Effective Math Online Learning (EMOL)

Master Project Proposal

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Signature and Date: _____________________________________________
I. Abstract

Mathematics Lecturers at Singapore Polytechnic need to design and develop online courses to replace some of their regular classroom instruction. They lack of clear conceptual framework and appropriate skills to develop “effective” online mathematics courses. The online course that we propose to develop will support the lecturers in their work by providing a framework for the design of their online courses.

The sponsor of this project is Singapore Polytechnic with the approval of the Director of Math/Science Department. Singapore Polytechnic (SP) is a government funded tertiary institution that trains technical personnel. The institution has been promoting e-learning. In its latest IT master plan, all lecturers are required to replace certain hours of face-to-face lessons by online lessons using the Blackboard 5 learning delivery system. However, the majority of the lecturers find themselves lacking adequate knowledge and skills as well as appropriate guidance, to produce effective online lessons.

One of us (Chao) is a math lecturer at Singapore Polytechnic. Chao understands the situation and shares in the agony of her colleagues. Miller has an interest in teacher preparation. Chao initiated the project in the hopes of helping colleagues and to provide quality education for the students at SP. Together, we also wish to share what we have learned in the LDT program.

To design the initial version of the online design course, Effective Mathematics Online Learning (EMOL), we will use a combination of participatory design with scenario-based design. Some of the benefits of this approach are:

- By engaging the target users (lecturers at SP) throughout the design process, we build consensus and a sense of ownership that may lead to higher usage of the product
- Through their participation in the design process, it provides them with an initial authentic experience, making the tacit design process explicit and visible to the lecturers
- The staged design process encourages them to view design as an incremental process and provides benchmarks to assess their own progress
- The scenario-based design process will help this collocated team reach sufficient understanding and agreement to enable work to proceed

Learning will be assessed by the discourse demonstrated by the lecturers using the Discussion Forum at Blackboard 5. Since their participation is part of the design process, we can use the Discussion Forum to review how they inquire and reflect on their own design process and the quality of the lessons they develop.

The main challenges we face in this project are the tight timelines and the volume of the work required. We intend to meet these challenges by careful planning and working in parallel. We will also regard this project as the testbed of our long term research interest.
II. Background and The Learning problem

1. BACKGROUND

Singapore Polytechnic has been promoting e-learning since 1996. It aims to supplement and complement its full-time as well as part-time diploma classes by providing online distributed learning. The diplomas offered at SP range from various Engineering diplomas to Business Administration diplomas. These are three-year programs for full-time students and on average five-year programs for part-time students. The expectation is that the main designer as well as the developer of the online lessons is the lecturer (i.e. the teaching instructor at the polytechnic).

The initial e-learning platform adopted by the polytechnic for development and delivery was Lotus Notes (release 4). With the advent of Internet technologies and the driving trend of web-based education, the polytechnic has migrated its e-learning development platform from Lotus Notes to Blackboard®. The Blackboard 5® learning system (http://www.blackboard.com) was tested and later adopted (1999) as the development platform for e-learning at SP.

The change in platforms did not cause a significant change in the training program for guiding the lecturer to be an online learning designer (as well as developer). The training programs for the lecturers are typically 2 to 3-day workshops conducted in-house by the polytechnic's Educational and Staff Development department. The workshops include training on software skills (e.g. Flash®, FrontPage®, Photoshop®, Audio/video production) and instructional theory for developing online lessons. The nature of the training is geared for individual self-enrichment rather than training for proficiency.

On the other hand, the requirement for lecturers to develop quality online lessons has become more and more demanding. Lecturers are encouraged to post their materials to the Web (as if that task were merely a click away). Currently, lecturers are required to replace a few face-to-face lessons¹ of their course with online lessons.

The majority of the lecturers are still at the exploration stage. They have developed their current online lessons using trial and error, experimenting with some design principles they have gathered from the workshops or from personal experience. There are also joint projects between the lecturers and the instructional experts from Educational and Staff Development Department. However, the majority of the lecturers are working on their own and online courses that are developed are mostly drill and practice and page turning applications. The outcome of the design depends greatly on individual effort and motivation to explore effective ways of designing and developing their courses. (The above observation is based on Chao’s years of experience and involvement in promoting e-learning at SP. However, more data about the current practice and problems and concerns of lecturers will be collected.)

