Designing of a Mobile Collaboration Application for Student Collaborative Group Work: Evidence from China

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Abstract

With the advance of mobile technologies, it has been easier for mobile devices to support collaborative activities. This opportunity brings about new possibilities to carry out mobile collaborative work and mobile learning (m-learning) which play an important role in relevant field. Researchers find that Process Support Systems (PSS) and Collaboration Engineering (CE) can benefit the collaborative process. However, there is few research applying PSS and CE theories to mobile collaborative applications. In this paper, we present the design of a simple PSS: one Android meeting application based on CE methods to support university students’ collaborative study. We carried out an experiment among 75 students from 6 Chinese universities and evaluated the capabilities of the application with a survey and in-depth interview. Our findings suggest that this application can improve the effectiveness and efficiency of students’ group collaboration. Our study further serves as an example that CE methods are useful for mobile collaboration systems.

1. Introduction

As mobile devices such as smartphones, PDAs and tablet PCs are becoming increasingly popular, mobile applications exert a great influence on the way people communicate and access information [1] as well as the way in education [2]. Students are increasingly in a position to get engaged in collaborative learning activities motivated by their time and circumstances of personal preferences [3]. Nevertheless, face-to-face collaborative learning, CSCL (Computer Supported Collaborative Learning) and mobile collaborative learning are frequently faced with problems such as ineffectiveness and inefficiency [4].

Mobile technologies have been considered beneficial for supporting learning activities in education [5]. Some researchers have been stimulated to facilitate learning by applying mobile technology and appropriate learning strategies, which can help students facilitate mobile learning process and achieve their educational goals [6]. In addition, findings of previous researches have shown that the provision for support of collaboration processes such as the Group Support System (GSS) technology can benefit the effectiveness and efficiency of collaboration [7]. Meanwhile, process support applications (PSA), as a collaborative software application, might make it possible to provide sufficient collaboration expertise to students, which enables them to collaborate and “facilitate in a box” without a facilitator and without extensive training [8].

Despite previous studies focused on the issue of mobile learning or the issue of software in computers or laptops, little research indicates what kind of mobile collaboration application is suitable and practical for university students to collaborate in case study or other group work. Besides, there are a number of challenges for mobile application designers, since mobile collaborative applications are not required to present in stationary collaboration scenarios [9]. Unlike computers or laptops, the mobile devices such as smartphones are easily limited in the screen space [17]. In order to enhance transferability and flexibility of the collaborative support, researchers have applied some collaboration techniques such as thinkLets [10] [11] to the PSS and built facilitation support with Collaboration Engineering (CE) method which is to create collaborative processes in collaboration support tools like GSS without professional facilitators [12][13]. Nonetheless, these trials were mainly carried out in computer systems rather than mobile applications.

Therefore, this paper aims to address the following questions: 1) How can we design a mobile application (APP) utilizing the methods of CE and thinkLets to support university students for collaborative work? 2) Does the application improve the effectiveness and efficiency of the students’ collaboration?
The rest of this paper is structured as follows. Section 2 includes a summary of existing mobile collaboration applications and a literature review in order to better justify these theories in detail. Section 3 describes our collaboration application design. Section 4 and 5 present the implementation issues of our mobile application with a case study, and analyze the results in both a quantitative and qualitative approach. Finally, Section 6 makes the conclusion by addressing the implications and limitations of our study and proposes some ideas for future work.

2. Background

2.1. Mobile Collaboration Application

There are a large volume of published studies asserting that the group support systems (GSS) can improve group efficiency and effectiveness [7] [14]. However, GSS in the mobile field, efforts to comprehend the implications that mobile collaboration has on collaborative applications design and collaborative support are still a research subject [15] [16]. Ineffectiveness and inefficiency of current mobile applications are due to limitations as follows: small screen size, lack of windows, navigation, format of accessible pages and speed [17]. In addition, what challenge the mobile collaborative application designers are the stationary collaboration scenarios [9].

In this research, we strive to carry out our android-based application with a simple interface and process to lessen the effect of above limitations. According to Briggs et al. [18], PSS or facilitator-in-a-box approaches enable facilitators to guide teams through step-by-step group activities. Moreover, it is suggested that collaborative technologies would be more effective and acceptable if guided by the models of collaboration [19]. Therefore, we try to combine our mobile application with theoretical methods and evaluate its effects. Our mobile application can be divided into step-by-step parts which are transferable and reusable to minimize the limitations of screen size; Also, a remote server that the mobile application uses allows the data interaction between the website and mobile application avoiding the format and speed problems to some extent.

