WRAP and supported the idea of developing a live version that included data bases of employers as well as links to all of the other databases indicated as links on the proto-type.

Integration of Multidisciplinary Knowledge

A number of applications have been developed by the research team to secure funding to further this important work. To date these have been unsuccessful.

Reflections

The team is aware of the difficulties securing funding for a project of this type particularly due to the dual responsibilities for government funding of employment and mental health services. In Australia employment is a federal responsibility and mental health is a state responsibility. The project sits across both areas yet unfortunately due to the different government jurisdictions the project team has not been able to secure a commitment form either employment or mental health providers with each seeing the other as having prime responsibility. For "our design-persona" Chris this is a reminder of not receiving adequate services due to a dual diagnosis of schizophrenia and drug dependency and being rejected by both services with neither taking responsibility. Each sees the other as being the "prime diagnosis" or having "prime responsibility". Employment agencies have expressed interest yet do not have sufficient resources to invest in establishing and maintaining e-WRAP. Moreover, e-WRAP is not designed as an income-generating activity and therefore does not attract interest from private industry. Charities and philanthropic trusts may

support the idea yet not be committed to the ongoing maintenance and updating that e-WRAP requires to be relevant and up-to-date.

Case Study 2: Tertiary Education

Observations

Teaching and learning in the new millennium requires engagement with new technologies and careful consideration of aspects that will add value to the student experience and those that will detract from it. These decisions are made within the context of declining fiscal resources allocated to universities for teaching and learning with students being able to afford less and less time on-campus due to paid work commitments. As education is no longer universally free a large proportion of students need to juggle paid work and study commitments along with other responsibilities and interests so they can afford to study. Fee for service creates another set of expectations with students considering value-for-money as part of their student learning experience.

Universities have traditionally been seen as places of learning. However since education is no longer free, market forces threaten this tradition. Students are driven by different considerations to seek tertiary education. Accordingly, universities have to compete for students and in so doing, must design courses that accommodate the demands students make of them without compromising their tradition. Increasingly students wish to complete in a minimum amount of time with maximum learning and skills. They want to clearly see how these outcomes are going to maximize employment and career opportunities.

Reflections: Personal and Persona

It is tempting to embrace new technologies and put courses on-line. This provides students with the flexibility they desire as well as providing them with a wealth of information. However student feedback tells us this is not what students are wanting and that education extends beyond reading copious amounts of materials on line, chatting to lecturers and other students electronically, and meeting assessment requirements. Many students complain about the amount of online learning that is being used in university courses and state a preference for face-to-face learning. It is only a small minority who prefer this on-line learning. Students value quality learning experiences that meet their educational needs. This often includes flexible delivery (Hooks, 1994).

The "persona" is a hypothetical student who is on a journey through your degree. The challenge with routine tasks and procedures is how to create a personal and "user friendly" environment. The persona assists by bringing the student to life as a reference point. The persona is given an identity as someone who plans to study in your degree program. A brainstorming process with members of the program Team responsible for the design and delivery of the degree is useful in identifying the main features of the persona. Planning and decision-making around educational experiences and administrative processes are done thinking about what this person's experience will be like.

Integration of Multidisciplinary Knowledge

In comparison to traditional educational models flexible education is broadly characterized by:

- Less reliance on face- to-face teaching
- Greater reliance on high quality alternate learning resources
- Greater opportunities to communicate – outside traditional teaching times
- An increasing use of IT
- The deployment of multi-skilled teams (Martin, Hess, Hawkins & Pitt, 2002).

Flexible education encompasses the range of multi-media materials used for the design and delivery of subjects and courses and the pedagogy by which these are meant to advance learning. This includes any combination of distance education, external/off campus studies, flexi-mode, min-conference and extended campus mode. There are many strategies, including the use of problem solving, experiential learning, practicum, video lectures and so on which can also be used to allow flexibility for students.