¹ The teaching method employ by the majority of the lecturers is still the teacher-centered approach. But there are also efforts on incorporating projects-based teaching, collaborative learning, conduct math laboratory sessions into the lessons.
2. A LEARNING PROBLEM SCENARIO

**Actor:** Mrs. Lee (Math lecturer at Singapore Polytechnic (SP))
She has 20 years of teaching experience, a responsible and excellent lecturer. She has a very busy work schedule. Besides teaching for 20 hours per week, preparing for the course lessons, in-course assessments and exams, she also has to prepare for remedial lessons, handle administrative paper work as well as sitting on some working committees.

As for her computer knowledge, she is pretty comfortable with Microsoft Word? and PowerPoint?. All meetings and memos at work are sent through emails. She has attended many in-house one or two-day workshops on IT related subjects such as Microsoft FrontPage?, Macromedia Flash? and basic HTML. But she typically has not used them after the workshops. She has also attended a couple of in-house workshops on designing online lessons, but once again, she finds these courses decontextualized and has difficulty transferring what she has learned to her task, i.e. to design her own online courses.

In summary, Mrs. Lee is an experienced designer of classroom teaching. Many of the indirect teaching processes such as interacting with students, diagnosing students' problems, ensuring students are attentive, etc. is automatic to her. Her challenge now is to design an online version of her teaching in the Blackboard 5? online environment.

**The Problem:**
Mrs. Lee has seen some online lessons developed by other colleagues, but most of these online lessons are simply the electronic version of the face-to-face lecture notes accompanied by some online quizzes, and drills. She thinks these lessons are ineffective since from her teaching experience, she knows learning will not automatically take place by asking the students to read through the lecture notes on their own. But the problem is she has no idea on how to design an effective online lesson!

“I've attended so many courses, but at the end of the day, it's still the same problem, don't know how to go about it.”

**Analysis of Mrs. Lee’s problem:**
1. **Time factor:** The heavy workload has left her little time to explore, think, collect, organize and put materials on the Web.

2. **Issues on designing:** The relevant IT knowledge and experience she has gathered on designing online lessons and software skills are fragmented, inert and na?ve.
   - She lacks models to guide her through the design process. The design process is tacit and invisible.
   - She lacks support (scaffolding activities) to guide her to:
     - Understand and plan the design. For example, the importance of making explicit the conceptual framework for her lessons, identify the learning needs of the students (target audience) and employ appropriate design approaches.
     - Visualize and carry out the design plan.
     - Evaluate and refine the design.
3. Issues on transferring: The current decontextualized training makes it hard for Mrs. Lee to transfer her computer knowledge as well as her classroom teaching experience to carry out her design task.

3. THE LEARNING PROBLEMS

For Mathematics lecturers (like Mrs. Lee) at Singapore Polytechnic, the problems are:

- How to design an effective online math lesson for their course?
- How to transfer his/her e-learning knowledge as well as classroom teaching experience to this new learning environment?

(The users of this design may be extended to K—12 mathematics lecturers or first year college math lecturers who are planning to develop online lessons for their course.)

III. Review of existing alternatives

The learning problems stated above are not new to teachers trying to use Web-based technology. Persistent efforts of techno-reformers and administrators who believe in the power of technology have created changes in schools and classrooms. The solution the administrators and organizations (profit or non-profit) have provided are mainly to build better infrastructures (well-equipped classrooms), provide high-end computers, invest in teacher training, provide sharing and learning communities of teachers (Cuban, L. 1996; MOE report). However, as Brown & Duguid (2000) described, “anyone who tries will quickly find how demanding making and maintaining a worthwhile web page can be.” Many efforts have been made towards investigating how to equip teachers with appropriate skills and knowledge to incorporate IT in teaching.

