Why Leave Learning to Chance? Planning for a Beneficial Synthesis of Motivation, Adult Learning Needs and Contextual Analysis

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Abstract

Instructional designers hold many philosophies and positions on the processes and procedures for designing learning resources and creating learning environments. There are those who support a pragmatic perspective and argue that we need to combine constructivism with the instructional design phases of definition, development, implementation and evaluation (ISD), in order to meet the needs of learners. In this paper we argue a case that while ISD is a useful planning tool, it needs to be combined with affective, experiential and contextual aspects of learning. By combining contextual analysis, experiential learning and motivational theory, the design of learning environments is likely to be more learner-centred. The study looks at the needs and perceptions of Indigenous adult learners who are about to embark on a bridging course for tertiary mathematics. An investigation of backgrounds, perceptions, motivation and learning needs was used as a core element of the design process. A generic design framework is presented which integrates adult experiential learning, motivation and contextual analysis into the instructional design phases of definition, development, implementation and evaluation.

Keywords
Instructional design, Online learning, Indigenous education, Motivation, Adult learning, Mathematics education

Introduction: Adult Learning Needs as a Starting Point for Design

There is an increasing trend towards mature-age students returning to study in the higher education sectors (FitzSimons, 1994). This trend continues to increase and includes an expanding proportion of students from diverse cultural, and in the main, lower socio-economic backgrounds. Personal commitment by these students, public investment in their education, their potential contribution to national enrichment, and their self-empowerment through education renders it of utmost importance that teaching institutions ensure the goals of these students are realised.

A high proportion of people returning to study in later life come from a diversity of lower socio-economic backgrounds than those who progress directly from school to university (Jordan, 1993). Many of these mature-age students require bridging courses in order to access university courses. Three quarters of these students may not have successfully completed Year 9 mathematics, had negative experiences in mathematics, and have no real understanding of university culture and its demands; the combination of which causes a considerable stress to students when undertaking university mathematics programs (Griffin, 1994). Thus, university bridging programs must not only address gaps in students' mathematics education, but also provide strategies to provide student support and empowerment. Because of the particular needs of Indigenous people for cultural maintenance, and for control of and access to educational resources, the starting point for the design process must begin with the learners themselves (Torres & Arnott, 1999).

Contextual Analysis: Prior Contextual Analysis of Learner Needs

Jonassen (1993) notes that "context is everything" to instructional design. However, despite informal recognition of contextual forces there is little evidence that current ID models have a specific stage for contextual analysis. Variations in pedagogical strategies are largely dependent on the nature of the learning task and according to Jonassen et al (1999:14),

"instructional design is premised on the congruity between learning objectives and instruction". The work of Keller (1987; 1983a) is one of the few approaches to ID that have recognised the centrality of the affective domain. Keller (1983b) provides a framework for the incorporation of motivation in instructional design, the ARCS model (*attention, relevance, confidence* and *satisfaction*).

Context however is much broader than motivation, and we argue here that a synthesis of motivation, design and contextual analysis enables a more complete learner-centred approach to instructional design. Tessmer & Ritchie (1997) propose a more comprehensive model that encompasses prelearning, learning, and performance contexts and indicates how designers can embed and utilise contextual elements to facilitate learning. For the purposes of his study the following definition of contextual analysis is adopted: *Context is a multilevel body of factors in which learning and performance are embedded…not discrete factors but the simultaneous interaction of a number of mutually interactive factors: physical, social and instructional* (Tessmer & Ritchie, 1997: 87). While instructional designers can accommodate context, they cannot control it, and effective instructional design must be situation specific and address a range of contextual elements.

With these caveats in mind, what elements of context can designers identify in order to provide a full picture of learner needs? Table 1, adapted from Tessmer & Ritchie (1997) provides a summary of the different factors that are involved in contextual analysis. Basically, the framework suggests that three aspects of context need to be investigated: orientation, instruction and transfer, each with several dimensions: learner factors, instructional factors and organisational factors. The framework is based on the premise that ID models must take into account wider categories of learner needs, values and beliefs that influence learning (Shabajee, 1999). Prior to designing the mathematics environment for online learners, a list of probable contextual analysis factors was created including orientation, learner and organisational factors that might impact on the provision of an appropriate environment for the learners. Data were then collected by surveying, observing and interviewing the target population in order to ascertain "environmental favourability" for creation of the online environment.