2.2. Facilitated collaboration using thinkLets

CE is an approach to create sustained collaboration support by designing collaborative work for practices for high-value recurring tasks and transferring those to practitioners to execute for themselves without ongoing support from professionals [20]. CE can just be considered as a combination of facilitation and design that aims to create collaboration processes that can be supported by collaboration support tools such as GSS.

Therefore, CE approach is widely used in computer collaborative systems. However, a few mobile collaboration systems are on the basis of CE approach or thinkLets patterns which can be combined to create a sequence of steps for a group to execute for the sake of reaching collaborative goals. ThinkLets are the design patterns that CE approach uses to design a predictable, transferable, reusable collaboration process [21]. ThinkLets can be used to design standardized and routine collaborative processes that are easily transferred to the group, thus helping group members use and understand easily [22].

To design our mobile application with facilitated collaboration approach, we make use of the following six basic patterns of collaboration identified by Briggs et al. [23]: Generate, Clarify, Reduce, Organize, Evaluate, Build consensus.

3. Android-Based collaboration application design

3.1. Overviews of application design

Our Android-Platform-Based application called “ThinkLight” is designed and developed to support the students’ collaborative work and benefit their thinking process and modes. Our application can run on a variety of Android platform devices on which the Android platform 2.0 or later is installed. Our design of UI layout supports multiple displaying resolutions. ThinkLight app is using Java language for development and is directly connected through the Internet such as 3G and Wi-Fi. With Wi-Fi or 3G network, the Java-based application can connect to the server side to retrieve data of ongoing meetings through different Internet I/O APIs and we compressed the data transferred to reduce the traffic of data sent by the application, and make it possible for devices to work in 2G network. Meanwhile, each participated mobile device has a presentation file locally in order to store the record of meetings. Furthermore, a technical advantage of our application is that it supports real-time communication and synchronization effectively by using a stable and safe server, regardless of the Internet environment of the client-side. Figure 1 presents the overviews of the major components and interactions among the mobile application and the server.
3.2. Simple database design

Since our application have high interactions with the server, through which many users may manipulate the same data objects at the same time or extract data later, we use a database management system to ensure integrity and storage of data and as little conflict data as possible [24]. In order to store arbitrary relational data in a fixed set of database tables, we create a simple database with seven entities in use of Mysql. Figure 2 shows the Relational Model of the database used in our application.

3.3. User-Interface design and implementation

In China, almost all university students have their personal mobile devices such as smart phones and tablet PCs for daily entertainment and learning, especially for group learning. In order to analyze the capabilities of ThinkLight application and evaluate the effectiveness and efficiency of its function, we carry out experiments to groups of university students in China. Each student can use their own smart phones or tablet PCs as the tools for collaboration in their group. Since the server is running on the Internet, everyone can easily access to their group room if they have installed the application and run it under the internet circumstance. Meanwhile, our application has the advantages that every group is independent from the other, making it safer to exchange information and each member can download the meeting record in their personal device. Consequently, the ThinkLight app is easy to develop, simple to install and convenient to use.

In the experiment, students are required to install ThinkLight app in their portable devices for the case study.

After installation, students can register their own usernames and the group leaders/facilitators can create their own discussion rooms, setting some key information: room names, subjects and passwords. Facilitators can check the room information after entering the room, and inform the members of the unique room ID and password so that the group members are able to log on the specific discussion room and begin their collaborative case study. Then the group facilitator can easily execute the basic collaborative process in the application.

In order to save space, a hidden menu is arranged on the left so that users can hide it whenever they want. The overall interface of the ThinkLight is just the discussing module in which users can chat with others instantly. An easy sliding from left to right can make the main menu visible. The main menu has six parts: Room information; View ideas; Create ideas; Download the report; Exit the room and Log out, which can be easily accessed by touching.

In Idea Generation module (Create ideas), we can create new ideas formally. The new idea created will be sent to the Idea Box module (View Ideas). Figure 3 shows some sample screenshots of application modules.
In the Ideas module, we can see the new ideas that the group members have created. The facilitator have the authority to add/delete an idea category, move or delete ideas, start a vote, end a vote and show vote results so expect for vote and show results function, special buttons are only visible in the team leader’s pull-down menu.