Some of the programs that help teachers design online distributed learning are:

- Illinois Online Network, [http://illinois.online.uillinois.edu/IONresources/instructionaldesign/](http://illinois.online.uillinois.edu/IONresources/instructionaldesign/)
- Distance Learning Resource Network, [http://www.dlrn.org/educ/design.html](http://www.dlrn.org/educ/design.html)
- iUniversity Online, Online Course Design and Development, [http://www.iuniversityonline.com/courses/education/F5A15I.html](http://www.iuniversityonline.com/courses/education/F5A15I.html)
- U4ALL Online courses, Online Course Design Workshop, [http://www.u4all.com/c/catalog/0,1245,4167_0-10651892,00.html](http://www.u4all.com/c/catalog/0,1245,4167_0-10651892,00.html)
- This reference is more about managing an online course. PBS Adult Learning Service, Surviving and Thriving in your First Online Course, [http://www.pbs.org/als/programs/itsk0101.htm](http://www.pbs.org/als/programs/itsk0101.htm)

There are many Web-based references that guide teachers in designing online materials, but these are not customized to the requirement of the SP context,
Blackboard? platforms, SP students, topics taught etc. We will review these products to gain any insight and to harvest any useful ideas.

Other non-computer technology driven sources are:

- Live workshops conducted by outside sources
- Workshops conducted in-house by SP training department
- Individual research by various colleagues at SP
- Joint Projects with the Department of Educational and Staff Development at SP

These again are not contextualized to the design of individual courses and are difficult for the lecturers to reference once the workshop is over. The reference material is static and therefore difficult to translate to the Web.

IV. Approach to be taken in this project

1. THE PROPOSAL
We propose to design an online Website that guides the math lecturers (novice designers like Mrs. Lee) through the design process while they are designing their online lessons.

Lecturers will be guided through an inquiry cycle to develop an understanding of the design process. They will be engaged in sense-making conversations regarding relevant knowledge and design principles, and using the conversations to carry out tasks in three stages:

- Understand the needs of the learners and plan the design to meet the needs
- Visualize and implement the plan
- Evaluate and refine the design (iteration)

The staged cycle will be built around a model of an “effective” math online lesson. This model will contain examples illustrating the concepts at the different stages of the design process. Hints, exercises and discussion will also build into each stage to scaffold the learning process. In short, the site is to make the design process explicit and visible to the novice designers (lecturers) by providing modeling and scaffolding activities. It will be a process that helps the designers construct knowledge and create a community of practice.

The first phase of our project will be to build the “effective” math online lesson on the Blackboard 5? platform together with a team of math lecturers at SP. The design process of this online lesson will follow the three stages of the inquiry cycle as described above. The topic chosen for the lesson is Exponential Function for it is self-contained and a required topic for the Pre-Calculus course.

Simultaneously, we will develop the inquiry cycle website (phase two). The process in phase one will be elaborated and made explicit in this site. According to recent large-scale research studies (Education Week, 1998; Wenglinsky, 1998), technology only has a large scale effect on student learning if it is used in appropriate ways. Simulation,
visualization, and exploration top the list of appropriate ways to use software, and dynamic notations and linked representations are primary attributes of these uses (Roschelle et al., 1998). We intend to incorporate these elements into our design.

2. THEORETICAL FRAMEWORK OF EMOL

Theoretical Framework for Phase 1:
The lecturers are already the designers of face-to-face lessons. Their job now basically is to design another version of those lessons in online format to complement their face-to-face teaching. In order for this to be successful, we need to identify the differences between these two formats. We will first look at the attributes of the best practices of face-to-face teaching and investigate if any correspond can be found in the attributes that online methods can provide.

From our preliminary study, time constraints and the students’ ability to work on the assessments are the lecturers major concerns. We will combine the Backward Design Process (Wiggins & McTighe, 1998) with Theory one (Perkins, 1992) in designing the “effective” math example online lesson:

1. Identify desired results -- State the understanding performances (Perkins, 1992) expected from the lesson.
2. Determine acceptable evidence -- Plan the assessments before designing the lesson.
3. Plan learning experiences and instruction -- Present clear information, thoughtful practice, informative feedback and build in intrinsic and extrinsic motivation to help students to succeed in the planned assessments.

Instead of developing our own interactive activities, the lesson will tap into the available resources from the existing resources on the Web, e.g. Interactive java applets, as well as the facilities provided by the Blackboard learning system such as the discussion forum, and online quizzes. It is important to use the existing delivery platform to minimize the skills requirements for the lecturers and at the same time, create a rich environment for exploration. Lecturers could then concentrate more on their pedagogical experience and evaluation of their design rather than learning new software.

In short, the framework of the lesson will emphasize: clear information, thoughtful practice, informative feedback and strong intrinsic and extrinsic motivation (Perkins, 1992).

