An Internet Model for Continuing Education in Mining

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Summary

This paper presents an Internet model for continuing education in mining that addresses the design constraints of browser compatibility, *any time, any place, any pace* accessibility, low bandwidth requirement, appropriate interactivity, formal accreditation, performance monitoring and certification. The model can be applied in a professional development context, technical reference context, or mining curriculum support context. The paper is illustrated by examples from an existing Internet provider of continuing education in mining.

1. Background

The mining community is geographically remote and widely dispersed. There is a growing requirement for formalized professional development of members by professional associations, and increasing recognition of the advantages of continuing education by both individuals and corporations. Working against these trends are the increasing expense and time commitments required for attendance at conventional courses and workshops. The result is a growing demand for a readily accessible source of continuing education and technical reference on the Internet.

Professional Development

North American state and provincial licensing boards for professionals increasingly require licensees to meet a Continuing Professional Competency (CPC) requirement as a condition of license renewal. Almost 50% of US state boards and their provincial counterparts in Canada have implemented, or are in the process of implementing, a CPC requirement (National Society of Professional Engineers [1] - 1/31/01; Canadian Council of Professional Engineers [2] - 4/04/01).

A CPC requirement mandates a licensee to demonstrate to the licensing board the satisfactory completion of specified activities as a condition for renewal of the individual's professional license. Each state and province maintains its own requirements regarding CPC, and adoption of a CPC requirement is ultimately decided by the relevant legislature, professional licensing board, and/or professional society.

CPC reinforces the need for lifelong learning to stay current with changing technology, equipment, procedures, processes, tools, and established technical and business standards. Rules specifying qualifying CPC activities are generally designed to give flexibility in selecting among a broad range of subjects that are intended to strengthen or maintain a licensee's competency.

CPC activities must be relevant to a licensee's profession and may include technical, ethical, or managerial (business) content. Activities should advance the professional or technical competence of the licensee. Qualifying CPC activities may be sponsored or presented by colleges or universities, employers, government agencies, nationally affiliated professional societies, or by various other organizations. Typically, licensing boards do not pre-approve courses for CPC, leaving it to licensees to ensure selected activities meet CPC requirements.

CPC credits are awarded for attendance or participation in conferences, workshops, courses and other approved activities. The generally recognized unit for CPC credit is the Professional Development Hour (PDH), where 1 PDH is equivalent to 1 "contact hour" or "presentation hour".

An alternative measure of CPC credit is the Continuing Education Unit (CEU), equivalent to 10 contact hours (1 CEU is equivalent to 10 PDHs). A qualifying condition for awarding CEUs is that the provider of the continuing education activity must meet the Criteria for Certification established by the Authorized Provider Commission of the International Association for Continuing Education and Training (IACET [3]).

The advantages to licensees, in terms of reduced cost and time commitments and convenience, of participating in online continuing education courses to satisfy their CPC requirements are obvious. However, as yet, most licensing boards have taken no action towards formal acceptance of online continuing education, leaving it to licensees to ensure such activities meet CPC requirements.

Technical Reference

Many professionals, particularly those in remote locations, require timely access to a technical reference resource that will assist them in meeting their career and employment objectives. A process engineer faced with a grinding problem, or an engineering geologist faced with an unstable pit wall, or a manager confronted with a risk assessment problem, likely do not have the opportunity to attend a conventional course on the subject.

A comprehensive library of professional development courses represents a repository of technical expertise and information on mining and geoscience topics. Internet access to such a resource, via appropriate search and retrieval tools, can make a significant contribution to the technical reference requirement.

Mining Curriculum Support

Cut-backs to educational and research funding have reduced the ability of mining schools and colleges to address the specialist topics demanded by modern mining practice. Some are reduced to focusing on the core mining curriculum and reliance on industry specialists to fill in the gaps wherever possible. The cost of developing courses on specialized topics is, in many cases, difficult to justify for a classroom audience.