The application of flexible education in university policy focuses on a student centered approach to flexible education. At Flinders University (n.d.), "…flexible education, in its broadest sense, recognizes that students have different learning needs…". At Macquarie University (n.d.) flexible learning aims to meet individual needs by providing choices that allow students to meet their own educational requirements in ways suiting their individual circumstances. At RMIT flexible education is synonymous with on-line teaching and learning using the Distributed Learning System (DLS) software. Educators are encouraged to develop on-line resources that will benefit students by increasing the flexibility of courses offered to students.

Flexible education provides choices in time and/or place of study including on and off campus or combinations of both. It can cater for different learning styles and preferences by providing a range of learning resources and tasks to suit individual needs (Nicholson, 1995). Contextualized learning occurs through the ability to tailor some, or all, of the learning content, process, outcomes or assessment to individual circumstances. This however begs the question of what an individual's circumstances are and how universities can afford to meet these in an environment of funding cutbacks to higher education. Catering to individual student needs and differences is generally seen as resource intensive with universities increasingly adopting uniform processes to cut costs.

How then can flexible education be delivered in a viable way that caters for individual needs yet is not making excessive demands on resources? A collective view of "individual needs" is required with teaching and learning "…that meet the needs of a particular group of students, the emphasis being on negotiated times, places and modes of learning and the combined use of face-to-face learning with communication by appropriate media and technology" (Hawkins & Sefton, 1989, p.41). Yet the question remains of how to gain a sense of the collective needs of a particular group of students. A student-centered approach assists with this process and the development and application of the "design-persona" serves to add a further personalized dimension to this process.

Systems theory assists with this process. Explicit assumptions of systems theory applied to tertiary education are:

- The university has an obligation to ensure that students have access to resources, services and opportunities that they need to meet learning needs, to alleviate distress and realize their educational goals and aspirations.

- In providing services the dignity and individuality of the student must be respected.

- Teaching and learning must maximize student's participation and self-determination

- Students have a right to control their own education.

- Problems are manifestations of a breakdown in the interactions between students and the university (Hawkins & Sefton, 1989).

Universities are viewed as complex, adaptive organizations that are continually changing and generating new patterns of actions, interactions and meanings. Mapping is a useful process for identifying personal and social factors that impact upon a student's ability to participate fully in tertiary education by identifying the needs, interests and concerns of the "persona" around main

issues in her or his life. These issues will extend beyond education to consider other aspects such as hours in paid employment, family responsibilities and possibly health. Mapping assists in identifying factors that will impact upon a person's ability to engage in university education. In developing teaching and learning experiences and resources a key to success is the level of commitment by students and educators, how well students' needs are met and how much they have been considered in the design of the educational experience. Teaching and learning experiences can then be developed to meet as many needs and concerns as possible identified during the mapping process.

"Task analysis" is useful in identifying the processes and tasks associated with university education and peculiar to your university and degree (Payne, 1997). This involves all stages- pre-entry, entry, engagement and exit. Pre-entry includes consideration of marketing and promotion, study pre-requisites, and processes for applying, student selection and enrolment. The pre-entry stage also includes consideration of credit transfers and pathways from other institutions, particularly TAFE as well as issues around access and equity and special learning requirements for particular students. Entry includes orientation, preparation for success at tertiary study and a sense of focus and belonging. Engagement extends to maintaining and developing this focus and in a student-centered environment that is responsive to student learning needs. Exit requires adequate preparation for transition from university to the workplace including professional socialization as well as considering ongoing links and relationships with the university. Alongside the identification of processes and associated tasks at a university level mapping is required to identify the personal and social features of the persona.

Informing Science: Design and Re-design

The student-centered approach underpinning flexible learning processes requires different teaching methodologies alongside a different relationship between teachers and students. It is a student driven curriculum that integrates theory and practice. It provides students with the knowledge and skills required by employers without compromising the academic rigour of a university education. It is thorough, comprehensive and flexible and uses the latest in terms of teaching and learning strategies and techniques and is responsive to student needs. What students want from a university course is presented in the "Student empowerment model".

Student Empowerment Model

- Student centered focus
- Excellence
- Flexibility
- Relevance
- Value for money
- Currency in the marketplace
- Learning community
- Sense of belonging
- Range of methods used suited to the course being taught
- Bring the community into the university and the university into the community
- Recognition of level of competency on entry into the course
- Teaching and learning pitched at a level appropriate to individual student learning needs
- Assessment needs to be clear and concise–aligned with educational and industry competencies, tasks and outcomes

 • Student interaction (Martin 2002).