Theoretical Framework for Phase 2:
Example online lessons are only one part of the content. Designers still need to develop sufficient knowledge and skill to design their online lessons. As discussed earlier, the main problem is most lecturers have too little time, more pressing responsibilities, and insufficient (or fragmented) technical expertise as to carry out the design task. In order for the lecturers to transfer their knowledge and experience to the design of their own online lessons, we think it is important to provide an environment that allow these novice designers to observe, engage in, discover workable strategies in the context of use, and participate in learning activities with their colleagues. That is, to build a community of

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2 An applet is a program written in the Java™ programming language that can be included in an HTML page, much in the same way an image is included. http://java.sun.com/applets/
practice for these lecturers who have the same background knowledge and similar learning problems to work together and help each other.

Phase 2 of our design will be grounded on situated cognitive theory (Collins & Brown, 1991; Lave & Wenger, 1991). This approach will allow the lecturers to see how the strategies combine with their factual and conceptual knowledge, how they can apply a variety of resources in the social and physical environment and put this knowledge into practical use. In this online environment, lecturers will be working on authentic activities, i.e. design and building their own online lesson. The staged process will engage them in inquiries that require sense-making conversations using the relevant knowledge and design principles, and tasks such as understanding and planning, visualization and prediction, evaluation and refining.

In addition to building the site as a resource to help individual lecturers develop their own online lessons, the site will also be a place where lecturers can participate, react and share with each other about their design experience, concerns and problems. For examples, lecturers can learn about the particular way this lesson will work, how students react to some aspects of it, what are some pleasant surprises other teachers experience, etc.

Hence learning in this context is viewed not only as lecturers being able to develop an online lesson, but also in terms of their participation as members in the practice of social communities which have shared goals (and shared histories), concepts and procedures, belief systems about what is interesting about problems, shared views of when it is appropriate to use particular tools, and developing kinds of sense-making activities that fit the world (Pea & Gomez, 1992)

Members learn from the supportive practice and resources, they self-evaluate through the inquiry process where the staged cycle provides them with concrete benchmarks for their own progress, and at the same time, learn from each other by participating in this community of practice. This will make the Website a useful resource and add a dimension to their practice.

### 3. THE LEARNING PERSPECTIVES AND DESIGN METHODS OF EMOL

<table>
<thead>
<tr>
<th>Learning Theories and design principles</th>
<th>Rationale (mostly adapted from Decker’s note for STEP project)</th>
<th>How it fits the learning problems of EMOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learner centered perspective</td>
<td>Learner-centered environment attempts to help learners make connections between their previous knowledge and their current learning tasks. In this learning environment, learners use their current knowledge to construct new knowledge and that what they know and believe at the moment affects how they interpret new information.</td>
<td>One of the learning problems is that the learners (lecturers) are having difficulty in transferring their knowledge to practical use. The learner-centered approach will help teachers to make connection between their teaching experience and their current task in designing a complement online lesson.</td>
</tr>
<tr>
<td>Knowledge centered perspective</td>
<td>Content is the most important for a learning environment. The ability to perform inquiry requires well-organized knowledge that is accessible in appropriate contexts.</td>
<td>Part of the learning problem is that lecturers lack relevant knowledge and skills on designing online lessons. The design principles, meaning of prototyping, and user testing are crucial processes that lead to a good design.</td>
</tr>
<tr>
<td>Assessment centered perspective</td>
<td>Feedback is fundamental to learning. The feedback imbedded in phase two of our design is primarily self-assessment through the activities involves in the inquiry process.</td>
<td>What the novice designers (lecturers) are most lacking in this context is the scaffolding activities. The staged cycles encourage the learners to view design as an incremental process, while providing them with concrete benchmarks so they can evaluate their own progress.</td>
</tr>
<tr>
<td>Community centered perspective</td>
<td>It promotes a sense of community. Learning is viewed not only as a relation to problem-solving activities, but also in terms of participation as member in the practice of different social communities (Pea &amp; Gomez, 1992)</td>
<td>In addition to building the site as a resource to guide individual lecturers to build their online lessons, it is also a place where the novice designers can participate, react and share with each other about their design experience, concerns and problems.</td>
</tr>
<tr>
<td>Situated Cognitive apprenticeship — modeling, scaffolding, fading and coaching (Collins &amp; Brown, 1991)</td>
<td>Students execute tasks and solve problems in an environment that reveals the various intended uses of their acquired knowledge; external support or scaffolding from the tutor in the form of ideal modeling of the performance, hints, reminders, explanations, or even missing pieces of knowledge to assist the apprentice’s tasks execution; fading of external support as the apprentice’s skill and autonomy build. Cognitive models enable this interactive and adaptive pedagogy by making tacit knowledge explicit and thus knowable.</td>
<td>One key problem for the lecturers is that the knowledge collected is decontextualized. Teachers lack a model that allows them to observe the otherwise tacit design process. The model online lesson intends to make the target processes visible. Together with hints and exercises built into the stages, the scaffolding inquiry cycle will guide the teachers through to carry out the task. The support will gradually fade out once the learners have completed the cycle and leave the learners to explore and share using the Discussion Forum. In this context, the learners are involved in authentic activity, i.e. to design their own online lessons. This activity will allow them to apply skills, devise solutions, and make decisions; solve problems that engage energy, creativity, and inventiveness.</td>
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<tr>
<td>Zone of proximal development</td>
<td>An in-between stage through which a learner grows in understanding. An effective leaning zone has two characteristics: the learner is being stretched (but not overly stretched), and the learner is provided with sufficient scaffolding that offers the support needed to traverse the zone successfully. As the learner traverses the zone, scaffolding slowly fades away.</td>
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### Design methods