In contrast, online continuing education addresses a considerably larger audience that is potentially capable of supporting course development costs. A comprehensive library of professional development courses represents a readily accessible resource of course material on specialized topics for mining schools and colleges to integrate into their curricula.

2. Design Considerations

The primary objective is to provide online courses that address the requirements of professional development. Meeting the objectives of online technical reference and mining curriculum support are important secondary objectives. The following considerations also influence the design of an Internet model.

- Many mining professionals operate in remote locations with relatively slow Internet connections; in some areas Internet connections must be paid for on a connection time basis.
- Although mining professionals have above-average familiarity with computer and Internet technology, the concept of online courses is unfamiliar to many, especially older-generation professionals; courses should therefor be as intuitive and easy to view and navigate as possible.
- Courses should be based on a content model that works efficiently for any of the identified target contexts and is reasonably similar to that of a conventional classroom/workshop content model.
- To satisfy the "any time, any place, any pace" learning requirement of continuing education as well as the technical reference requirement, viewers should be allowed unrestricted access to all available courses when necessary.
- Viewers with a professional development requirement should be able to register for certification in a specific course and receive confirmation of their learning achievements.

- A mechanism is required for monitoring viewer performance in a course and confirming that the intended learning outcomes have been achieved.
- Both the content model and the learning process should qualify for accreditation in a formal continuing education context that is recognized by professional licensing boards and associations.
- Available research on viewing habits on the Internet should be taken into account.

3. Internet Model

An Internet (browser compatible) model for continuing education, that addresses the requirements of professional development, technical reference and mining curriculum support, is presented below. The underlying technology of the model is XML (Extensible Markup Language), an Internet standard formulated and published by the W3C (World Wide Web Consortium [4]). The technology aspect is covered in detail elsewhere (Houlding [5], 2001) and is dealt with only briefly below.

The Internet model is illustrated by examples from an existing Internet-based provider of continuing education (EduMine [6]).

Bandwidth

The bandwidth requirement for online continuing education is a primary concern. Many mining professionals operate in remote locations with relatively poor and/or expensive (by North American standards) connections to the Internet. To ensure courseware interactivity, the bandwidth requirement must be kept to an absolute minimum.

Unlike a conventional HTML (Hypertext Markup Language) document, which is concerned with a mix of content, presentation and styling information, an XML document is concerned exclusively with content, resulting in significantly smaller file sizes. Styling and presentation information is transmitted once only, then applied to multiple XML content documents, as required, within the viewer's browser.

Interactivity

Certain advantages of the conventional classroom or workshop learning experience, such as question-and-answer dialog and peer discussion, are not available with online courses. These omissions can be at least partially compensated for by including interactive examples in an online course to enhance the "hands on" experience.

A feature of XML is its significant support of interactivity within the viewer's browser, i.e. without any need for communication with the provider's website. In contrast to a conventional HTML solution, the XML solution provides opportunity for maximizing viewer interactivity at the same time as minimizing the bandwidth requirement.

Presentation and Style

By using an XML model, the presentation, style and functionality of courses is controlled by a template and several stylesheets. The "look and feel" of all available courses can be modified or enhanced to meet new requirements simply by editing the template and stylesheets.

4. Content Model

The content model of an online course is defined by a division into "parts", and a set of working "sessions" plus an interactive review session within each part. This structure is based on the concept of a "viewing session" as defined below.

Viewing "Session"

The results of research into viewer habits on the Internet indicate that the average viewer will concentrate on detailed information presented on a computer screen for only 30 - 60 minutes without a break (Fleming [7], 1998). The content model is designed around this concept of a 30 - 60 minute viewing session; roughly equivalent to a lesson in a conventional classroom context. Within a session, the course content is presented at several information "levels" (Figure 1 below).