For idea voting part, the facilitator starts a vote and members can choose a score for each idea range from 1 to 5 here. When a voting result is announced by the facilitator, we get the results, ranked by mean scores and standard deviations.

Figure 4 shows some sample screenshots from the step of viewing ideas to the step of showing results.

During the meeting, every member can log out, exit the room or download the meeting record in the left sliding menu. The record will be stored in the default path of the SD card. Furthermore, every member can keep their username for another new room or re-enter the former one.

4. Case study and validation

In order to validate the fact that mobile application can help university students perform more effectively and efficiently, an experimental case study was conducted, observing 75 undergraduates from 6 different universities in China. We have then applied the pattern into a real e-business case study that the students needed to analyze the current problem and came out with a group decision of solutions. They were asked to accomplish one discussion about the case on the mobile application and give some feedback on this case.

As in previous sections, few mobile collaboration applications provide a set of process for group work. Our ThinkLight app was developed on the basis of CE approach and thinkLets. However, it’s inefficient to design an application dealing with all the process of group collaboration, which often involves different activities such as sense making, goal setting, solution generation and evaluation, negotiation, decision making and so on [18]. Therefore, in our design, we don’t design all collaboration process for students but the process with six basic thinkLets collaboration patterns according to Vreede et al. [23]. We encourage the students to learn and use some basic thinkLets like FreeBrainstorm and FastFocus on our ThinkLight app.

4.1. Collaboration process

With the ThinkLight app, students can collaborate with their group on mobile devices at any time and any place with the Internet. Nevertheless, they should still ensure every team member is online so that they can have a synchronous communication. At the end of their collaborative work on the application, they were asked to respond to a survey to comment about the experience and some of them were chosen to have a further interview for more information about collaboration experience with open questions.

Figure 5 gives an example of the basic collaborative process what the sample Group One used on our app. The group facilitator created a discussion room on the ThinkLight app and utilized the process to collaborate. After all the group members were in the room, the facilitator first utilized the discussing module to plan for the time of each step. Then they had a FreeBrainstorm to generate a broad set of highly creative ideas about the case. After the FastFocus which means letting them select a set of important ideas and score the ideas from 1 to 5, the facilitator added some categories for the ideas and moved all the ideas into the right category, which is called the PopcornSort. In the next step, all the members had the BucketWalk that requires them to delete the insignificant ideas that got low mean score in the former step and keep the valuable and unduplicated ideas. In the Strawpoll step, the facilitator started a vote and all members evaluated the classified ideas from 1 to 5. In the CrowBar step, the facilitator asked the members for discussing the vote result and tried to build high consensus so that one task was finished in the end. Or they should be back to the Strawpoll step if
the members dissented to the results for the sake of higher consensus.

4.2. Data collection

In this paper, 75 students from 6 Chinese universities (39 of them are male), collaborated with the collaboration process on the app. They were divided into 15 groups which consisted of 4-6 students in each group to collaborate for the case study. For better facilitation, the leader/facilitator of each group had learned the basic CE knowledge from the help documentation of the app before the meetings. None of the other team members had used the similar collaboration system or thinkLets previously. There were no observed problems with the functioning of the app during the meeting. All team members reported successfully as a result of the meeting (their discussing task was successfully completed).

After the session, we then carried out a survey mainly referring to the work of Kolfschoten et al. [29] and Briggs et al. [30] and an in-depth interview. Quantitative method is apt to explore feelings of the user’s first time experience and get some comparatively accurate data, which can prove the capabilities of the mobile app. Interviews allow us to explore much more detailed viewpoints from the participants. Besides, during the interview, the questions and information can be explained and supplemented to avoid misunderstanding between the interviewer and the interviewee, which helps to guarantee the validity and accuracy of the data.

Altogether, 75 participants have responded to the survey and 8 have attended the interview. Of all participants, they are from 6 different universities in China and 5 different majors. They ranged in age from 18 to 23 years old and they were from freshmen to graduates. All participants have over 1 years’ experience of group learning in the university. Given that groups from distinct majors responded with some similar characteristics for the app, this research is relatively convincing.

5. Results

5.1. Survey evaluation

At this stage, we have just done a simple analysis of the survey data and the in-depth interviews. We divided these 27 questions into 6 groups. Since we combined all the questions from the work of Kolfschoten et al. [29] and some questions from Briggs et al. [30], it is necessary to take a reliability test for the survey. We take the reliability test in SPSS [31] and the exploratory measures of user’s first time experiences are shown in the Table 1.

