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iTree: Does the Mobile Phone Encourage Learners to be More Involved in Collaborative Learning?

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Abstract. A web-based collaborative learning sites has the bulletin board system (BBS) and allow learners to interact, exchange information, engage in discussion, and collaborate on projects. This paper outlines the development and evaluation of iTree, a Java mobile phone application that encourages learners to participate in online BBS forums. In essence, the application reminds the students of their level of participation in a class BBS forum via an image on the wallpaper on their mobile phones. Postings to the forum are represented as a tree, the growth of which reflects the learner's degree of participation. Our evaluation has shown that iTree encourages learners to engaging in forum exchange in a positive light. Many learners have come to regard iTree as a useful learning tool..

Keywords: Mobile phone, e-learning, discussion, collaborative learning

RESEARCH BACKGROUND

Collaborative learning and e-learning

In recent years, higher education institutions around the world have expressed a growing interest in e-learning, or internet-based educational services (Tate 1997, Yoshida 2002, Kaneko 2002). The U.S has the highest ratio of e-learning with 90.4% of public universities and 55.9% of private universities now offering e-learning courses (Yoshida 2003). In Japan, the School of the Internet (SOI) at Keio University has been streaming video Web lessons since 1996 (Murai 2000). Since April 2002, a number of graduate schools have implemented e-learning programs, including Shinshu University and Tohoku University.- Background to this trend has been a progressive loosening of the accreditation criteria for distance education. This process was triggered by a 2000 University Council report that concluded "distance education, being of equal merit to face-to-face education, may now be recognized for up to 60 credits of a degree program" (The University Council 2000). The Central Council for Education also recently proposed that university courses "be made available off campus" (The Central Council for Education 2003). This trend toward looser university accreditation criteria is expected to continue. With it, university e-learning programs are also expected to spread.

iii online

Since April 2002 we have been developing and operating the e-learning site "iii online" for the Interfaculty Initiative in Information Studies at the Graduate School of Interdisciplinary Information Studies, University of Tokyo (Yamauchi, Nakahara 2002). Graduate students in the initiative can earn course credits by (1) watching on-demand lecture videos, (2) participating in BBS discussion, and (3) submitting final reports online.

Collaborative learning on BBS in e-learning site

BBS forums such as "iii online" are interactive communications tools that play an important role in web-based e-learning. Forums encourage collaborative-learning, information exchange, and discussion. However, many issues related to BBS use have yet to be addressed. One pressing concern the medium faces is learners need encouragement to browse and respond to BBS postings. Effective collaborative learning will not occur unless learners make an effort to read posts and respond to them. The situation is exacerbated when a learner does not keep up with the forum, when it becomes extremely difficult to catch up with the backlog of information and volumes of new posts .In order to address this issue, learners would benefit from a convenient system to inform them of BBS postings in a timely manner. Up until now, course coordinators, mentors, and moderators have had to take on this task (Salmon 2000; Collison, Elbaum, Haavind and Tinker 2000). Yet monitoring the board in this fashion often entails a very heavy workload (Nakahara, Maesako, and Nagaoka 2002).

To address this challenge, we have developed iTree, a mobile-phone application which encourages learners to participate in BBS forums. iTree displays wallpaper on a learners' mobile phone screens to keep them up to date with their level of forum participation and encourage them browse and post. Learners can simply glance at the screen in their pocket to check their level of participation and the level of board interest in their posts, saving a trip to the PC. We hope the convenience of the application will encourage the learner to browse and respond to BBS postings. iTree displays wallpaper images but has no posting or browsing function. Mobile phones have limited bandwidth, small screens, and often awkward text input functions and so we feel the PC remains more suitable for browsing or posting.