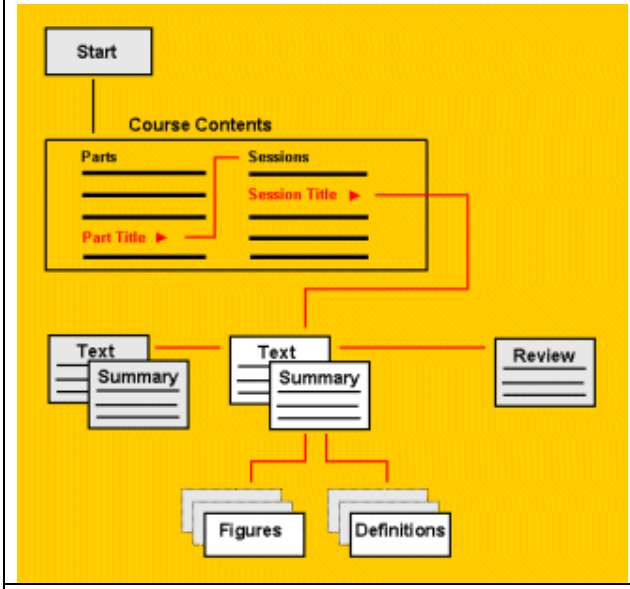

Figure 1 - A schematic of the course content model. A course consists of multiple Parts, each of which comprises a set of related Sessions and an interactive Review. Each session can be viewed at a Summary or a Text level, both of which are linked to supporting Figures and Definitions.

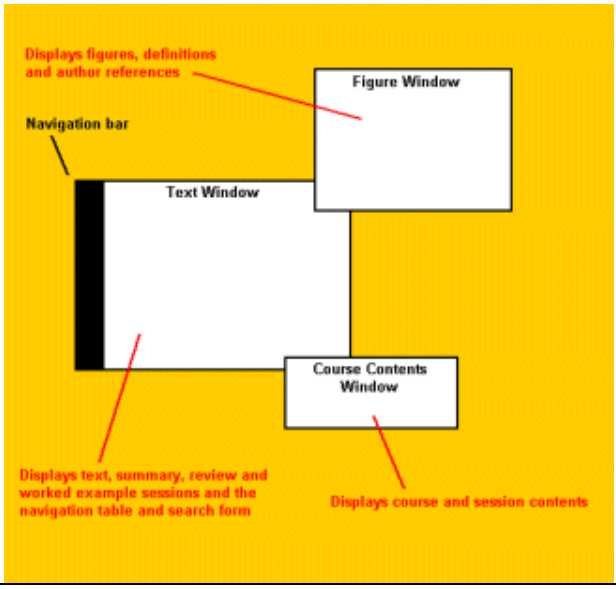

Figure 2 - A schematic of the browser template for viewing course content. The template includes a Text Window with a Navigation Bar on the left, a Figure Window and a Course Contents window.

Information "Levels"

The summary level presents the principle points of a session, providing the viewer with an overview of the material covered by the session (Figure 3 below); in effect, this is the equivalent of the lecturer's presentation in a conventional classroom context.

The text level is a detailed presentation of the material covered by the session (Figure 4 below); the equivalent of course notes in a conventional classroom context. The viewer may either complete the summary level presentation, thereby obtaining an introduction to the material covered, then switch to the text level, or toggle freely between the summary and text level on a point by point basis.

Both summary and text level presentations are supported by figures, interactive examples, detailed definitions, reference tables, video clips and author references. All supporting materials are displayed only at the viewers request in order to minimize the bandwidth requirement. They are represented within the summary and text levels as thumbnail images or hypertext links.

Courseware Template

Course content is displayed within an XML-driven courseware template that integrates navigation functionality and support tools with the content (Figure 2 above).

Navigation functionality is made deliberately redundant to provide maximum flexibility and alternative options for the viewer to navigate within a course. Included are Next, Previous, Last Visited, Session Start, Summary/Text Level and direct links to other sessions within the current part of the course. A Course Map and a Course Contents window provide direct links to all other parts and sessions within the course. The template also makes provision for color-coded links within the course content for cross-referencing, author references, and links to reference tables and definitions.

The courseware template provides the viewer with direct links to an online course discussion forum and course support from both the continuing education provider and the course author.

