

Strategies for e-learning content development at the University of Tokyo and UC Berkeley

J. O. Entzinger, K. Morimura, S. Suzuki

Institute for Innovation in International Engineering Education (IIIEE),
School of Engineering, The University of Tokyo

j-entzinger@t-adm.t.u-tokyo.ac.jp, morimura@t-adm.t.u-tokyo.ac.jp, tshinji@mail.ecc.u-tokyo.ac.jp

Abstract

Both the University of Tokyo (UT) and the University of California at Berkeley (UCB) have developed their own e-learning system over the past years, and are in the process of creating educational content for these systems. At both universities, students create these new e-learning modules in courses or as part of their research, under the guidance and supervision of teaching staff. This integrated approach of creating teaching materials and teaching students at the same time has several advantages, but of course also poses some challenges. The UT and UCB have been exchanging their strategies and experiences regarding this process, and found many similarities, which we believe will be useful to share with others involved with the creation of e-learning materials.

Keywords: e-learning, teaching materials, development, pedagogy, teaching practice

1. Introduction

The e-learning systems at The University of Tokyo (UT) and the University of California at Berkeley (UCB) are quite different in their setup and aims, but the methods we use to create content for our e-learning systems are surprisingly similar. Both at the UT and at the UCB, students take the initiative and create the e-learning content in a credited course through group discussions with their peers, teaching assistants (TAs) and faculty.

The authors exchanged their ideas and practices with the UCB faculty on several occasions, and recently visited the UCB with a group of 9 enthusiastic Japanese and International students from The University of Tokyo. During that visit, we were given the opportunity to participate in classes and a research group meeting. This paper will provide some background and draw on the experiences and discussions we and our students had at the UCB to make a comparison between the UT approach and the UCB approach to developing e-learning content.

We will first briefly introduce the background of the e-learning systems at the UT and UCB and highlight the main commonalities and differences. Then we will describe the courses where students make the e-learning content. Since we had the opportunity to observe a few classes and meetings at the UCB together with some of our students, we will share some of our impressions, in particular on (classroom) culture.

2. E-learning systems

2.1. SNOWBALLS (UT)

In the winter of 2009, The University of Tokyo started the development of the “Self-Navigation Web-Based Literacy Learning System” or SNOWBALLS for short. In the first place it is aimed at helping Japanese undergraduate students learn technical English vocabulary that they will need as a basis for their further studies and career. As one of the projects in the Bilingual Campus Action Plan at the School of Engineering, the aims of SNOWBALLS have been widened to include teaching International students how to get around in Japan and Japanese language basics, as well as providing English lessons for office staff and teaching faculty.

One of the main problems of e-learning is to keep the learner motivated. Especially when teaching vocabulary through e-learning, it is important that the learner can see the usefulness of what he learns and to add additional features to the e-learning system to keep the learner motivated. We therefore decided to include students in the creation of the SNOWBALLS system (as well as its content) from the start. Built upon the students’ ideas and polished by their feedback, SNOWBALLS now offers not only a study section, but also customizable avatars, a forum, and an online game [1].

The study section contains (multimedia) textbook materials, practice questions, tests, and various functions for self-evaluation and progress measurement. Learners can earn snowballs (points) by correctly answering questions, winning a game, or giving good comments in the forum. These snowballs can then be used to customize one’s avatar by buying items in the “shop”. The forum and online game are in the first place added to create opportunities for learners to interact with one another, since we believe peer learning as well as a community feeling will be essential in making the e-learning experience both effective and motivating.