<table>
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<tr>
<th>Participatory design</th>
<th>Rationale</th>
<th>How it fits the learning problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>The approach is to share the ownership of the design and endow all of the participants with enough negotiability to decide how to participate in the process meaningfully. Engagement is not just defined as involvement in activities, but of community building, inventiveness, social energy, and emergent knowlegeability (Wenger, E.)</td>
<td>This approach helps to make the tacit process open and visible. Learning becomes situated. The users (lecturers) will be able to see the tangible product. The skill and knowledge learned is situated and be able to apply the knowledge immediately.</td>
<td></td>
</tr>
<tr>
<td>Participatory design</td>
<td>Rationale</td>
<td>How it fits the learning problem</td>
</tr>
<tr>
<td>Scenarios were found to be especially useful in helping development teams reach sufficient agreement to enable work to proceed, and in ensuring consistency with predecessor systems. Descriptions of people using technology are essential in discussing and analyzing how the technology is reshaping their activities. A secondary advantage is that scenarios descriptions can be created before a system is built and its impacts felt. (Rosson &amp; Carroll, 2001)</td>
<td>Since the team is geometrically distributed and will communicate via emails and video conferencing, it is even more crucial to make the process and ideas explicit to facilitate the discussion and understanding among the members. We hope that this method will help to facilitate the discussions and inform our design.</td>
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### Technologies to be used

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<tr>
<th>Technologies to be used</th>
<th>Rationale (why they are appropriate)</th>
</tr>
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<tbody>
<tr>
<td>Blackboard 5?</td>
<td>It is adopted as the platform for e-learning at SP. The institute has purchased the license and all lecturers have gone through the basic training. Most importantly, it is the platform for lecturers to develop their course site. Hence it is most natural to use it as a development platform so as to enable the lecturers to gain a better understanding of the platform and facilitate direct transfer of knowledge to practical use.</td>
</tr>
<tr>
<td>Dreamweaver?</td>
<td>Web authoring tool to create the EMOL Website and upload to Blackboard?</td>
</tr>
<tr>
<td>Java applets</td>
<td>Available at the web/ collaborate with institution’s educational and staff development. Promote interactivity.</td>
</tr>
</tbody>
</table>
Benefits of the Approach:

By engaging the target users (math lecturers at SP) throughout the design process, empowering them to evaluate the “effectiveness” of the design, and lay out the inquiry stages of design process will

- Make the tacit design process explicit and visible to the lecturers.
- Enable the novice designers (lecturers) to see that the design process is useful and meaningful, understand the reasons for undertaking the process (motivational factor).
- Encourage them to view design as an incremental process — provide benchmark for own-progress
- Encourage the lecturers to think analytically while they’re teaching the online lesson
- Enable lecturers to transfer the skills and knowledge learned — learning is situated
- Make the model lesson (template) meaningful and flexible — serve as a model as well as a reminder of design principles

V. Project Plan

1. CONCEPT

The project will be developed in two phases (developed in parallel).

