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Tips for Developing Media-rich Online Courses

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1. Introduction

From the literature, the phrase 'online course' seems to mean different things to different people. For our purpose, the following definition describes an online course:

A multimedia-rich course delivered completely online. It engages the learner interactively, actively and effectively.

The course should be multimedia rich in the sense that it should contain text, animations, voice, and possibly video clips. The online course should be comprehensive enough such that it can be considered a replacement of the tradition face-to-face method of teaching. It should be a self-contained learning package with concepts adequately illustrated and explained in voice narrations. The course should provide sufficient interaction with the learner in order to give a 'human touch' to online learning.

The remainder of this paper is structured as follows. The following section outlines the salient features an online course should have for effective learning. Section 3 presents the major milestones in online course development and highlights what needs to be done in each milestone in order to realize the salient features outlined in Section 2. Section 4 discusses course management issues after completing and deploying the online onto a learning management system. A case study is provided in Section 5 indicating how much time online course development may require. The paper concludes with a summary and acknowledgement in Sections 6 and 7, respectively.

2. Salient course features for effective learning

This section presents important characteristics that should be reflected in course contents in order to make learning effective. While these issues may apply to both traditional face-to-face and online courses, they are especially important in an online learning environment. As we discuss these issues we point out how we addressed them in the three online courses that we developed.

Puts learners into perspective

Before beginning course development, online course developers should have a clear understanding of their target audience, the learners. We should know learners' level of motivation, current knowledge level, their language skills and computer literacy. This will keep an online course developer focussed towards developing better instructional material with a minimal chance of causing boredom and frustration.
We teach in English in our university where English is not the first language of the students. This requires us to put extra effort in contents presentation and transcript writing. We base our students' current level of knowledge on the knowledge units of pre-requisite courses of our online courses. Our audience analysis reveals that our target students are highly computer literate with 98% owning personal computers.

Spells out learning contract clearly

The course rationale, measurable objectives, learner responsibility and learning outcomes should be clearly spelt out. Grading policies and related matters should also be highlighted early enough. Students should know what they are expected to be able to do after

graduating form the course. From our experience [Junaidu, 2002], time management issues are especially important for effective online study.
The first unit in each of our online courses is devoted to spelling these issues out clearly for the students. On the first day of the semester, we give the students a broad introduction to the course structure and organization giving them a battery of study tips based on the course's graduate students' experiences.

Covers course contents adequately

Without proper planning, online course developers may find themselves overwhelming the learners with material. All knowledge units to be covered and their extent of coverage must be carefully stated and course contents developed accordingly. Course contents must be up to date and appropriate choice of examples should be made to enhance the realization of the set learning outcomes.
Computer science, our teaching subject, is a fast changing field, like many other specializations. We have to keep ourselves current, as course developers, to ensure that we prepare and present course contents that incorporate the latest technologies. This will give a relatively longer lifetime to our online courses before revision or redesign becomes necessary.

Contains sufficient motivating elements

Probably the most critical factor in learning is the motivation of the learner [Macromedia, 2001]. As online course developer, you must ensure that online learners are properly motivated. You should include instructional elements that catch and hold learners' attention. Attention is like a flashlight in a dark room; we observe the details of objects in the bright beam but notice less about objects in the dim shadows.
We incorporate graphic images, which serve as metaphors, alongside newly introduced concepts with a view to catching learner's attention. We also use small pop-up screens, in a measured way, to indicate when certain important events occur, like reaching the base case when executing a recursive program.

Illustrates concepts adequately

Studies show that combining various media can increase the receptiveness of the human senses (Durand, 1997), shortening learning time and improving results. An online course should make use of multimedia elements (animations, sound, graphics, color etc) to illustrate and explain important concepts. Multimedia allows a variety of learning styles and preferences to be accommodated. This is where the online author can really appeal to learners' intuition and, potentially, do better than what can be done in the traditional face-to-face method of instruction.

Animations are one of the central vehicles for realizing learning effectiveness in our online courses. Although animations require high time investment to be built, their effectiveness at enhancing learning is worth the time investment. We built animations that take only about ten minutes to preview but take about 15-20 hours to assemble.

Engages learners actively

There is a general belief that "interactive engagement methods" enhance the effectiveness of teaching [Dannenberg, 1997]. Interactive engagement methods include: collaborative peer instruction, problem sets, tests and quizzes, computer-based simulation, and model building.

In addition to the rich media used to explain concepts, each lecture unit of our online course consists of an average of two interactive quizzes within it and a set of review exercises at the end of it. Our courses are deployed and delivered using WebCT, a rich learning management system, supporting a number of ways of achieving real-time interaction and assessment.