Support tools integrated within the template include an intelligent search engine, a comprehensive mining and minerals dictionary, and a units converter to cater for international audiences.

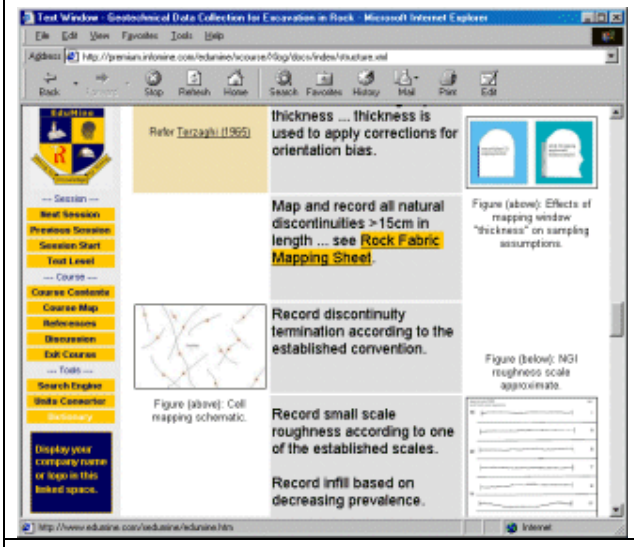

Figure 3 - An example of summary level presentation of course content.

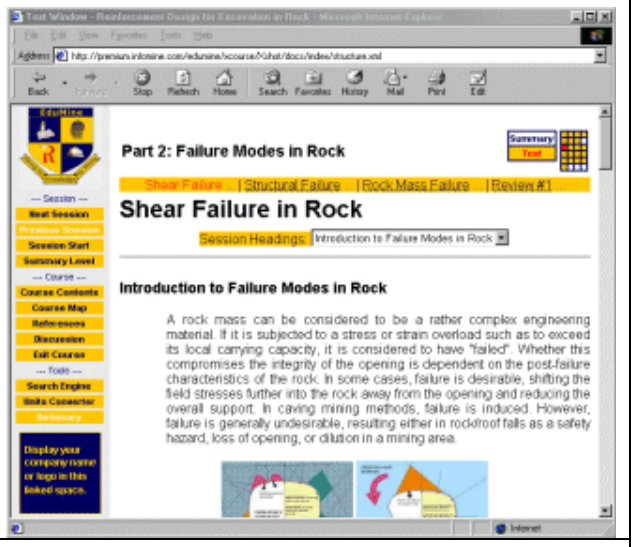

Figure 4 - An example of text level presentation of course content.

Interactive Reviews

The sessions within each part of a course are followed by an interactive review designed to test the viewer's knowledge of material presented in the preceding sessions. A review comprises questions and multiple-choice responses (Figure 6 below). The viewer is allowed a one-click selection of each response and is immediately informed of the correctness or otherwise of the selection. Incorrect responses may not be corrected, but alternative responses to a question may still be selected. For incorrect responses, the viewer is directed to the relevant session for further study. The viewer's review "score" can be displayed at any time.

Courseware Development Environment

A premise for development of a continuing education website for mining professionals is the existence of relevant course material developed for conventional classroom or workshop delivery. A range of tools, including scanning, optical character recognition, and automated conversion to XML, is provided for converting existing material to the content model. Additional tools are provided for development of new material directly in XML format.

5. Learning Model

The learning model is based on the premise that a viewer should have unrestricted access to a course during the learning phase, and should be allowed to take as long as necessary to achieve the intended learning outcomes. The viewer should register for certification in the course only when he/she is confident that the learning outcomes have been achieved. The certification process is designed to confirm this achievement.

Enrollment for Unlimited Access

Viewer access to all available courses is obtained by enrollment and payment of a monthly fee. Enrollment thereby meets the access requirements of both professional development and technical reference.