Educational use of mobile phones

Japan has a high rate of mobile phone ownership. As of May 2003, mobile phone penetration stood at 84.4 % (Including people in their sixties: 79.2%). Penetration rates among the young are especially high: 80.3% of teenagers, 96.9% of those in their twenties, and 96.2% of those in their thirties own mobile phones (Nomura Research Institute, Ltd. 2003). Because of this widespread penetration, many educators are optimistic about the potential of mobile phones as a learning tool. Some educators have even incorporated mobile phone technology into their course design. There are three categories of this kind of usage: Firstly, students have been sending course evaluations and comments via mobile phone. Otsuka and Yahiro have developed a class evaluation system that uses the mobile phone (Otsuka & Yahiro 2002) with students evaluating lessons by clicking through a checklist on their phones. One benefit is results can collected and tabulated instantly. The similar system was developed by Nakayama, Morimoto, Akahori, and Shimizu in 2001. Their system allows a lecturer to collect real-time feedback on his distance course via mobile phone. Secondly, mobile phones can now run language study materials such as drills and educational game applications (Seki, Shimizu, and Shigematsu 2001).

In addition, mobile phone subsidiaries now offer commercial education services geared in many fields, for instance courses in Engligh grammar and listening. Learner using the mobile phone can take a short quiz of English words, get the feedback when they make a mistake and memorize them(Fig.1 Copyright Marvelous Liveware Inc.&Sansai Books/Team Project Moetan). They can memorize English words over the mobile phone as they used CAI software on desktop computer.

Thirdly, schools now distribute to students official notices regarding class cancellations, scheduling changes, or job seminars via mobile phone (Yamaoka 2000). The e-learning mobile phone application we developed differs markedly from the above. We always have our mobiles with us, switched on and ready to use. When we make a call or check the time, the first think to catch our eye is the screen. We decided to take advantage of this prime real estate to encourage learners to participate in BBS forums.

The concept of WILD, or Wireless Internet Learning Devices, was introduced by Roschelle and Pea and billed as the future of collaborative-learning media. Roschelle and Pea also gave an overview of potential uses (Roschelle & Pea 2002). Examples of WILD given include (1) a response analyzer, (2) a database for field observations, (3) a sensor or measuring instrument, (4) an exhibition guide in a museum. Although the Internet-connected mobile phones such as those used in Japan can indeed be classified as a variety of WILD, Rochelle and Pea made no mention in their report of iTree-like applications for e-learning (Roschelle & Pea 2002).

Fig.1. Commercial web site over the mobile phone to memorize the English word (http://www.moetan.jp/online.html)

ITREE

System configuration

iTree renews the wallpaper display with enrollment data stored on the "iii online" web server(Figure 2). "iii online" is housed on a Windows 2000 server running Internet Information Services (IIS) 5.0. The server uses the processing environment Active Server Pages 3.0 to handle iTree requests and various other functions. The iTree application runs on the Java SDK 1.4 development environment in NTT DoCoMo 504 Series mobile phones. Figure 1 shows a mobile phone with iTree installed. When a learner flips open his phone, iTree immediately retrieves updated data from the BBS server via HTTP protocol (Figure 3). First, iTree assigns each learner a unique ID with which it performs database searches. Results are sent to the learner's iTree via the HTTP protocol in text format. iTree then interprets this text data as a wallpaper image. It takes on average two seconds to load image data after open the lid.

The image is displayed as wallpaper on the LCD screen whenever the mobile phone is on.

The black arrow denotes this wallpaper. Switching on the power of the mobile automatically runs the iTree application, which refreshes the wallpaper image. The image begins to load as soon as the learner flips the mobile phone open. iTree immediately sends for and retrieves data from the BBS server via HTTP protocol.

Figure 2: iTree

VISUALIZING ON THE WALL PAPER

The choice of image needed to meet two requirements: (1) BBS forum information had to be available at a glance, and (2) the image itself had to be appealing. A tree which grows and changes was chosen to fulfill these requirements. The metaphor of a growing tree was chosen as (1) the tree itself comes to symbolize the learner and (2) the growth of the tree expresses growth in forum participation. The image of the tree is fixed in the middle of the mobile phone screen. The growth of the tree is affected by four variables: (1) your number of posts, (2) the number of times your posts are read, (3) the number of replies to your posts, and (4) your ratio of total forum posts to replies. These variable factors make up an individual user's BBS participation profile. Table 1 shows the screen changes that these variables correspond to.