Phase 1 — Designing an effective math online lesson part of the content of EMOL

- Participatory design — engage a team of five math lecturers at SP throughout the design (they will be the perspective users of this design)
- “Effective” will be defined and evaluated by the team members
- Survey on the current practice, problems lecturers faced when carrying out the design task. Literature review
- Employ a combination of “backward design process” (Wiggins & McTighe, 1998) and “Theory one” (Perkins, 1992) in designing the online lesson:
  - State the performances (Perkins, 1992) expected from the lesson.
  - Plan the assessments before designing the lesson
  - Present clear information, thoughtful practice, informative feedback and build in intrinsic and extrinsic motivation to help students to succeed in the planned assessments
  - Tap into the available resources from the Web
- Research/collect useful objects from the Web (e.g. applets and good example problems from The Math Forum, ESCOT, JOMA, EOE) to weave into the lessons. For example, (i) incorporate interactive Java applets on investigating the meaning of e and the graphs of exponential function, (ii) engage students with real-world problems on exponential growth and decay for exploration activities.
- Storyboard and write scenarios of use of the lesson.
- Collect feedback and build prototype on Blackboard 5?.
• The teachers will evaluate and test the “effectiveness” by conducting user testing on our students.
• Evaluate and refine the design.
• The design process of this online lesson will be made explicit and visible to the members and it will be built in as examples in phase two (i.e. used as an illustration of the staged inquiry cycle).

Phase 2 — Website on the inquiry cycle of design process
• The design process will be broken down into 3 stages (modified from design methodology by David Kelly, IDEO (Winograd, T, 1996)) (As shown in figure 1):
  o **Stage 1 — Understand and plan**: Context, Needs, Approach (design principles and learning theories), Benefits and Competitors (alternatives). Time plan for the project.
  o **Stage 2 — Visualize and predict**: Identify appropriate learning objects, write storyboard, scenarios of use, develop prototype.
  o **Stage 3 — Evaluation and refine**: conduct user testing and collect feedback. Analyze the results and refine the design.

• The “effective” math online lesson (phase 1) will be used as a **model** for illustration during the staged process
• The **scaffolding** activities such as tips/exercises/discussions will be built into the cyclical process
• The model aims to make the design process **visible and explicit**

![Diagram showing the staged process of inquiry cycle of design](image-url)

**Figure 1**: The staged process of inquiry cycle of design
## 2. THE KEY FEATURES OF EMOL

### 2.1 The online math lesson

<table>
<thead>
<tr>
<th>Key features</th>
<th>Explanation</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive java applets[^1]</td>
<td>These are the individual educational components (learning objects) that can be collected from the web or created using AgentSheets (<a href="http://www.agentsheets.com/">http://www.agentsheets.com/</a>) so that teachers (non-technical designers) can incorporate them into their lessons for simulation activities such as investigation, exploration, etc. For example, “graphing exponential function” (<a href="http://cs.jsu.edu/mcis/faculty/leathrum/Mathlets/exponential.html">http://cs.jsu.edu/mcis/faculty/leathrum/Mathlets/exponential.html</a>) is an applet that draws an exponential function of the form $y=Ce^{kx}$ through two points. Activity will design around it so that students can investigate the shape of exponential graph as well as the properties of the function.</td>
<td>Visualization, simulation, ease of understanding and motivation</td>
</tr>
<tr>
<td>Explorative activities on exponential growth and decay (collaborative group work)</td>
<td>Group work will be built to explore the exponential growth and decay on real life problems.</td>
<td>Exploration, motivation, arouse interest</td>
</tr>
<tr>
<td>Blackboard learning environment.</td>
<td>Blackboard 5? learning system will be used as the development platform for the lessons</td>
<td>Blackboard? is the platform adopted by the institution. It allows ease of management, developing, as well as keeping track of students progress and participation</td>
</tr>
<tr>
<td>• Course Management (Announcements, course information, staff Information, course documents, assessments records, usage statistics, etc)</td>
<td>These are the built in features provided by Blackboard? . Developers (i.e. lecturers) requires only minimum knowledge of HTML to build their course site in this environment. Registration of students, creation of course shell, training of students will be handled by the technical support of the institution.</td>
<td></td>
</tr>
<tr>
<td>• Discussion Forum &amp; online communicatio</td>
<td>Provide opportunity for the community to interact synchronously and asynchronously (among students as well as with the instructors). These are also components provided by the Blackboard learning environment</td>
<td>To encourage discourse and sharing.</td>
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</tbody>
</table>