	Orientational context	**Instructional context**	**Transfer context**
Learner factors	• Learner profile • Learner goals	• Learner role perception	Perceived utility Transfer strategy

	• Perceived utility		Experiential background
Environment factors	• Social support	• Instructor role perception • Content culture	Transfer opportunities Social support
Organisational factors	• Incentives • Learning culture	• Rewards and values • Learning support • Teaching support	Transfer culture Incentives to transfer

Table 1: A framework for analysis of contextual factors (adapted from Tessmer & Ritchie, 1997)

The immediate context and rationale for the study

Edith Cowan University has been offering bridging courses for Indigenous adults for over 20 years. In this time, courses have been conducted in both internal and external modes, with two levels of difficulty. From 2000, the university offers a range of study units for Indigenous Australian students in the external mode. The mathematics units in the Edith Cowan Program have undergone some revision during the past two years; it is due for a complete re-write as a result of a major review of the entire course. Prior to the unit being offered on-line, there was an expressed need to design an online environment that was uniquely tailored to Indigenous needs, given the very high attrition rates among students who undertake bridging courses into university. This research was undertaken to find out about the students' perceptions of mathematics, their attitudes to the general concept of learning on-line, and in particular to learning mathematics on-line. The data gained from this research are being used to inform the design of the new mathematics unit for online delivery.

Instructional and contextual factors that impact on design

According to Taylor, Spielman, Ross, Gilligan & Mohr (1998), the changing nature of Australian universities is resulting in a student intake with a broadening range of abilities. Allied to this trend is an uneven preparedness by students, particularly in mathematics (McInnis & James, 1995 cited by Taylor et al.), and a continuing lack of confidence by adults in their mathematical ability (Cockcroft, 1982 & Benn, 1995, cited in Taylor et al.) so that many students are anxious about, and have difficulty with mathematics. Hembree (1990) defines mathematics anxiety as a general fear of contact with mathematics including classes, homework, and tests. Such anxiety is generally a learnt condition from negative school experiences.

The impact of school experience in the learning of mathematics on adult attitudes and perceptions of mathematics is culturally universal, but is compounded for Indigenous students who often find schools to be stressful environments in which their culture, history, home and family circumstances, and Indigenous views and understanding of mathematics are not well enough understood (Howard, 1996). One reason why Aboriginal people have anxieties towards mathematics and low levels of achievement is that modern Western mathematics embraces concepts such as time, number, length, weight, and measurement in ways largely irrelevant to traditional Aboriginal culture (Bishop, 1994; Shellshear 1983). Also Aboriginal children, particularly from traditional oriented communities, grow up in a society where it is more to do with "who" rather than "how many" and with "whose land" rather than "how much land" (Graham, 1988). These findings have an enormous impact for the design of an appropriate learning environment, as they immediately bring to the fore issues of learner self-esteem, the need for support and the creation of appropriate tasks to enhance motivation and reduce anxiety. A further stage of analysis focussed on organisational factors, such as the learning culture and its impact on student perceptions.

Organisational Factors: Online Learning as a Form of Self-Actualisation and Learner Control

Investigating the learning cultures and incentives offered by online learning to the target group was an issue that was deemed part of the contextual analysis. Henderson (1993) argues that technology, as well being a learning tool integral to modern society, can facilitate many of the learning characteristics of Aboriginal people and are be used by Aboriginal and Torres Strait Islanders as a means of empowerment to help redress disadvantage. Empowerment, maintains Hart (1996), is a powerful feature of online learning as it enables students to take greater control of their own learning. However, to achieve such a goal, curriculum designers must restructure learning activities in ways that utilise the attributes of multimedia to accommodate culturally diverse learning styles, and to support the cultural choices and values of Indigenous learners.