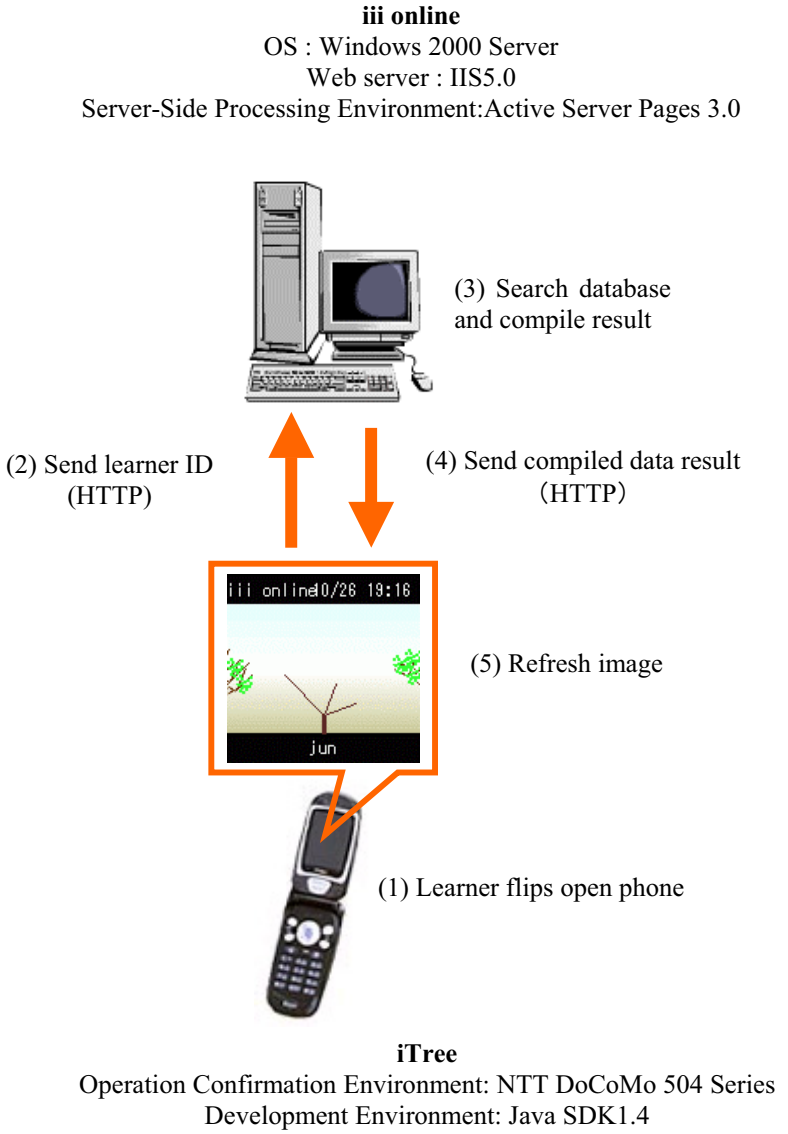

Figure 3: System Configulation

Table 1: Screen Changes

Participation Variable	Change on Screen
Number of posts	Tree growth. Posting thickens the trunk of the tree and grows branches on the
Number of times posts are read	Number and color of leaves. As posts are read, leaves sprout and turn green. After a certain period, leaves eventually fall.
Number of replies to posts	Red nuts. A red nut denotes a reply to a post.
Ratio of total forum posts to replies	Color of sky. The more replies received vs. overall posts, the darker the blue of the sky.