[^1]: An applet is a program written in the Java™ programming language that can be included in an HTML page, much in the same way an image is included. [http://java.sun.com/applets/](http://java.sun.com/applets/)
2.2 The inquiry process of design

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<th>Explanation</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>The design process is stages of inquiry</td>
<td>Engage users in inquiries that require sense-making conversations using the relevant knowledge and design principles in stages such as understanding and planning, visualization and prediction, evaluation and refining.</td>
<td>Inquiry, exploration, self-assess. This becomes a repositories of information, documentation, and tracking; retrieval mechanisms. The last stage -- evaluation and refine invites teachers to reflect on the process they've gone through.</td>
</tr>
<tr>
<td>The online lesson is used as a model (template) that exemplifies the principles</td>
<td>Knowledge learning is organized around main design principles and exemplify by the model.</td>
<td>Modeling, scaffolding</td>
</tr>
<tr>
<td>Hints and exercises are built into the stages.</td>
<td>These will be the scaffolding activities that helps students’ thinking to become visible so that they (as well as the facilitator) can assess and revise their understanding.</td>
<td>Scaffolding and reinforcement</td>
</tr>
<tr>
<td>Blackboard learning environment.</td>
<td>Blackboard 5 learning system will be used as the development platform for this site. Lecturers will develop their lessons on this platform.</td>
<td>Familiarize the lecturers with this learning environment. Understand the affordances of this learning system.</td>
</tr>
<tr>
<td>Discussion Forum &amp; online communication such as chat and email</td>
<td>Provide opportunity for the community to interact synchronously and asynchronously (among students as well as with the instructors). These are also components provided by the Blackboard learning environment</td>
<td>For sharing and form a community of practice. Allow people to observe others on how to carry out the tasks. (the sharing and interaction will not be limited to virtual space, the people are colleagues and many share teaching the same course) Occasions for exercising judgment and for mutual evaluation, negotiation of joint enterprises.</td>
</tr>
</tbody>
</table>
3. DESIGN PLAN

- Literature review.
- Conduct survey of the lecturers’ current practice and needs.
- Employ participatory design — form a committee of lecturers from SP — already identified members with an assistant located in Singapore.
- Meeting with the team will be via video conferencing (NetMeeting), ICQ chat, phone calls.
- The platform used will be Blackboard 5? at http://esp.sp.edu.sg. Two course site accounts (Figure 2) were created on the SP network and the members of the design team were added as teaching assistants.

(For guest sign in– username: emol, same for password)

![Figure 2. A screenshot of the Blackboard coursesite](image)

- Gathered the opinions of the topic of the lesson. Exponential functions chosen as the topic for the online model lesson.
- Design the lesson with the team members employing the theoretical framework described.
- Convert the concept of the lesson to storyboards, describe scenarios of use. This is for the ease of discussion with the team.
- Build prototype (on Blackboard?) for user testing
- Teachers conduct user testing and feedback.
- Evaluate and refine.
- At the same time, build the inquiry cycle (Phase two).
- Study Legacy developed by Prof Dan Schwartz, et. al. and modify from there.
- Build the content, design activities of the Website simultaneously
- Gather feedback from the members (they are the users!).
- Transfer the process the team has gone through into the cycle.
• Build the prototype for phase two
• Evaluate by the team members
• Set up the discussion forum and invite the participants to discuss their concerns and the problems encountered.

4. KEY QUESTIONS TO BE ANSWERED
Q How do we determine if the learning problem has been successfully addressed?
  • If the teachers (designers) can follow the inquiry cycle of design, answer the questions posed and discuss at the discussion forum.
  • They're happy with their online lessons. They think that the lessons are effective and learning has taken place
  • Their students passed the exam.

Q. What questions (from the lecturers) do we plan to focus on answering?
  • Will this help to boost the results of my students?
  • Will this increase my workload?
  • Can you guarantee the lessons produced will be effective?
  • How do you measure the success of this project? That the lecturers have learned?

Q. What kinds of evidence do we plan to collect?
  • Survey data.
  • Comments from the discussion forum.
  • Prototypes developed

5. PLAN FOR COLLABORATION
Chao will be the project leader. She will do the research and planning, write the draft proposal, organize and form the team, create the courses on Blackboard? platform, enroll users and teachers, do literature review, prototype the lessons and the Website (storyboarding and scenarios), evaluate the data from user testing. Miller will assist in the planning and research, designing content, building prototype and report writing.