Responsiveness to individual student needs and flexible education are central features of the empowerment model. The "design-persona" is a useful tool for the design and delivery of flexible education that is student centered and is responsive to the individual and collective needs of students in ways that are resource efficient. The importance of the "persona" for developing a student-centered focus that creatively utilizes a range of teaching and learning techniques cannot be under-estimated. The persona provides a personal focus for the planning and delivery of all teaching and learning experiences and guards against institutional practices that lose sight of student needs.

Conclusion

The HCI spiral is particularly useful for multidisciplinary collaboration. Careful observation and reflection and the sharing of information across disciplines informs science as to the wide range of possible responses. The use of the persona assists in the process by keeping the focus on an individual who is representative of the target user group. This personal aspect assists in keeping a human focus as well as providing a reference point for all aspects of design and implementation. Design responses include a diverse range of knowledge, theories and perspectives that are thoughtful and reflective on a personal and professional level. The case study of mental health and employment and the development of the e-WRAP prototype illustrate the application of the HCI spiral to develop an integrated response to the application of e-technology to assist people recovering from mental illness who are seeking employment. In the second case study applying the HCI spiral to tertiary education, educators are encouraged to think creatively about how greater flexibility can be achieved by using e-technology as an aid to quality teaching and learning and not as a replacement. Educators need to think about how they can best meet the changing needs of students, industry and society in the design and delivery of courses. A student centered approach including the use of the "persona" provides a reference point for the relevance of content as well as for designing the means and methods of delivery. As illustrated in these two case studies the HCI spiral has application across a wide range of social issues. It can be applied across a wide range of diverse disciplines and problems. Through observation, critical reflection and the integration of theory and knowledge across disciplines, the HCI spiral provides a process to facilitate creative and innovative responses to complex and varied social problems.

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Biographies

Jennifer Martin, PhD. Associate Professor in Social Work at RMIT Univ., Australia: research and practice experience in conflict prevention, management and resolution. She has a Bachelor of Social Science, a Bachelor of Social Work, a Masters of Social Work and a Graduate Certificate in Developmental Child Psychiatry. Much of her academic and direct practice work is in multidisciplinary teams. She has developed a model for effective multidisciplinary collaboration.

Research interests: conflict prevention, management and resolution, mental health and multidisciplinary and cross cultural communications. She is a practicing mediator and forensic consultant.

Elspeth McKay, PhD, MACS(Snr), Senior Lecturer – HCI Research, at RMIT Univ., Australia; investigates how individuals interpret text/graphics since gaining her PhD in *Com. Sci. and IS, at Deakin University, Australia.* She has a Bach. of Business, with distinction (Business IS), a Grad.Cert. of Applied Science (Instructional Design), and a Grad. Dip. of Education (Computer Studies). She identified that not all individuals cope effectively with graphical learning. Research interests: specialist e-Learning shells implemented through Rich Internet Apps, interactive dynamics of Web-mediated knowledge mediation, ontological strategies of learning design with asynchronous Web-enabled frameworks, and development of enhanced accessibility through touch screen technologies.

Linette Hawkins, Lecturer in Social Work at RMIT Univ., Australia: research and practice experience in the flexible delivery of education. She has a Bachelor of Arts, Diploma of Social Studies, Graduate Diplomas in Applied Sociology and Public Policy and a Certificate of Adult Education. She has been a consultant on projects aimed at increasing the use of ICTs to enhance the teaching and learning experience of tertiary students. She was awarded an RMIT Certificate for Scholarship of Teaching for her work in flexible delivery. Much of her research and writing has been on professional expertise and multidisciplinary collaboration, particularly in community development and field education. This is within local, national and global contexts. Research interests, particularly participatory action research, include: ICTs and flexible delivery of tertiary education, teamwork and multidisciplinary collaboration, standards for practice, professional expertise, field education and human services labor markets.