Computer assisted learning, according to Rice (1993) and Henderson (1993), has many potential pedagogic elements relevant to Aboriginal education, in particular its ability to be interactive, highly visual and auditory, and provide individual feedback. The use of graphics and

animation, which form a substantial component of computer software, is a feature of computers that accommodates the cognitive strength of Aboriginal and Torres Strait Islanders in visual and spatial information processing. The concept of on-line learning, while confined to the use of personal computers, embraces diversity of access, styles of learning, freedom from the supervision of a teacher and portability. On-line learning can involve the use of, and diversity of possibilities that go with, for example, increased opportunities and control through email, computer assisted learning, on-line chats and discussion groups, electronic work books, text on-line, computer conferencing, (Edmonds, 1998; McLoughlin & Oliver, 1995) and computer mediated communication (Reid, Stacey, & Henry, 1995).

This initial search of the literature for orienting context factors confirmed that online learning would be appropriate to the learner profile and learning culture of Indigenous communities. Further data collection was needed in order to gain a better picture of the forms of social support and learning cultures of the target population.

Data collection: Instruments and frameworks

One of the purposes of offering the mathematics unit online was to make it more accessible and relevant to the students. We needed to find a model of instructional design that considered student motivation as a major factor for design, and to link this with the contextual analysis. The Keller's (1987a, 1987b) ARCS Model of Motivational Design was chosen when designing the questions for the interviews because students' lack of confidence in mathematics has been identified as the biggest barrier to successful mathematics programs (Cockcroft, 1982 & Benn, 1995, cited in Taylor et al.; Milne, 1992). The dimension of the model can be used to uncover attitudes, feelings and conceptions towards mathematics. Main (1993) states that "we need to spend as much effort in motivating the student to learn as we do with the cognitive and psychomotor needs. Perhaps we should spend *more* time and attention, since it has such a powerful impact on achievement" (p. 37). The ARCS Model of Motivational Design, as developed by Keller (1983a, 1993b), incorporates the major conditions of Attention, Relevance, Confidence and Satisfaction in order to have a motivated learner.

The initial step in motivating students is to gain and maintain their *Attention*. Keller (1983b) says of this condition:

> *At one level, it is fairly easy to accomplish. A dramatic statement, a sharp noise, a 'pregnant' pause, all of these and many other devices are used to get attention. However, getting attention is not enough. The real challenge is to sustain it, to produce a satisfactory level of attention throughout the course … (p. 1-2)*

The second condition of the model is that of *Relevance.* A student will not be motivated to learn if he or she cannot see any point in what they are studying. To rectify this, the content can be made relevant to students' present or perceived future needs, or the relevance may come from the method of instruction, the challenges presented or the social benefits of the learning process rather than the content itself.

Confidence, an expectation of success, is the third condition. Students need to believe that if they try hard enough, they have a good likelihood of achieving their goals. They need a learning situation where they "do not have to fear loss of face or embarrassment as they try to develop their skills. In contrast, a degree of risk, or challenge, is necessary to stimulate peak performance once the learner has begun to master the new skill." (Keller & Kopp, 1987, p. 294). The final condition, that of *Satisfaction*, refers to "the combination of extrinsic rewards and intrinsic motivation, and whether these are compatible with the learner's anticipations". (Keller (1983a). Each of the four dimensions of the ARCS model was used to formulate questions that were designed to uncover details of the transfer context and students experiential background. Specific factors influencing learning were gained from face to face interviews with the students. Interviews with a total of 22 students were conducted at three Regional Centres in Western Australia. Each interview was audio-taped, and the participants had in front of them a set of the questions being asked as follows:

> *What do you think about Maths generally?*
> *How useful is Maths in your life?*
> *How do you feel about Maths?*
> *What aspects of Maths do you think should be included in the online unit?*

For each interview conducted, there were two interviewers, one of whom was Indigenous. The interviewers did not adhere rigidly to the questions, but sought explanations or clarification where necessary.