When a learner opens his mobile phone, iTree refreshes the screen image according to these four participation variables. In Figure 4, the number of posts is expressed as tree growth. Each post causes the tree to grow branches and the trunk of the tree to thicken. There are sixty-four stages to tree growth. When the final stage is reached, the tree covers the whole screen and growth stops. Conversely, if the learner neglects to post for a time, branches thin out and the trunk withers. In Figure 5, leaves indicate the number of posts read by forum members. The more forum members read a learner's posts, the thicker and greener his iTree leaves become. In Figure 6, the number of red nuts indicates the number of replies a learner's posts have attracted. One nut indicates one reply. Red nuts disappear in time.
The higher the ratio of a learner's posts with replies to overall posts, the bluer the iTree sky becomes, as shown in Figure 7. The rationale for including this factor is that a narrowing of this ratio indicates the learner is communicating interactively in the forum and therefore solving problems in a collaborative manner. Figure 8 indicates the screen changes that correspond to these four variables. Ordinarily, learners will see their own tree onscreen, yet with the touch of a button they can also view other learners' trees. Finally, of course there are other methods of encouraging learner participation in BBS discussions. The objective of this paper is not to explore this variety of possibilities, but rather to focus on a specific educational use of the mobile phone and analyze its effectiveness. The following section assesses the effectiveness of the iTree application when put to the test.

