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Management of a student centred online environment

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With the development of new undergraduate degree programs within Murdoch University's School of Engineering, the decision was made to offer courses, as much as practical, online. In addition to being driven by other key objectives, the web was seen to empower students with regard to their learning experience by providing an environment well suited to support student control of the learning process.

However, the self directed learning environment requires an infrastructure to support the students and foster their construction of knowledge:

- to present information within an organised framework
- to know whether the material is being covered appropriately
- to know what component in relation to the whole course has and still needs to be undertaken within the timeframe
- to ensure meaningful interpretations are made and learning objectives being achieved.

In addition to providing mechanisms for the student to self regulate their learning, the infrastructure must be able to provide the teacher with mechanisms to evaluate that the learning is meaningful within the requirements of the course. In order to address these issues, two environments have been built. The purpose of this presentation is to demonstrate and to discuss the components of this infrastructure:

- the elements common to the two environments:
- support provided to early year students to plan and monitor their own study program
- the navigational scheme provided for senior students with more developed study habits.

This allowing the students to complete elements of a course at their own pace, and with some degree of choice as to the order in which topics are studied and how these elements are integrated into the instructional framework that supports learner control and self regulation.

Education via the web

Murdoch University School of Engineering's decision to offer courses, as much as practical, online is based on currently accepted models of learning. These suggest that the learner constructs personal meaning by engaging in

dialogue	internally or with others, in order to obtain consensus, and
reflection	multiple perspectives and challenges provide opportunity for reflection and introspection in order to make sense of experience gained (Laurillard 1993).

The web is seen as a medium that supports student control of the learning process through its capacity to

help learners develop unique knowledge representations (Miller and Miller 1999) and is said to be well suited to domains of conceptual complexity and case to case irregularity. Here teaching in a hands on medium has application (Brandt 1997). Many areas of Engineering (and in particular Software Engineering) fit this category of material.

However, some educationalists emphasise the problems of the web as a learning environment. Many of these are inherent in any information system:

disorientation
navigation inefficiency
cognitive overload, where the amount of information provided exceeds what is needed

so that it is difficult to separate system or navigational information from the "real" answer (Brandt 1997).

Students are seen to need conceptual knowledge in several overlapping domains to use the web successfully:

information retrieval skills
knowledge of how the system works
subject domain
problem solving skills.

There is therefore an element of Catch 22 in using a medium to teach skills that the student needs to have in order to utilise the medium effectively.

Miller and Miller (1999) suggest that the strategies used to present the content and strategies used to sequence delivery of course content will determine to a large extent the manner in which a student interacts with the material. This course design conveys information that shapes student experience, including

expectations about the purpose of learning
depth of reflection and understanding
degree of learner control.

Course design, therefore, has increased importance in a web based learning environment, where, to some extent, it compensated for the absence of communications cues found in face to face interaction. By the same token, the design is expected to support, not control, the learning process.

A web based learning environment requires an infrastructure to support the students and foster their construction of knowledge, so that it too does not control the learning process:

- to present information within an organised framework
- to evaluate whether the material is being covered appropriately
- to know what component in relation to the whole course has and still needs to be undertaken within the timeframe
- to ensure meaningful interpretations are made and learning objectives achieved.

In addition to providing means for the student to self regulate their learning, the infrastructure must be able to provide the teacher with mechanisms to evaluate that the learning is meaningful within the requirements of the course.

In order to address these issues within the School of Engineering, two environments have been built to underlie the courses offered online. The purpose of this presentation is to demonstrate and to discuss the components of this infrastructure:

- the elements common to the two environments

- support provided to early year students to plan and monitor their own study program
- the navigational scheme provided for senior students with more developed study habits. This allowing the students to complete elements of a course at their own pace, and with some degree of choice as to the order in which topics are studied.

Components in common

While the cognitive issues of designing online material have been well documented (see, for example, Ebersole 1997), and are generally accepted as goals for web based design, the opportunity for greater focus on the "real" answer should be emphasised.

Both environments are set up to present a coherent system and learning context. Rules are established in each so that the cognitive overhead required by the medium in minimised through:

consistency (limiting the appearance of fragmentation)
effortless/automatic navigation
increased orientation so that the content (not just the user interface) allows the student to identify current position, history, options, etc.

Both environments provide learning support in terms of access to discussion fora, email, bug reporting, etc.

Unit template (early years)
http://eng.murdoch.edu.au/WebTeachingDemo/MUEpage12.html#Unit%20template%20(early%20years)
Unit template (Software Factory)
http://eng.murdoch.edu.au/WebTeachingDemo/MUEpage14.html#Access%20to%20a%20topic

[Note: the links to static pages throughout this document reflect components of a "live" demonstration]

Support for planning and monitoring own study program

The environment provided in the early years of study exposes students to mechanisms that enable them to take charge of their own learning progress. This environment may be categorised as exogenous (based on Moshman (1982)'s constructivist categories) and is characterised by recognition of the value of direct instruction, but with increased learner control. This model requires opportunity for putting knowledge into practice through the use of quizzes, multiple choice and the like to provide feedback (Dalgarno 1996).

Two infrastructure tools are used extensively in this environment.

Progress Monitor

Students have access to a tool that supports the planning and management of their work patterns.