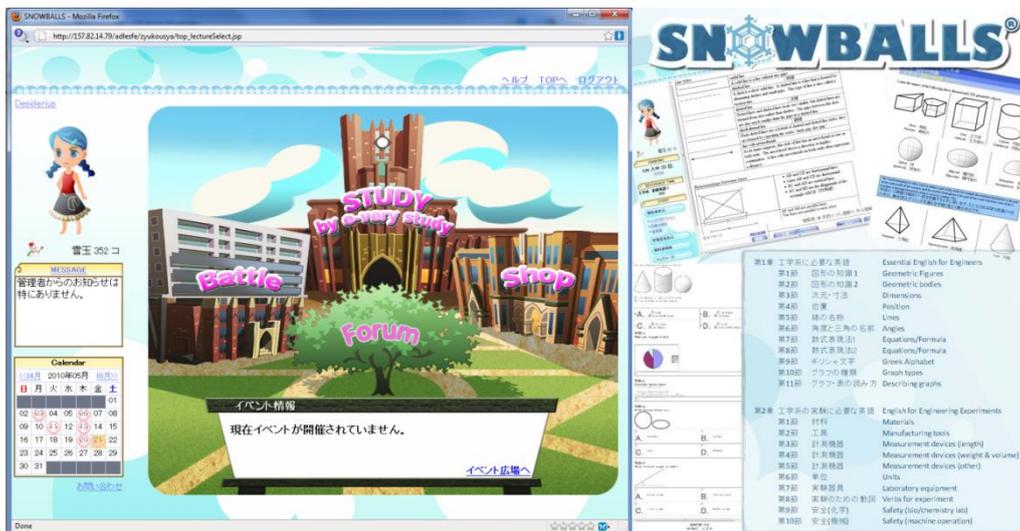


Fig. 1 Main screen of SNOWBALLS (left) and an example of the current e-learning modules (right).

2.2. WISE (UCB)

The UCB developed the “Web-based Inquiry Science Environment” or WISE with the Technology Enhanced Learning in Science (TELS) community in order to teach Middle School and High School students science through an investigative approach similar to the way real research happens. WISE was developed to implement and further research on the “knowledge integration framework” for learning and instruction [2].

WISE offers a large number of pre-defined page formats called “step types”. Typical step types include “text (with pictures)”, “question”, and “interactive graph”. The system is set up such that each step only contains a little piece of information, and learners are asked questions to illicit and organize their own ideas, rather than just providing the learner with an explanation of the main ideas. The system is open-source and the developing community contains people with backgrounds in programming, science, pedagogy, and teaching.

Since WISE is also used for pedagogics research and especially for research on curriculum design, it focuses on features that make it easier for the course-developer to rearrange steps and to gather large amounts of detailed usage data. The platform itself does not offer specific features to increase learner motivation. Motivation therefore depends completely on the creator of the content and on the environment in which WISE is used.



Fig. 2 Screenshots from the WISE4 Demo project library: “Investigating Planetary Motion and Seasons - Spring 2011 Pilot (ID: 944)”

2.3. Main Differences between the Systems

Both SNOWBALLS and WISE offer a large number of features common to most e-learning and content management systems. These include the possibilities to show multimedia content to the learner and have the learner submit answers to questions. They also both offer a web-based authoring interface and teacher tools for viewing learner data. There are, however, large differences between the philosophy behind and intended use of both systems. Table 1 provides an overview of these differences.

3. Creating the e-Learning Content

Any e-learning system is useless without content. One of the main challenges after building the systems is therefore to create educational and motivating content. In order to do so, it is important to know the target group’s interests and their learning styles. Apart from that, deep knowledge and understanding of the topic to be taught, as well as a considerable amount of person-hours are needed to create quality content.

Table 1. Overview of the main differences between the SNOWBALLS and WISE e-learning systems.

	SNOWBALLS	WISE
Project start	2009	1997
Developed by	Students (Supervised by School of Engineering faculty; Implemented by a commercial partner)	Educational researchers and technology specialists (With feedback from educators; Additions by an open-source community)
Main goal	Education	Research
Main audience	University students (undergraduate) (Japan)	K-12 Students (USA)
Main content	(Technical) English vocabulary & phrases	Basic science knowledge & understanding; Research & critical thinking skills.
Usage examples	<ul style="list-style-type: none"> • Help Japanese students learn technical English vocabulary • Educate International (visiting) students on local issues & language • Educate office staff and teaching faculty in order to boost internationalization 	<ul style="list-style-type: none"> • Research on inquiry-based science learning in Middle Schools • Research on High School student's data-based argumentation • Research on university level Computer Science education
Usage environment	Individually, in the lab, during commutes, or at home	In pairs, during class hours in the computer room at school
Particular strengths	Various features to increase motivation and communication between learners, such as on-line games, a point scoring system, avatars, and a forum.	Various tools behind the scenes for researchers and curriculum designers, such as powerful system for collecting detailed learner (usage) data, and easily rearranging learning "steps".
Teaching philosophy	Autonomous learning (The system allows access to any module at any time and offers tools for self-evaluation, progress visualization, interaction with peers, and increasing learner motivation)	Knowledge Integration (System is set up to "explain" concepts by guiding the learner to discovery through a number of "steps" containing short explanations or exercises.)

