ProBoPortable:
A Cellular Phone Software to Promote Emergent Division of Labor

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Abstract
This paper deals with a design of a cellular phone software, called “ProBoPortable”, which displays an awareness of task status and division of labor in Project-based Learning (PBL). According to the situated learning theory, learners learn not only the cultural practice but also the “legitimate learning strategy,” which refers to the way in which learners can learn effectively in the community using their meta cognition. Based on this concept, learners are expected to monitor the actual status of their achievement by themselves, and reorganize their division of labors ad-lib in order to improve their learning in PBL. The authors developed a cellular phone software which cooperates with a Web-based groupware in order to enhance learners’ reorganization of their learning activity from the viewpoint of the division of labor in their PBL. ProBoPortable is expected to enhance the awareness of the status of learners’ collaboration in PBL.

1. Introduction

Project-Based Learning is a type of learning activity in which learners study along with other learners whilst working toward a common goal and collaborating on tasks as a group. Throughout the PBL, the learners rarely share the same task parallel with that of other learners. They prefer to divide a certain part of the task into smaller tasks and allocate each task to individual group members. This division of labor should take place constantly, even when two persons work in collaboration with each other on one task; for example, in the case of one person working on a task and the other monitoring the task performer’s approach to his work, as noted by Shirouzu et al. [1].

Even in cases where the rules for division of labor are institutionalized by a teacher or an organization, people sometimes cross the borders of the division and coordinate their tasks across the borders with other people as the occasion may demand. For instance, if the task monitor gives the task performer some instructions when the monitor notices the task performer’s errors, it implies that the monitor becomes involved in performing the task. Thus, division of labor is reorganized in a more or less ad-lib and ad hoc manner in order for the task to progress uninterrupted and error free. Kato et al. [2] termed such a cross-over of division of labor as “emergent division of labor (EDL),” and argued that EDL should provide rich opportunities for learning wherein scaffolding [3] takes place naturally.

However in Japanese universities, the actual amount of time that undergraduate students get to interact with each other on campus; when on campus in Japan, students get the opportunity to meet each other for very short periods of time, for example, in the classroom, or while eating lunch, etc. It can be conceived that most students would not possess an overall grasp on how to proceed with group work in such a semi-distributed environment [4].
2. ProBo: Web-based groupware for PBL

The authors have developed a web-based groupware for PBL called “ProBo” (formerly “Project Board”) (see Figure 1). This software enhances the learners’ recognition of their emergent division of labor both in classrooms and in distributed environments. ProBo has been designed to visualize and allocate tasks among the learners in a community. ProBo has four features: (1) ProjectHome, which indicates the manner in which the learners should organize their division of labor and the progress of their respective tasks, (2) the TODO list, which presents the structure of the tasks in the form of a tree view, (3) Schedule, which allows the learners to confirm the schedule for each task for which the deadline has to be scheduled, and (4) FileBox, which functions as a storage space for files pertaining to the tasks.

Through its implementation in an undergraduate course, the evaluation showed that the learners did not feel to be encouraged to help mutually in the PBL but to monitor their own learning activity.

3. Design of ProBoPortable

In order to enhance the awareness of the emergent division of labor, the authors designed and developed a cellular phone software called “ProBoPortable,” which is based on ProBo.

In Japan, the cellular phone penetration among undergraduate/graduate students stood at 96.3% as of October 2004. Therefore, the authors decided to adopt this medium for displaying the status of the division of labor among student groups.

ProBoPortable was designed to be displayed as a wallpaper on the learner’s cellular phone screen in order to keep them updated with regard to the progress of their project and stimulate the division of labor as soon as the need or inevitability arises.

ProBoPortable was designed to display only selected information from the ProBo database because the size of a cellular phone screen is very limited. Differently from ProBo, ProBoPortable does not allow learners to allocate tasks and modify there status from their cellular phone interface. In accordance with the requirements of EDL, the authors selected the necessary information to confirm and reorganize the division of labor, such as the number of tasks to be completed by each learner, the progress of each task, etc. Table 1 shows the information that ProBoPortable displays on the screen.

The ProBoPortable application used in NTT DoCoMo 902 series cellular phones runs on the Java SDK 1.4 development environment. Figure 2 shows a cellular phone with ProBoPortable installed. When a learner activates his/her phone, ProBoPortable immediately retrieves the current status of the project from the ProBo database via i-mode HTTP. The learner is required to enter their login ID for ProBo with ProBoPortable prior to performing a database search. The result is received via i-mode HTTP in the form of text data, following which the ProBoPortable application interprets the data and draws a wallpaper image based on it.

ProBoPortable describes the learners that have to complete tasks as godown keepers, i.e., those who are...
Table 1. Relationship between Visualized Information on ProBoPortable and ProBo.

<table>
<thead>
<tr>
<th>Information</th>
<th>Index</th>
<th>Target Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member(s)</td>
<td>Each member</td>
<td>Godown keepers and their facial colors Each of the members is color-coded</td>
</tr>
<tr>
<td>Number of Tasks</td>
<td>Number of boxes</td>
<td>Box(es) If a new task is added on ProBo, a new box is added from above</td>
</tr>
<tr>
<td>Progress of each task</td>
<td>Shift length</td>
<td>Box corresponding to the task If a learner carries forward a task, the corresponding box shifts slightly</td>
</tr>
<tr>
<td>Approaching the time limit for the task</td>
<td>Color (normal or red)</td>
<td>Corresponding box If the deadline approaches, the color of the corresponding box changes to red</td>
</tr>
<tr>
<td>Progress of the project</td>
<td>Background color (normal or red)</td>
<td>Backgrounds of all the members of the project If the progress of the project shows a lower value than the benchmark, the color changes to red</td>
</tr>
<tr>
<td>Money</td>
<td>Amount of money</td>
<td>If the task is completed, the amount increases</td>
</tr>
<tr>
<td>Whether or not each learner has confirmed the status</td>
<td>Background color (of relevant learner(s))</td>
<td>Relevant learner(s) If the learner has not confirmed the status of EDL via ProBo/ProBoPortable, his background color changes to black</td>
</tr>
</tbody>
</table>

required to clean the boxes. If a learner carries forward a task, the corresponding box shifts slightly. The other learners should recognize such a change when they activate their cellular phone. When more than two learners collaborate to carry forward a task, the corresponding box in each of their positions moves. When the learner(s) completes the task, the corresponding box drops down and the amount of money increases; all the learners can recognize the completion of the task. In accordance with the requirements of EDL, ProBoPortable expresses whether each learner has confirmed the status of PBL via ProBo or ProBoPortable.

Thus, the learners are expected to recognize the status of the other members on a daily basis, carry forward their tasks, and reorganize their division of labor as and when required.

4. Conclusion

The authors have developed ProBoPortable—a cellular phone software for enhancing some functions of web-based groupware. To stimulate the division of labor among learners, ProBoPortable displays the status of the division of labor on the cellular phone screen. The authors are currently investigating the effectiveness of ProBoPortable in the learners’ emergent division of labor through its implementation in undergraduate courses.

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References