Provides regular feedback

In addition to intra-presentation feedback, an online course should provide feedback to learners through facilities provided by course delivery tools like e-mails, discussion groups, chats, online quizzes etc. Other means of assessment are projects, written assignments, case studies, and essay questions all coordinated using the delivery tool of choice.
Regular assessment and feedback is necessary to assess whether learning has taken place and to identify problems early and institute corrective majors quickly.
Our college has also supplied the facilitators of our online courses with Web cameras (Web Cam). These Web Cams are attached to the facilitators' computers so that the students can see the facilitators, from remote computers, as they provide real-time feedback to students' concerns.

We give three surveys to the students to get input on the effectiveness of our courses. Three surveys are given; one at on the first day of the semester, one in the middle and the other towards the end of the semester. These provide useful seeds for improving our courses.

Addresses originality issues adequately

Online course authors may find ready-made animations or video clips that they can incorporate into their course contents, if their authoring tool permits. Appropriate written permissions should be sought and acknowledgements or references should be given to all material for which the author is not the originator.
In our online courses, most animations were developed internally using our authoring tool, Macromedia Authoware. In a few cases, we incorporate external animations, in the form of Java applets, into our course contents.

3. Course Development Milestones

We now identify and discuss the major steps in the process of developing media-rich online course contents. At each of these steps or milestones, we highlight the issues involved, mention some of the choices available to the developer, implications of the different choices and proffer practical suggestions.

Contents preparation

Developing an online course can require a total re-engineering of an existing course and course contents, for the online course to be valid for a relatively long time. That is, syllabi may need to be redesigned or reviewed and course contents redeveloped. The task is not just that of mere transfer of our existing 'dusty course contents' into electronic form but requires bringing the course up to date and mimicking, within the online course contents, certain classroom learning situations.

This task, therefore, requires a multitalented team of a content expert, a visual designer, a programmer, a multimedia and a presentation expert. Sufficient time should be allotted to the design of the course content, choice of examples, animation elements and the general flow and smoothness of the course contents.

With proper design, content experts can reach more students in less time, raising the likelihood that students will have access to the best instructors [Dannenberg, 1997]. An important byproduct of well-designed online courses is that the concept of 'bad instructors' can be eliminated totally.

Our online course development team members work closely with each other to the extent that we assumed all the various specialties of a development team. For example, all members contributed in the content development process. We conduct weekly meetings during which individual members present a two-lecture-worth material they prepared. This affords our course contents the thoroughness of a team view with the attendant benefit that subsequent tasks follow smoothly since each member has sufficient knowledge of the course contents. The alternative approach of assigning certain tasks to

specific specialties may save time but will lack the team view advantage and its associated benefits.

Choice of authoring tool

The second important milestone in online course development requires the choice of an authoring tool. An authoring tool is a software environment used for developing, implementing and deploying learning contents. At this stage we need such a tool to translate our design and prepared content into the learning experience we envisioned. Obviously, the choice of an authoring tool will be dictated by many issues including [Macromedia, 2001]:

- **Where the content will be delivered**
- **Kind of media to be incorporated**
- **Level of interactivity needed**
- **Level of students' data tracking needed**
- **How much content to produce and maintain**
- **Authors' technical skills**

Based on the needs, expertise and budget of your development team, these considerations will help you choose authoring tools most suitable to your purpose. For example, if your online course is to be delivered completely on the Internet with complete logging of students' activities, you will need authoring tools that support the creation of relatively small applications with low bandwidth requirements. For detailed tracking of students activities the online contents must be deployed on a learning management system that supports the necessary features.

In the early phase of our online course development we experimented with applications, like Microsoft PowerPoint, FrontPage, Comtasia etc and realized that they are limited to support our needs for media-rich online course development. In the end, we settled on Macromedia's suite of authoring packages. Each tool in the suite can be used to develop online course contents covering all aspects of animations, data tracking etc at an intermediate level. Advanced aspects in particular tasks are better done using the tool in the package specifically designed for that task. For example, Macromedia Flash is best when developing content for delivery in low bandwidth communication channels.

Animations

Research has shown that learners learn more effectively when they are engaged in doing things [Anderson, 1985]. Interactivity in online classes is more crucial because of the absence of face-to-face contact with the instructor. Learners will learn most effectively when their learning environment causes them to have continuous high-levels of interaction.