Both the UT and at the UCB offer an elective, for-credit course to their university's students in which the students can take the initiative in developing a new e-learning module. The course is a vehicle to teach students various skills, while a (draft version of) a new e-learning module results at the end. The UT course "SNOWBALLS" [3,4] is organized by the authors as one of the projects within the "Creative Engineering Project" course, which is open to all (3rd & 4th year) Bachelor, Master, and PhD students, although mostly Engineering Bachelor and Master students join the course. The UCB course "Science and Mathematics Education: Designing Educational Technologies (SCMATHE)" we observed during our visit is one of the courses offered by the Cognition and Development lab of the Graduate School of Education, and most of the students are from Engineering departments or from the Education department but with a (undergraduate) background in Engineering.

3.1. Class Objectives and Flow

The setup of the SNOWBALLS and the SCMATHE course are surprisingly similar. The main objectives are that students learn about pedagogy in general and e-learning technology, learner engagement and motivation, designing teaching materials, and assessment in particular. In the course, students will become aware of their own learning experiences, and through reflection and discussions with their peers they learn to think about different teaching styles and writing for different audiences. These courses therefore teach more than pedagogy, they help the students develop various skills which they can use in their study or professional career, such as Brainstorming, giving and receiving feedback, writing clear reports tailored to specific audiences, ways to visualize concepts that are difficult to grasp, etc.

In the first few classes, students have to brainstorm and decide on a topic for the e-learning content they want to make. In the following classes the students will work their ideas out and gain hands-on experience in designing teaching materials for e-learning. Using the ideas and feedback from class discussions, they will be able to polish their work and think about the assessment of learners of their modules. By the end of the semester, every student should have a (draft) version of an e-learning module that is uploaded to the (test) server.

Both the UT and the UCB classes have general parts, where a teacher (or another member) provides some background on pedagogical or design principles or introduces a discussion topic. Typically, the teacher will ask the participants for their ideas and opinions after a brief introduction, rather than giving a solitary lecture about the topic. The teacher will then try to summarize the ideas and highlight the main points. The idea behind this approach is that active learning is more effective than passively listening to the same information. An additional benefit is that the teacher gets a clearer insight in the level of understanding of his students, and the students may even come up with ideas that the teacher did not think of.

In the second part of the class, the students are split into breakout groups of 3 or 4 students based on their interests and backgrounds. The students will discuss their progress in the group, and give each other feedback comments and ideas to improve or expand their e-learning modules. At this time, TAs or other more experienced members — including the teachers — join the groups in their discussion. At the end, all group discussions are summarized by one of the group's members, and the other groups are allowed to ask questions or make comments. This is to make sure all discussions are wrapped-up properly, and to share the main ideas with everyone. We found this a very effective way of making sure every student receives a fair amount of individual feedback comments, while we can also make sure that all important topics come to the table.

We found that the variation in student backgrounds, as well as the variation in their experience levels was very helpful in various activities. It helps to get many diverse ideas in brainstorming session, it promote multidisciplinary thinking, and it makes students aware that what (technical content) seems obvious for them, may be very hard to grasp for others. This way, the classroom is an effective test-bed for new ideas and a good place to check the clarity of the teaching materials.

3.2. Guidance & Supervision

At the UT we hire excellent students from the previous semester as Teaching Assistants (TAs) to share their experiences and knowledge with the group and to guide the discussion when working in breakout groups. Additionally, there are some students who took the course as an undergraduate student, and want to take it again as a graduate student. At the UCB, PhD students and post-docs of the Cognition and Development lab join the class and have a similar function in the class. Having a number of more experienced people involved in the group discussions guarantees the continuity of the know-how existing in the organization, and ensures that every student can get a minimum level of feedback and guidance required to produce quality materials.

3.3. Differences

Although all students —both at the UT and at the UCB— have an engineering background, the UCB students are generally enrolled in a Master's or Doctoral course of the Education department. The focus at the UCB is therefore more on the research of pedagogy in primary and secondary education, while the UT focuses more on the internationalization and education of university level engineering students.