Certification and Professional Development

Certification requires registration for a specific course, payment of a course fee, and satisfactory completion of the interactive course reviews within a specified period (generally of the order of several weeks). The viewer's performance in the interactive reviews is monitored during this period via the courseware template and recorded in a database at the continuing education website. From the viewer's perspective, the certification requirement is roughly equivalent to a conventional open-book examination. Optionally, a more rigorous approach to certification can be achieved by requiring invigilation of the viewer's performance by a registered professional. On satisfactory completion, the viewer is awarded a certificate that confirms his/her achievement.

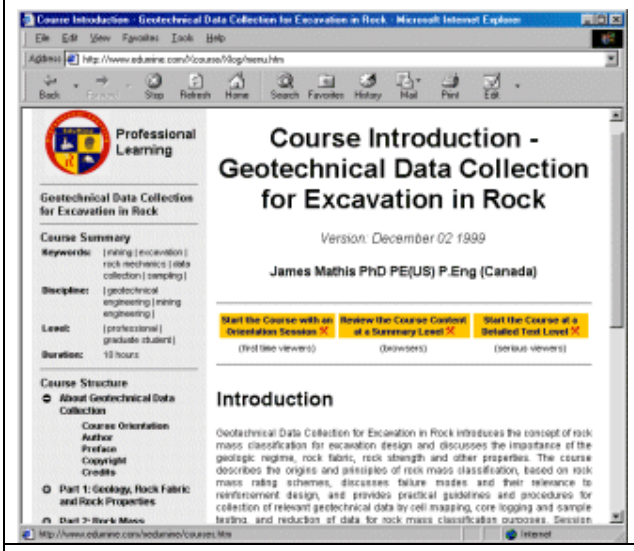

Figure 5 - The introduction to a course includes information on the course structure, duration, target audience, learning outcomes, and CEUs (PDHs) awarded for completion.

Figure 6 - The multiple choice questions in a course review reflect the correctness of a selected response and direct the viewer to the appropriate session for further study when necessary.

Courseware Accreditation

To satisfy the requirements of professional development, both the content model and the learning model should qualify for accreditation in a formal continuing education context that is recognized by professional licensing boards and associations. The criteria for accreditation have been established by the International Association for Continuing Education and Training (IACET [3]). An approved provider of continuing education may award Continuing Education Units (CEUs), or the equivalent in Professional

Development Hours (PDHs), to viewers who successfully complete the certification process. The IACET criteria may be summarized as follows.

- The provider must have an identifiable continuing education unit or group with assigned responsibility for administering continuing education activities, courses, or programs
- The provider, through its continuing education unit, ensures that certification criteria are followed.
- The provider has a system in place to identify learners who meet requirements for satisfactory completion. The provider maintains a complete, permanent (at least seven years) record of each learner's participation, and can provide a copy of that record upon request.
- A learning environment and support services appropriate to the continuing education goals and learning outcomes is provided.
- Each activity, course, or program is planned in response to identified needs of a target audience.
- The provider has clear and concise written statements of intended learning outcomes (e.g. behavioral or performance objectives) based on identified needs for each continuing education activity, course, or program.
- Qualified personnel are involved in planning and conducting each activity, course, or program.
- Content and instructional methods are appropriate for the learning outcomes of each activity, course, or program.
- Procedures established during activity, course, or program planning are used to assess achievement of learning outcomes.
- Post activity, course, or program evaluation: each learning activity, course, or program is evaluated.

6. Reference Model

A library of professional development courses represents a large and expanding repository of technical expertise and information on mining topics. To interface with and access this repository effectively for technical reference purposes, the viewer is provided with interactive tools for interrogation, review, search and retrieval of information from all available courses (Figure 7 below). The functionality of this toolset is enhanced by the XML-based content model of the courses; this enables more intelligent searching than is possible with a conventional HTML-based model.

7. Authoring Model

Continuing education is dependent on the ability of the provider to attract qualified authors who either have, or are prepared to develop, courses on appropriate topics. This ability is based on several factors.