Results

In these interviews, students were asked about what aspects of mathematics should and should not be included in a bridging unit. Results are presented in Table 3. Over half (59%) of the participants believed that the unit is OK as it stands, 15% felt it should be more difficult, and only 5% wanted to see it made easier. There were several students who stated that they felt there should be more examples dealing with money and budgets. The four operations of addition, subtraction, multiplication and division were generally regarded as essential components of the unit. When asked what should not be in the unit, 68% could think of no particular aspect, while 14% wanted more detailed explanations and examples.

Students were also asked if they thought that on-line learning would be useful. Some had not studied a computing unit and had not come across on-line courses. Therefore they wanted to discuss what on-line learning actually was. Once the question was clarified, 95% of the students answered in the affirmative.

	Example	% of students
A **Attention**	*What do you think maths is about?*	
	• Numbers/sums	45%
	• Everyday life	32%
	• Don‘t really know	14%
	• Money	9%
R **Relevance**	*How useful is maths in your life?*	
	• Very useful.	68%
	• Helping with children’s homework only	9%
	• Money only	23%
C **Confidence**	*How do you feel about maths?*	
	• Like	37%
	• Dislike	27%
	• In between	27%
	• Like it now, disliked it at school	9%
S **Satisfaction**	What aspects of maths do you think should be included in an online maths unit?	
	• Unit OK as is	59%
	• More money/real life	18%
	• Don’t care about maths	4.5%
	• Needs to be easier	4.5%
	• Needs to be harder	14%

Table 3: Summary of responses to ARCS questions

When asked about whether on-line learning was preferred to the traditional (book) way of learning, 50% believed it was. Another 23% said that sometimes it was, and sometimes not. 18% gave a definite no, and the other 9% were not sure. The

students' comments on the advantages and disadvantages of online learning are summarised in Table 4.

Advantages and disadvantages of online learning	No. of students	% of students
Teaches computer use	5	23%
Not as subjective	1	4.5%
More interesting	4	18%
Quicker, better feedback	3	14%
You can go at your own pace	1	4.5%
Easier to get information (as long as technology works)	2	9%
Less distractions	1	4.5%
As long as you have access to a tutor	2	9%
Can be confusing on-line	1	4.5%
No answer	2	9%
TOTAL	**22**	**100%**

Table 4: A summary of responses on the advantages or disadvantages of learning on- line

After the discussion that resulted from the earlier questions, students were then asked if they would prefer to study in an on-line or more traditional unit. 55% (12 students) said that they would prefer the on-line way, 27% would like both, and 13% said that they would prefer the more traditional way. These results confirmed our initial findings that online learning would be prove to be highly motivating for the students.

Instructional Context Analysis: Perceptions of the Advantages of Learning Mathematics On-line

The effective teaching of mathematics to Indigenous adult learners entails creating resources, environments and support systems that incorporate cultural perceptions of, and attitudes towards mathematics. There is also a need to accommodate culturally acquired prior mathematical knowledge, ensure student-centred real-life learning takes place, and negotiate with Aboriginal communities and students on the content, design, and delivery of on-line mathematics programs to ensure ownership (Peard, 1996; Jack, 1999). On-line learning based upon constructivist, experiential principles of learning involves purposeful interaction by students and must embed culturally appropriate pedagogies.

In the interviews, students were asked whether they thought that on-line learning of mathematics would be better than the traditional (book) way. A summary of responses is given in Table 5.

Response	No. of students	% of students
Yes	13	59%
Depends, still need to do working out on paper	2	9%
On-line but with concrete material	1	4.6%
On-line with tutor support	1	4.6%
Yes, for younger people	1	4.6%
Both	1	4.6%
No	2	9%
Don't know	1	4.6%
TOTAL:	**22**	**100%**

Table 5: Responses to whether on-line would be a better way of learning maths

The students were asked what they thought would be the advantages of learning mathematics on-line. There were many different aspects that were suggested. One said, *"I guess you can probably have a problem and actually then you can go into it and have a visual of it, which would be good. Because if you can see the problem and have that visual then you can grasp it a lot more than just having it written down on paper."* Four people said that an on-line unit would enable them to go back over the work (revise) until they understood it, and two others made the point that they could go back and correct it on-line. The other main advantages mentioned were that it was more interesting, faster and not subjective. Again, the motivating power of online learning was in evidence.