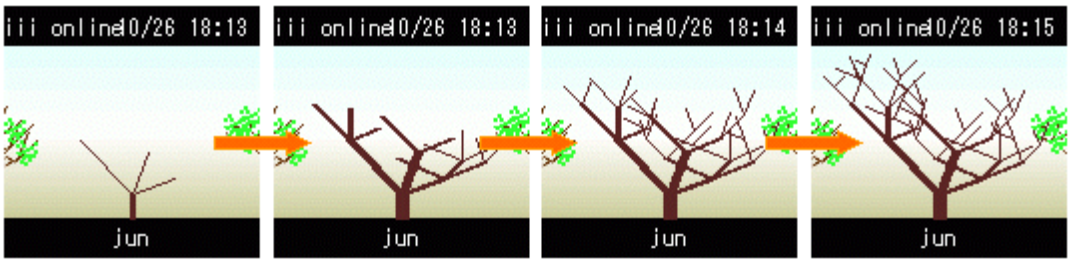

Figure4. the growth of tree's trunk

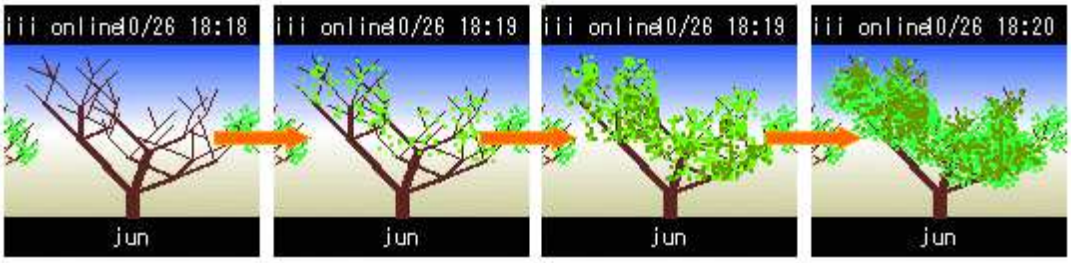

Figure5. the growth of tree's leave

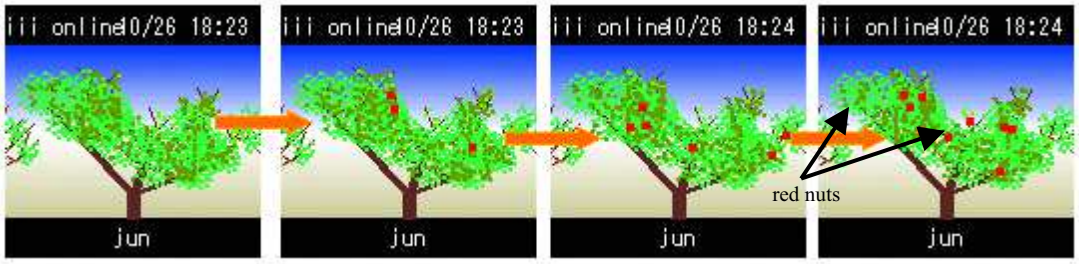

Figure6. red buts

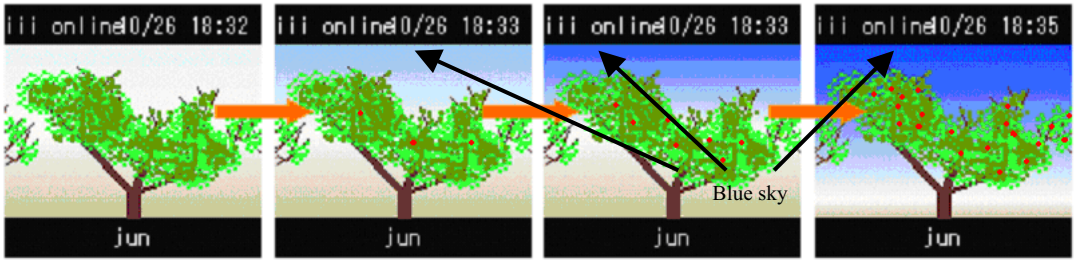

Figure7. The color of sky

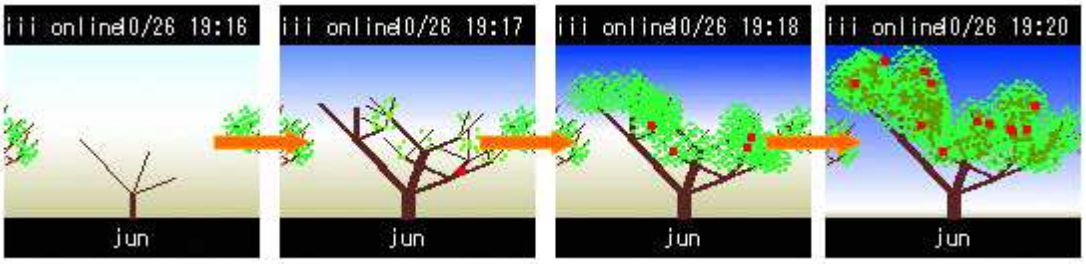

Figure8. The change of whole image

EVALUATION

Overview

Our iTree experiment was conducted in cooperation with students of information policy at the Interfaculty Initiative in Information Studies Graduate School at the University of Tokyo. The experiment was conducted on students in the course Information Policy, a winter term option of fifteen lectures given between Oct. 4, 2002 and Jan. 31, 2003. The first four lectures of the course summarized Japanese information policy at the national and municipal levels. In his fifth lecture, the lecturer asked students to research an aspect of information policy that took their interest and prepare a presentation on it for the class. The sixth to fifteenth lectures of the course consisted of these student presentations, which covered a wide range of subjects. Presentation titles included

"Transportation Policy in an Information Society," "Remarks on Music and Money in TV Broadcasting," "The Role of the Public Record Office in the Computerization of Public Administration," "The Current State of the Contents Industry and Policy," "Progress of Singapore IT Policy," "Current Terrestrial Broadcasting and Public Broadcasting," "Considerations on Mega-Disasters and Info-Communications". Students were also asked to conduct Q&A sessions and discuss the presentations in the course BBS forum. The ten information policy students asked to volunteer as subjects of the experiment were asked to use iTree throughout the remainder of the course. At an early stage, one subject dropped out, leaving the experiment with nine subjects, four male and five female.

Vantage points and methods of evaluation

We set the following three vantage points: (1) Have the subjects been browsing the forum?, (2) Have the subjects been posting to the forum?, (3) How does the learner evaluate iTree?.
In order to answer these three questions, we analyzed the data in the following way: First, focusing on points (1) and (2), we analyzed "iii online" log data and compared the iTree group and non-iTree group results. The latter group numbered 53 students. To address point (3), the nine iTree group subjects filled out a questionnaire at the end of the experiment. eliciting responses on a five level scale: "Very much agree," "Somewhat agree," "Hard to say which," "Somewhat disagree," and "Very much disagree."