- Author royalties are based on a percentage of course revenues from viewer enrollment and certification. Because enrollment provides unrestricted access to all available courses, enrollment revenues are allocated in proportion to monitored viewer access to the courses; the more popular a course is, the greater its share of enrollment revenue.
- An online course has a potentially much larger audience than a conventional classroom/workshop course, with correspondingly greater opportunities for revenue generation and author recognition.
- Tools and support services are available to assist authors with development of course content in a format suitable for online presentation.

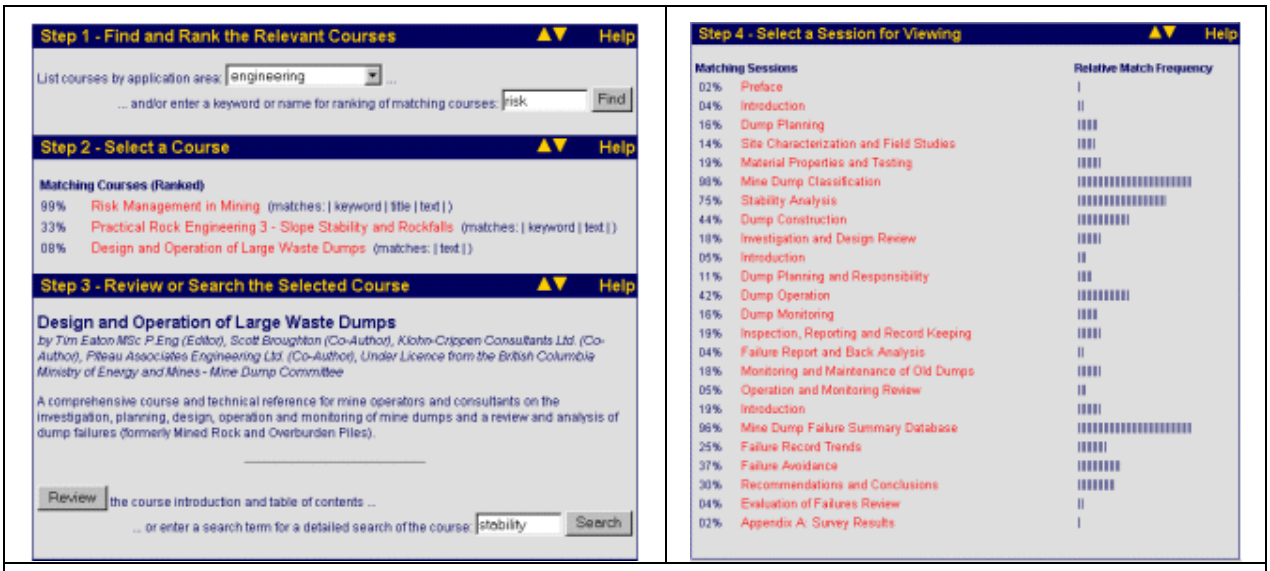

Figure 7 - A viewer interface for interrogation, review, search and retrieval of information from the course repository in a technical reference context.

8. Conclusions

The proposed Internet model for continuing education in mining satisfies the primary objective of providing a resource for professional development. It also provides a resource for technical reference and mining curriculum support. This conclusion is supported by the experience of EduMine [6], an existing provider of online continuing education with more than 500 professional development hours of course content on mining and geoscience topics.

The interactivity, bandwidth requirement, development efficiency and maintenance of the proposed content model are significantly enhanced by employing an XML solution.

For mining professionals with a licensing requirement to demonstrate continuing professional competency, the Internet model provides a cost and time-efficient alternative to attendance at conventional courses and workshops.

9. References

1. National Society of Professional Engineers (1/31/01) - http://www.nspe.org/

2. Canadian Council of Professional Engineers (4/04/01) - http://www.ccpe.ca/

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6. EduMine (a division of InfoMine Inc.) - http://www.edumine.com

7. Fleming, J., "Web Navigation - Designing the User Experience", O'Reilly and Ass. Inc., Sebastopol CA (1998)