Progress Monitor
http://eng.murdoch.edu.au/WebTeachingDemo/MUEpage13.html

The Progress Monitor acts as planning tool in that students are provided with numerous milestones against which they may pace themselves. However, it should be noted that while students are encouraged to monitor their own progress, this is not enforced.

Learning feedback

While feedback on activities is standard educational practice, immediate feedback has greater effectiveness in a constructivist environment as it enables the student to alter the way information will be encoded. Learning is further enhanced where explanations are linked to multiple attempts.

MCQ
http://eng.murdoch.edu.au/WebTeachingDemo/MUEpage17.html

The MCQ (Multiple Choice Questions) environment allows the teacher to set several parameters

whether the student can browse
whether a set of questions can be attempted more than once
time/date of test availability.

Questions/answers/explanations are input and optionally assigned a degree of difficulty, with a 'set' composed by including/excluding specific questions.

After an attempt, the student chooses to have the test marked. Once marked short explanations can often be found under the "?" buttons. The student record database records visits, attempts and score achieved. This information is available to the unit coordinator.

While the degree of difficulty feature is not greatly used at present, the ability to vary this will allow students quickly to gauge what is at their zone of proximal development (and therefore just beyond current ability), where the learning is more positively effected (Vygotsky 1978).

Support for senior students

Within the second year, and increasingly in 3rd and 4th year, SE (Software Engineering) students work within a less structured (but supportive) learning environment. In contrast to the earlier environment, the Software Factory assumes a learner directed discovery of knowledge. Within the Software Factory, lectures and tutorials are replaced by workshops that focus on human contact and provide support through worked examples, discussion and a forum for review of understanding. The teacher interacts to convey attitudes, experience and motivation to attack the material (Allen et al 1998). This complements well the dialectic environment (with a focus on social interaction and group work) outside the web based component of the Software Engineering curriculum.

Web based environments are said to draw on this endogenous constructivist model by allowing/enforcing active exploration as a mechanism for knowledge discovery. A study in Singapore in 1998 concluded that a strategy of minimal rote tuition and a focus on raising student motivation to explore topics at their own pace resulted in demonstrably improved success in grades (Gilliver, Randall and Pok 1998). Implicit, however, is the availability of support tools and scaffolding to assist the learner.

Context

Constructivist theory makes much of establishing a context for learning so that opportunity to construct personal meaning is enhanced (Miller and Miller 1999).

Within the two clusters (each comprising four courses with an emphasis on theory or application) which make up the Software Factory, topics are categorised mnemonically. This allows for "chunking big" and focusses on connections between topics in the same category for content and context dependent knowledge construction (Jonassen 1992).

Software Navigator
http://eng.murdoch.edu.au/WebTeachingDemo/MUEpage14.html#The%20content%20dimension

Production Line

Within each course (unit) topics are sequenced and displayed on a production line/underground map that provides alternative routes from commencement to completion. To a certain extent these provide choice in the order of topics studied and allow students to vary the sequencing of content. This degree of freedom

to control access to information is not unlimited. While, in theory, the exam date is the only relevant marker for completion of the course, in practice milestones (in the form of assignments/projects) and support in the form of workshop schedules dictate which topics must be completed by when. External students have some greater degree of freedom by not being involved in workshops.

Instead of the Progress Monitor provided in the early years environment, the Software Factory allows students to graphically indicate inprogress/completed information for specific topics. The expectation here is that teacher monitoring is not as vital since the students have (hopefully) better developed study skills to allow them to undertake "purposeful navigation"(Miller and Miller 1999) and hence meaningful interpretation of the material.

In addition, the Production Line enables students to easily "explore the world" of each course - each node is directly linked to the relevant topic for browsability, although backwards/forwards links exist between topics as well.

Production Line
http://eng.murdoch.edu.au/WebTeachingDemo/MUEpage14.html#The%20content%20dimension

Scaffolding

While a constructivist learning environment implies a focus on activities/real world problem solving, online/interactive activities cease to be meaningful if the student hits a snag and is unable to progress from there. The purpose of scaffolding is to provide activity sensitive help mechanisms.

The Software Factory provides examples both of purpose built activity help and underlying manuals. The former takes the form of an icon on an activity screen:

Activity based help
http://eng.murdoch.edu.au/WebTeachingDemo/MUEpage18.html

The latter is best demonstrated through the underlying help in the FM (Formal methods) topics.

Support for Z
http://eng.murdoch.edu.au/WebTeachingDemo/MUEpage16.html

Both of these mechanisms are not imposed on the student, but are readily available. Links to the help mechanisms are seamless, which enables the student to maintain focus on the learning activity, rather than on the task of retrieving aid.

Experience shows dependence on the scaffolding (especially the Z manual) decreases over the semester. However, the scaffold is never withdrawn, but afterwards acts as a reference tool in the same way that a dictionary or user manual does.

Other tools (for example the CASE tools) act both as scaffolding and impart necessary skills - using the CASE tool, for example, won't allow students to perform "illegal" moves. This is a learning outcome in its own right.

Conclusion

In conclusion, what we hope we are providing is a rich learning environment that encourages multiple learning styles and multiple representations of knowledge and supports the communications and negotiation processes between members of the class community.

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