As we have mentioned earlier, animation decisions are best made at content preparation time. Before implementing these decisions, we have to have an appropriate presentation template. That is, a presentation template should be designed to contain a modest number of navigational elements. This may require a visual design specialist to design page layouts, specify colors, design navigation buttons and icons, create logos and other emblems, and to draw the most important graphics for the content [Macromedia, 2001]. Such a specialist must have a keen design sense as well as mastery of the authoring software for producing high-quality electronic artwork that looks good and downloads quickly.

The first page of each of our lecture units includes a hierarchical menu structure with

hyperlinks to provide for fast navigation through the course material. By providing a rich navigation model, we enable learners set their learning pace and select their learning style by taking the course in a sequential, top-down, bottom-up, or exploratory order. Results of our questionnaires on our online courses indicate that learners are in constant need of having more control on navigation through course material.

The chosen authoring tool should provide a convenient environment for creating animations internally. We make use of Macromedia Authorware to develop most of our animations internally. The advantage is that we can have any level of control over the animation elements as we desire. Alternatively, developers may choose to import external animations and video clips into their presentations provided the authoring tool supports incorporating external multimedia elements. Although this may save time, it may not give developers the right granularity units of control that they may desire.

Another dimension to interactivity in online courses is that since online learners must monitor their own progress, we must help them by building in plenty of opportunities for them to do so. We include an average of two interactive self-test exercises in each lecture unit to achieve additional interactivity. This helps learners monitor and evaluate their accomplishments. We note that quizzes and practice exercises should be authentic; they should reflect the course learning goals, provoke learners to think and require learners to apply knowledge.

Although animations can be very effective, presentations should be kept simple, short, precise and straight to the point. You should design and present material to teach but not to impress. For example, although the use of images and interactive animations are essential elements in online courses, they must be used in a measured way. Presentation elements that dazzle the learner without conveying or teaching much should be avoided.

Presentation transcript

The next milestone is to do with the presentation transcript. There is an important relation between the material displayed on the presentation window and the voice narration. Content presentation can be in the traditional slides format or in an electronic-book style where the voice narration is identical to the display material. Our online courses are implemented in the traditional slides format. Even though our display material consists of bulleted points of major items, results of our course surveys show that about 25% of the students attempted to study from the printable slides alone. We therefore feel that presentations in the form of electronic book style will not be as effective as the slides format. Furthermore, even in the slides format the voice narration must contain additional information that adds value to the displayed material.

The next question is, is a written presentation transcript necessary? From our experience, a written transcript is necessary for a smoother and, consequently, better quality voice narration. This is especially important when the target students, or a reasonable percentage of them, are deficient in the language skills. In that case transcript must be written with more care so that words are selected carefully to facilitate learning.
The level of details with which transcripts are written depends on who will eventually do the recording. If the recording is to be done by the writer of the transcript or by another person also familiar with the course contents, then the transcript will be straightforward. If, however, the recording is to be done by someone with no content expertise, then the transcript must be more elaborate indicating where emphases are needed etc.

Recording

After wring the presentation transcript, the next issue is the selection of an appropriate sound editor. The chosen sound editor must support the production of editable sound files from the recorded material. The sound files will need to be edited to properly interleave animation elements with the corresponding voice narrations explaining the animations. In the early part of our course development we tried tools like the MS Windows' sound

recorder, MS PowerPoint recording facility, Comtasia, CoolEdit etc. We settled on Sonic Foundry's Sound Forge for our recording purposes. Sound Forge produces .WAV files that are then converted into shockwave format to reduce the size of the sound files. Lately, we have been recording our voice narrations using AT&T Natural Voices' text-to-speech engine. This requires learning a new language, XML (eXtended Markup Language), in order to add markups to control the speed, tone as well as add custom pronunciations.

An important and tedious issue to handle with regards recorded sound files is the issue of synchronization. That is, how do we ensure that we interleave voice narrations with text and animation elements in a way that ensures complete synchrony between them? One choice for us was to use functions provided by Authorware to place break points within a sound file to ensure synchronization. To get this right, one will have to run the piece, record the time needed to play before a break and then use the appropriate Authorware function to specify the play duration. This is very tedious and difficult to get right. Furthermore, this method of synchronization is not susceptible to content modification; adding or removing contents or explanation requires changing the synchronization settings.

Having gone through this process, we discovered that is it much easier to subdivide the sound files into smaller files, one for each animation or text unit. For example, we have a separate sound file corresponding to each bulleted point in the presentation slide. Although this will lead to a multitude of files especially for graphics with animations, the pay-off with regards to synchronization is invaluable. Synchronization in this case requires simply interleaving a pair of text or animation unit with its associated sound file in the Authorware flow-line of the presentation.