RESULTS

Effect of iTree on learner participation in a BBS forum

As previously mentioned, "participation" refers to browsing or posting messages in a BBS forum. Table 2 indicates the average numbers of times both iTree and non-iTree groups read and posted to the forum. On average, iTree group subjects browsed the forum 421.7778 times each (total number of browses: 3796; S.D.= 348.6734). On average, subjects in the non-iTree group browsed the forum 232.5849 times each (total number of browses: 12 327; S.D.= 242.5107). A Mann-Whitney's U Test of the above result showed it to be statistically significant ($p<0.05$). On average, iTree group subjects posted 7.11111 times each to the board (total posts: 64; S.D.= 5.2546). Non-iTree group subjects on average posted 5.8235 times each (total posts: 313; S.D.= 6.9360). We did not obtain a statistically significant result for these figures. Consequently, our results indicate that iTree does not encourage learners to post. It does, however, encourage learners to read forum postings.

Item (unit)	iTree Group (9)	Non-iTree Group (53)
Average number of reading sessions	421.7778(S.D.=348.6734)	232.5849(S.D.=242.5107) **
Average number of posts	7.111111(S.D.=5.2546)	5.8235(S.D.=6.9360)

** $p<0.05$

Table 2: Analysis of Log Data

Learners' subjective evaluations

The subjective evaluations of the iTree group regarding issues such as operation ease and appeal of images is shown in Table 3. Responses to statements (1) "iTree easy to learn" and (3) "Useful BBS tool" were on the whole positive. Subjects tended to disagree with statement (2) "Screen hard to read". These responses suggest subjects regarded iTree favorably in general. We also asked subjects how they responded to the changes in their tree. We found subjects responded positively to statement (4) "Worried about growth of tree." This concern was evident in the generally positive responses to both statement (5) "Change in color or number of leaves triggered posting or forum browsing" and (6) "Change in number of red nuts triggered posting or forum browsing". This concern suggests that iTree may act as a trigger for subject participation in a BBS forum. Leaves change color

when others read your posts. Red nuts appear when others post replies to you. What is significant in both of these cases is that the activities of others are changing your tree. It would seem that interest in the responses to your posts is a factor which triggers a poster to browse the forum.

Table 3: Learners' Subjective Evaluations

Item	Very much agree	Somewhat agree	Hard to say which	Somewhat disagree	Very much disagree
1. iTree easy to learn	3	5	1	0	0
2. Screen hard to read	0	0	2	4	3
3. Useful BBS tool	3	4	2	0	0
4. Cared about thegrowth of tree	4	3	2	0	0
5. Change in color or number of leaves triggered posting or forum browsing	0	7	1	1	0
6. Change in number of red nuts triggered posting or forum browsing	4	5	0	0	0
7.Branch growth triggered posting or forum browsing	0	5	2	2	0
8. Change in sky color triggered posting or forum browsing	0	0	4	4	1

CONCLUSIONS AND FUTURE ISSUES

iTree, the mobile phone application developed and evaluated in this research project, was designed to increase student participation in course-related BBS forums. The application aims to accomplish this by simply displaying their state of BBS participation via mobile phone wallpaper. Our evaluation led us to the following three conclusions:

(1) Learners who use iTree more actively browse.
(2) Overall, learners evaluate iTree positively.
(3) Among the iTree functions, those which represent others' evaluation of a learner's posts have the potential to encourage learners to browse the forum.

iTree gives learners the information about who sent reply and when they should go to the forum. Some previous research has showed that learners need not only to share their knowledge but also to get the awareness information about the status of interaction (Gutwin, Stark and Greenber 1995). The information that iTree offered is a type of awareness information which triggered browsing. When learner get the messages from others, they feel like checking it and feel confident that their messages are relevant and useful for others. By this, iTree motivated learner to participate in online discussion.
Nonetheless, there are still some issues yet to address. Most significantly, due to iTree's limited specifications, it does not sufficiently encourage students to post on forums. In the future, we may overhaul the iTree graphic interface in an effort to address this limitation. The number of higher education institutions offering e-learning classes grows every year. Applications such as iTree have the potential to facilitate this growth. This research marks the beginning of a mission to improve and refine iTree and related socially significant technologies.

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