The team members will provide feedback on the design of online lesson, conduct user testing on their students, help in evaluating, and participate in the discussion forum (DF) of the online website.

The most important questions that remain undecided are
  • Whether the project is too big for us to complete by May 17.
  • Whether lecturers at SP (users) will buy the ideas?
  • Whether they will participate and engaged in this community of practice?
VI. References


### Appendix 1. Deliverables /Milestones

<table>
<thead>
<tr>
<th>Date</th>
<th>Tasks</th>
<th>Deliverables</th>
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<tbody>
<tr>
<td>Dec 26 - Jan 18, 2001</td>
<td>Planning Research for resources Arranging for collaboration Getting approval from SP Consult Prof Greeno</td>
<td>Submit Project Proposal</td>
</tr>
<tr>
<td>Jan 27</td>
<td>Plan and conduct survey</td>
<td>Results of survey</td>
</tr>
<tr>
<td>Feb 1, 2001</td>
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<td>Project proposal approved</td>
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<tr>
<td>Feb 3</td>
<td>Compile and analyze results from survey</td>
<td>Summary of findings</td>
</tr>
<tr>
<td>Feb 3 - March 17</td>
<td>Design online lesson</td>
<td>Storyboard and scenarios of use</td>
</tr>
<tr>
<td>March 17 — April 7</td>
<td>Prototyping</td>
<td>Prototype lesson</td>
</tr>
<tr>
<td>April 7 — April 14</td>
<td>Planning User testing</td>
<td>The plan</td>
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<tr>
<td>April 14 — April 28</td>
<td>Conduct user testing of the lesson and collect feedback from teachers</td>
<td>Summary of findings</td>
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<tr>
<td>April 28 — May 5</td>
<td>Study the findings and discuss with members</td>
<td>Plan for refining the prototype</td>
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<tr>
<td>Feb 3 — April 7</td>
<td>Study Legacy, design content of the inquiry cycle</td>
<td>Storyboard and scenarios of use</td>
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<tr>
<td>April 7— May 5</td>
<td>Prototyping</td>
<td>Prototype website (Blackboard)</td>
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<tr>
<td>April 21</td>
<td>Setup discussion forum</td>
<td>Teachers participate in the forum</td>
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<tr>
<td>May 5 — May 8</td>
<td>Users testing on the inquiry site</td>
<td>Summary of findings</td>
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<td>May 17, 2002</td>
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<td>exhibition</td>
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<tr>
<td>May 5 - June 3, 2002</td>
<td>Write report</td>
<td>Submit Final report</td>
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</table>
Appendix 2. Contributors/Collaborators

We will consult the following people for their expertise, guidance, and feedback throughout the project:

Professor Decker Walker, Director of LDT, Stanford University
Professor James Greeno, Stanford University
Professor Dan Schwartz, Stanford University
Professor Roy Pea, Director of LSTD, Stanford University
Ms Deborah Kim, LDT coordinator, PhD candidate, Stanford University
Mr Liao Kuo Tang, Director of Math/Science Department, Singapore Polytechnic
The EMOL team members at Singapore Polytechnic: Mrs Kok-Mak Chew Pheng, Mrs Goh Bee Lan, Mrs Linda Tan, Ms Huang Hong Ying
Ms Cindy Lai, Technical support of Blackboard system at Singapore Polytechnic
Appendix 3. Resource & Estimated Budget for Needed Resources  
Access to Blackboard, video conferencing (NetMeeting), ICQ, long distance calls

<table>
<thead>
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<th>Human Resources:</th>
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<tbody>
<tr>
<td>Chao, Yunn Chyi</td>
<td>60h research &amp; preparation. 10 h/wk for 15 weeks, $30/h</td>
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<td>Miller, Gloria</td>
<td>5 h/wk for 15 weeks, $30/h</td>
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<td>5 Team Members (at SP)</td>
<td>3 h/wk for 15 weeks, $40/h x 5</td>
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<td>Sub-total for personnel</td>
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Materials/communication

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<th>Blackboard? 5, Dreamweaver?, NetMeeting (free), ICQ (free)</th>
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<td>Videotape</td>
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Total

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