Finally, we observe that for recorded material to be uniform and free of variation, we recommend the creation of a multimedia laboratory, where possible. This will standardize the recording platform and provide a conducive environment for doing this job well. We faced problems with inevitable background noise and varied sound support on the different computers on which the recording was done.

Packaging

The final milestone in our online course development process is packaging and deployment. Right from the stage of choosing an authoring tool, we would have decided where and how our course content would be delivered. We may choose to deliver on CD, on the intranet or over the Internet. Whatever was our choice we need to package our developed content for delivery using the software that delivers our content most successfully.

We use the streaming technology of Macromedia Authorware to package our courses both for CD delivery as well as for the Internet. This technology includes a Web packager that enables us to package all libraries and external media internally into our piece. We can also package our piece so that it is completely stand alone without requiring a Web browser to run. Alternatively, we can package our piece so that our piece can be run using Web browsers. In this case users need a Web Player plug-in that is freely available from Macromedia's Web site . When publishing for the Web Player, we can break our compiled piece into segments of appropriate sizes. Depending on the speed of our network connection, we can customize the size of the segments for faster download from the Web server. There is also an option of using Authorware's advanced streamer that can profile learners' pattern of viewing the course material and downloads contents ahead of time probabilistically and seamlessly.

After packaging and deployment, the remaining task is that of course management that we now discuss.

4. Course Management

At this stage, the online course content is now published on a learning management system. We should select such tools that provide a rich set of options that enable us to manage delivery of course material appropriately. For example, WebCT and Blackboard, the learning management platforms licensed in our university, provide means for monitoring interactions, students' tracking, online quizzes and exams and for handling other course administrative matters.
In addition, WebCT and Blackboard contain course survey tools that we can take advantage of in order to get feedback on the online course. Online course developers should conduct surveys to analyze the usability of their system, its efficiency, how its meets learners satisfaction etc. This is an important exercise because online courses rely on continuous and periodic improvements and learners' surveys are one of the best ways of getting such input.

5. Time Requirement: A Case Study

Our case study is based on a single lecture from one of our online courses. The case study lecture is on introduction to recursion. This lecture is a representative of our lectures in that its animations requirement is modest. The main purpose of the lecture is to introduce students to recursion, the runtime stack and how the runtime stack is used to implement function invocations.

The lecture consists of three examples of simple popular recursive algorithms. These are the Factorial function, a string reversal algorithm and the Fibonacci function. The animations for the first two algorithms are very similar: each illustrates the step-by-step execution of the program, creation and placement of activation records on the runtime stack and also how the contents of activation records change and how they are disposed as recursive calls return. Figure 1 shows a snapshot of our animation page for the Factorial function.