At the UT, the main objective of the e-learning system is language education. This means that virtually all teaching materials have to be bilingual at to some degree. We also take this opportunity to have international students and Japanese students collaborate in pairs and assist one another with translating vocabulary, phrases, or even cultural background information. We urge the Japanese students to use English in class and for their homework, and International students to use Japanese. This multicultural, multilingual, multidisciplinary, and multi-experience-level collaboration offers some challenges for both students and teachers, but proves to be a rich environment for various learning experiences.

At the UCB, the students develop e-learning content aiming at guiding learners to a deeper understanding of science topics (physics, biology, chemistry, etc.) through explanations, visualizations, and interactive animations. Here, the difference in scientific backgrounds really adds to looking at the same problem with different eyes, and thinking about different ways to visualize difficult concepts in ways easy to understand for K12 learners.

One of the striking differences almost all students accompanying us on our visit to the UCB noted was that in the both the class and the research meeting TAs, PhDs, and experienced researchers (not only the teachers) mix in the discussion groups very naturally. One of our international students —who studied in the US before but looks with “Japanese education eyes” now— described it as following:

“In particular, the missing of a hierarchy in class and in any student organisation impressed me than ever before. [...] we saw that all students, no matter what age or status, participated in the discussion enthusiastically, as if they were talking with peers [...] and asked [meaningful] questions [...], which is a huge contrast to Japan where the discussion style is stiff and questions are usually there only because the asking person wanted to assert his/her presence. [...] the students were able to give really helpful comments.”

Another (Japanese) student noted:

“The lecture mainly serves as an opportunity for students to critique on each other's project and to learn theoretical notions from published papers. Hence, the lecture is a discussion-style, putting most of the students from the University of Tokyo in a challenging environment. I read the assigned papers beforehand and prepared discussion points for the lecture. Thanks to my preparation, I gave a number of useful comments to the PhD. students.”

These comments show the difference in culture between Japan and the USA in general and maybe the respective schools in particular. In Japanese education, there is a strong sense of hierarchy and a student will not openly disagree with a teacher. Everyone is continuously aware of how other's may judge one's behavior, and students hesitate to share (personal) opinions since a change of mind later on is seen as an error and causes one to lose face. At the same time, there is no culture of assigning readings as a class preparation. Therefore, students will also feel less confident making critical remarks toward those higher in hierarchy.



Fig. 3 Classroom discussions & feedback about the e-learning content students are preparing in small breakout groups (Top: The University of Tokyo, Bottom: The University of California Berkeley)

3.4. Challenges

There is a number of challenges in making quality e-learning content that we experienced both at the UT and at the UCB. We will list the most important ones briefly:

- Choosing the proper design and layout. It is often said that “beautiful things work better”.
- Closely connected to the previous point is the notion that consistency between sections and modules is important to smoothen the learning experience. However, should design and layout be dictated by the system, or should the author be given the freedom to change the design according to what he believes is best fitting the content? Finding a balance between consistency and flexibility is a challenging problem.
- How to make optimal use of graphics or visualizations
 - Sometimes you have to trade detail or accuracy for highlighting the main concept or idea.
 - Sometimes an added picture may make the content more interesting or motivating, while at other times it may just distract from the actual message.
- We noted the importance of adding context when using or explaining words with multiple meanings. We also note that scientific or engineering vocabulary may sometimes have a different or wider meaning in daily life usage.
- How can we motivate the learner? What can we do to arouse self-interest in the project or learning matter? Providing analogies, examples taken from daily life, or framing the problem differently may have a great impact.
- Peer learning can be very effective, but creating the right environment for peer learning is a challenge. Especially when individual learners can use the e-learning system autonomously, it is important to offer tools that creates a “community feeling” when the learners use it.

There are also several challenges to the organization of the course in which we develop the e-learning content.

- As mentioned in the previous paragraph, it may be difficult to have everyone engage in a free and open discussion due to socio-cultural factors. Brainstorming, giving and receiving peer review comments, and sharing one’s personal experiences or opinions require a certain classroom atmosphere that has to be created by the teachers and felt by all students. If such a atmosphere does not exist, long silences and ineffective group discussions will result.
- Like in the online learning environment, peer learning inside the classroom is also most effective when a community feeling exists. Our aim is to have students who started the semester as individuals with various backgrounds become friends with shared experiences toward the end of the course. Not only knowledge and skill transfer, but also personal growth is a goal of the class.
- Large projects introducing new technology or education methods take a long breath. The initiative may not seem successful at the start, but with continued effort and support it will be possible to convince

more and more people until a critical mass is reached.