Perceived disadvantages of learning mathematics on-line

The final question asked the students to think of any possible disadvantages to learning mathematics on-line. Six students felt that there were no disadvantages, while another four said that there would be none, as long as they had access to a tutor. Three students were concerned for people who were not familiar with, or did not like using computers. A further three were concerned about technological problems, with one saying:

> Disadvantages of on-line maths. Technology breaking down. That is the only thing I can see. [We were warned of this.] It is terrible.

When asked if there was any final comment she would like to make, one student stated,

> No, I'd just like to see this happen. I'd like to see it working. Not only just in universities, I think in the schools as well because we've got a lot of kids with a fear of maths and hate maths. And you try and bring that and turn that around.

These responses indicate that supportive learning contexts are required to orient students to online learning of mathematics.

Summary : Implications for Further Research

The contextual analysis conducted revealed that factors shaping Indigenous adult perceptions and attitudes to mathematics are complex. Perceived usefulness, attitude towards success, confidence in learning, and mathematics anxiety are some of the key elements that define adult attitudes towards mathematics. The interviews for this research indicated that most of the participants were aware that mathematics played an important part in their lives, but they mostly equated this with monetary needs and concerns about job opportunities. This has implications for the design of mathematics bridging units online.

Student responses indicate that there needs to be less learning for the sake of knowing, and more consideration given to the use of mathematics in real life situations. Contextualisation of tasks is essential. Other design considerations that emerged from the analysis were related to the need for community base support structures. The adoption of the 'community of practice model' for online delivery (Lave, 1988) enables learners to have access to community knowledge, support structures and shared interests. This form of emancipatory pedagogy ensures recognition of students' capacity to construct their own knowledge, bring prior experience and culturally preferred ways of knowing to learning tasks and develop a sense of ownership and pride in their own knowledge. Further, for adult Indigenous mathematics education to be successful, instructional design of educational programs must incorporate the skills and values of the community, its cultural traditions and its problems and issues in order to create a unified and authentic learning environment. Immediate needs that were recognised as result of this contextual analysis were those of initiation, support and skilling in information literacy. From the outset, awareness of student needs must inform the design process for online units of study. For most students, initiation into an online community is a new experience and therefore technology-related skills have to be learnt.

Conclusion: Research on Online Design for Adult Learners

The number of adult students, including Indigenous adults, returning to higher education is increasing. What these students have in common is that they have chosen to return to education, are motivated to succeed because of personal investments of time and financial resources and the need for self improvement and enhanced career prospects, and are entering an educational age where computers play an increasing role as the primary learning tool that offers flexibility to accommodate a diversity of access and learning needs. In this article we argue that contextual analysis reveals salient learner characteristics that can be built into the design process. The analysis reported here is based on empirical evidence and combines adult learning theory, motivational aspects with contextual analysis of learners, their situations and orientations.

On-line learning is emerging as an important means of educational access and pathways to learning opportunities and success for adult students. Adult Indigenous students, though they may have initial apprehensions, find on-line learning and the use of information technologies motivational, flexible, a means of interactive learning with other students, and more suited to personal needs and circumstances. Adult Indigenous students positively embrace on-line learning. Ninety five percent of the students interviewed believed that on-line learning is useful, is motivational, and a means of accessing distance education.

It is evident that literature on the teaching of mathematics to Indigenous adults is sparse, that there is a dearth of research on adult perceptions and attitudes to mathematics and on-line learning of mathematics, and that this is particularly so for Indigenous mature-age students. Given the increasing need and trend for these people to return to education and the emerging importance and benefits of on-line learning opportunities for mature-age Indigenous students, this is clearly an area in need of further research. This research was undertaken to find out about the students' perceptions of mathematics, their attitudes to the general concept of learning on-line, and in particular to learning mathematics on-line. The implications of the study are that designers can utilise contextual elements and motivational frameworks to design learning tasks, enhance relevance and increase intentional learning. The complementarity of approaches provides a rich source of data that can inform instructional design and lead to more learner-centred environments.

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