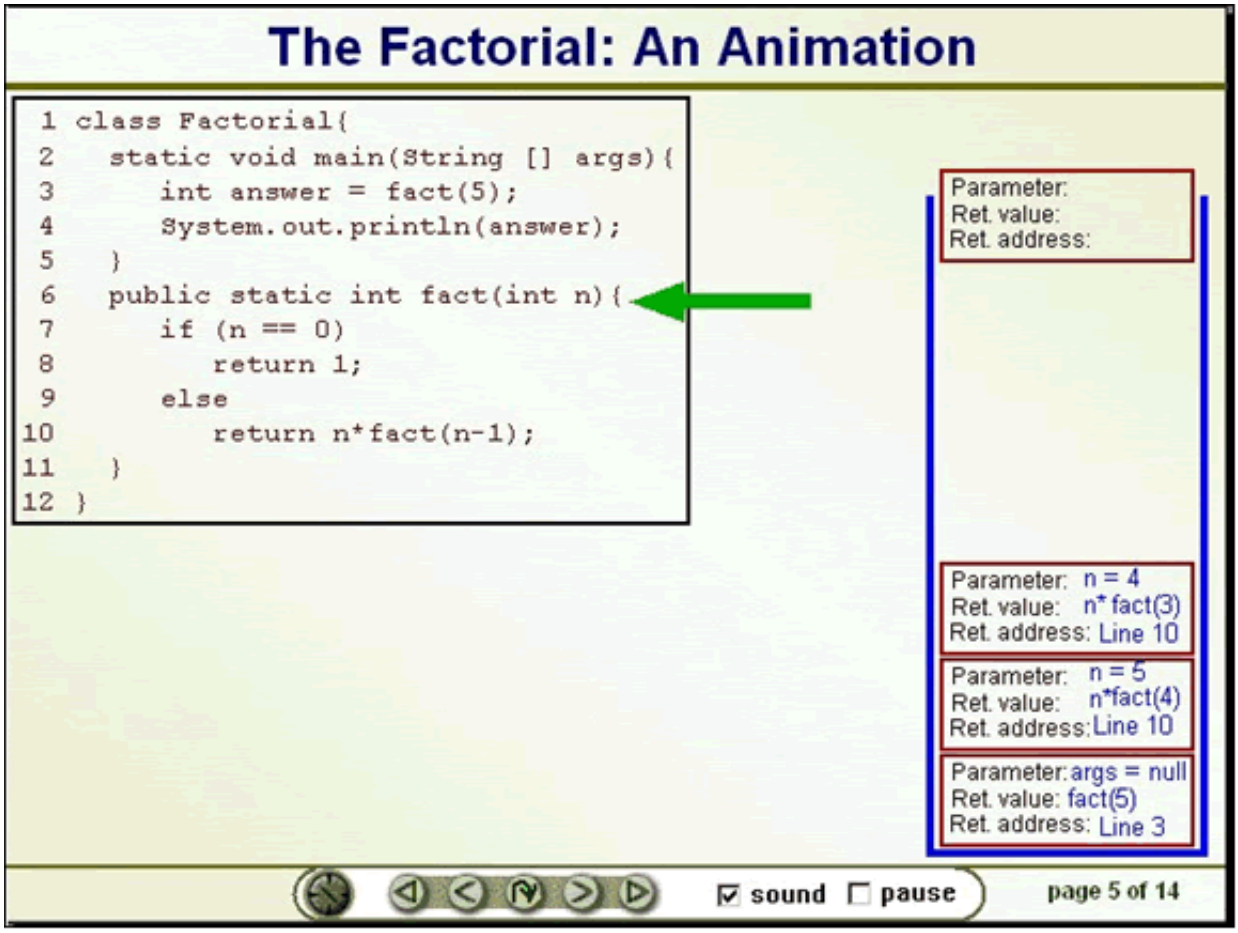

Figure 1: Factorial Function Animation Snapshot

The blue rectangle, open at the top, in Figure 1 represents the runtime stack growing upwards. Each brown rectangle represents an activation record, a workspace for a function call. Each activation record consists of a copy of the parameter with which the function called, an expression indicating what value would be returned and where execution will continue when the function returns. Note that if we require the students to observe how an item changes during the execution of the program, we must make that item as a separate animation element and associate it with a corresponding voice narration that explains it. For example, to show how the expression fact(4) changes in the second activation record when the function returns, we must make fact(4) a separate unit to illustrate how it changes when the method returns.

The case study lecture belongs to the second online course we developed. That means the timing in Table 1 is based on that of a developer with modest experience in the use of the authoring tool. The implication is that with less experience, the time requirement may be more. Another variable to consider is the extent of animation in the content to develop in addition to the authoring expertise of the developer.

Activity	Approximate time required (hours
Content preparation	10
Transfer to Authorware	5
Interactive quizzes	5
Animations	25
Writing transcript	5
Recording and synchronization	20
Total	70

Table 1: Time Requirements for a Single Lecture Case Study

Content preparation is based on the prepare-present-evaluate-prepare cycle discussed earlier. Transfer to Authorware is the time required to transfer the completed lecture material into the Authorware presentation template. Each lecture unit consists of, on average, two interactive quizzes with an average of four questions. There were three interactive animations in the case study created entirely using Authorware as we highlighted earlier. It took about five hours to write the complete presentation transcript for the case study lecture. Recording and synchronization issues took the next greater part of the time, after animations, for this lecture. With a recording expert, the time needed to re-record poor quality voice narrations may be saved.

6. Summary and Conclusions

A central issue in online course development is quality of design. Good audience analysis, proper content design, concepts illustration, rich and continuous learner interactivity are necessary pedagogical elements for effective online learning. Detailed and careful planning should be made to ensure that the online course covers the course knowledge units adequately and without overwhelming learners. Organization of course content should reflect both global and sequential aspects of course contents. Course materials should be up-to-date.

This paper presented the essential features a good and effective online course in this paper and discussed detailed steps that are followed when developing a media-rich online course. In each of the course development milestones, we highlight the issues to be considered and alternative choices available to the developer. We briefly discuss the consequence of each choice in terms of its advantages and disadvantages. We also highlight what choice we made in our online course development projects and why those choices were made.

We discussed the important role of learning management systems for leveraging course communication, monitoring and evaluation. Regular surveys are necessary using learning management systems and results of those surveys serve as seed for future course enhancements.
An important investment in online courses is that of time. We have presented a single lecture case study to provide prospective online course developers with a feel of how much time it takes to develop media-rich online courses. The figures shown in our case study are a conservative estimate and can be more or less depending on the nature of the course contents.

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