4. Conclusion

We showed a comparison of e-learning content creation approaches at the UT and the UCB. Although there are several major differences between the SNOWBALLS and WISE e-learning systems and their objectives, we found surprisingly many similarities in our strategies for developing the e-learning content.

Our group at the UT and the Cognition and Development lab at the UCB appeared to have very similar courses where students take the initiative to create content. At both universities, students from various departments who are interested in teaching their knowledge to others come together in a class that guides them through the creation of an e-learning module. Discussions and peer-teaching are main elements in these courses, and besides knowledge about e-learning technology and pedagogy, students learn a variety of skills during the course. We also noted we have many challenges in common, especially when it comes to designing quality content that is both educating and motivating.

At both the UCB and the UT, the courses are also a way of pushing education innovation. By introducing the students to new ways of learning, we hope to improve the existing education systems in our countries. Since the students choose to participate in these courses, they apparently have an interest in teaching or at least sharing their knowledge or experiences with others by means of creating e-learning content. We actually noted that many of our students take pride in their project and become very enthusiastic when about half-way the course they realize that they are creating something that will last in the (university) education system, even after they graduate.

Continuing the mutual exchange of ideas between the UT and the UCB and possible other partners, we hope to further polish our courses, as well as to improve the experience the users of our e-learning systems and their contents.

References

1. Kumiko Morimura, Jorg Entzinger, and Shinji Suzuki, "The "SNOWBALLS" Web-Based e-learning System and its Development", *Proceedings of the IPCC 2011 (IEEE International Professional Communication Conference)*, Cincinnati, USA, October 2011.
2. Marcia C. Linn, "The Knowledge Integration Perspective on Learning and Instruction", in R. Keith Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences*, Cambridge University Press, 2006. Chapter 15.
3. Jorg O. Entzinger, Kumiko Morimura, and Shinji Suzuki, "Developing e-learning for internationalization: results and prospects of a seminar style course", *Proceedings of the JSEE 59th Annual Conference and Exposition / International Session*, Hokkaido University, Sapporo, Japan, September 2011.
4. Jorg Entzinger, Kumiko Morimura, and Shinji Suzuki, "Developing e-learning content to raise global awareness in a seminar style course", *Proceedings of the IPCC 2011 (IEEE International Professional Communication Conference)*, Cincinnati, USA, October 2011.
5. Marcia C. Linn, Michael J. Clancy, Camillia Matuk, *Science and Mathematics Education: Designing Educational Technologies (SCMATHE)*, The University of California Berkeley Course #220C (CCN 79305).

Biography

Jorg Entzinger, PhD, was born in The Netherlands, where he received his M.Sc. in Mechanical Engineering from the University of Twente. He graduated on the automatic calibration and control of an industrial robot using visual information. After that, he investigated the human decision making and control process of airline pilots in the visual approach to landing, for which Jorg received his PhD in Aeronautics and Astronautics from the University of Tokyo in 2010. He currently works for the University of Tokyo as research associate at the Institute for Innovation in International Engineering Education on various projects concerning globalization and increasing students' leadership and teamwork skills.

Kumiko Morimura, PhD, is an Associate Professor at the University of Tokyo, where she teaches technical English to undergraduate and graduate students in the School of Engineering. She studied acoustic engineering and received Ph.D. in Interdisciplinary Information Studies from the University of Tokyo. Member of Acoustic Society of Japan (ASJ), IEEE Professional Communication Society, and JSEE.

Shinji Suzuki was born in Japan and obtained his bachelor in Aeronautics & Astronautics from the University of Tokyo in 1977, and his master's degree in 1979. From 1979-1986 he worked as a researcher for the Toyota Central Research and Development Inc. on Noise & Vibration analysis. In 1986 he obtained his PhD degree from the University of Tokyo, where he then became an associate professor in Aeronautics & Astronautics, and in 1996 a full professor. His main research interests are flight safety, flight dynamics, control, optimization and Unmanned Aerial Vehicles.