On the whole, participants feel positive about the experiments since all the group items in the survey have a mean score higher than 4.00. In particular, the Tool Difficulty items got the highest mean: 4.2160 (t=-5.564, df=74, p<0.05), which meant most of the participants considered it easy to use the application. Process Difficulty (t=-5.298, df=74, p<0.05) got the second highest mean (4.2107), meaning that the collaboration process on the app was easy to use. Though Satisfaction with IS/IT Artifacts (t=-8.748, df=74, p<0.05) received the lowest mean (4.0080), it still illustrated that the participants were fairly satisfied with the app since the mean score was higher than neutral attitude (score=3).

From Table 1, we can see the index of sig. (two-tailed) were 0.000 which were smaller than 0.05. Consequently, all the group items (df=74, p<0.05) were statistically significant.

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<th>FastFocus</th>
<th>Judge and select some valuable ideas</th>
<th>Strawpoll</th>
<th>Vote for each idea to find out the popular one</th>
<th>Buckwalk</th>
<th>Generate</th>
<th>To add some additional ideas</th>
<th>Crowdbar</th>
<th>Build</th>
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Figure 5. Collaboration Process
5.2. Interview evaluation comments

In addition to the survey, we got 8 in-depth interviews for the experiment. We extracted and sorted critical statements of the interview and keywords. The qualitative measure showed that some participants were positive about aspects of their experience, while others were negative. These analyses are consistent with the phenomenon shown from questionnaire data. Due to space limitation, part of the analysis is shown as follows.

In response to the open-ended question about how the app or the process supported them to make decisions, 6 interviewees gave some positive response, for example:

"It helped us to make decisions more effectively and efficiently especially with the support of category and voting steps."

"I think the high-score ideas could represent what most members thought, and this made the result more obvious and objective."

"It reduced some unnecessary time because of distraction during the meeting."

"Easy to understand how to use the function of the application."

On the other hand, 2 participants made some neutral or negative remarks, for example,

"It didn’t help too much and it couldn’t replace face-to-face meetings either."

"I think it was unnecessary to classify the ideas since we wanted to get the results as soon as possible."

In response to the open-ended question about comparison between our app and other frequently used applications in China (like Tencent QQ, Wechat, Skype, etc.), 5 interviewees gave some positive response, for example:

"The quality of the outcome that the app achieved was higher than other apps since the outcome was considerably objective."

"This app was easy to use and it could guarantee the focus of members’ attention while others couldn’t."

"QQ and Skype didn’t have a standardized process, but this app helped us a lot."

3 participants also made some neutral or negative comments, for example,

"The effectiveness of them was similar."

"To some extent, it would be limited to talk than other communications apps."

"The app was not beautiful as other applications."

6. Discussions

In this section, we will discuss the findings from our study and validation and discuss the contributions, limitations and future work of this study.

The first question in this study sought to design a mobile application with CE and ThinkLets methods. The second question in this research was to find out whether the mobile application could improve the effectiveness and efficiency of the students’ collaboration. By analyzing the data from the survey and interviews, we can easily find three main points:

(1) The mobile app and process are easy and simple to use.

(2) The mobile app is effective and efficient to support the students’ collaboration.

(3) The mobile app has some shortness, reducing the degree of users’ satisfaction and the quality of collaboration.

In general, we can safely draw the conclusion that we achieved the primary design goal of the mobile collaboration application.

6.1. Contributions

Theoretically, our research will primarily contribute to the new form of mobile application designed with the research in the CE methods for mobile area. According to the data, current mobile applications like Skype, Tencent QQ and Wechat lack professional guidance or function for collaboration and only provide a platform for chatting. Meanwhile, some mobile collaborative applications have limits in stationary collaboration scenarios [9]. So it is interesting to apply the CE and ThinkLets methods to design a mobile collaboration application. Compared to other applications, our application can provide a flexible and reusable process for students’ group work and it improves the effectiveness and efficiency than other mobile applications.

Additionally, this research can serve as an example that it is feasible to validate the capabilities of a mobile collaboration application through collecting
observations from a particular case study and conducting a designed experiment.

In practical, this research also provides empirical evidence from design to practice in Chinese context. It would provide practical reference for collaborative group work in university education using mobile app. Furthermore, this research will also give clues to the system designers in collaboration research field for designing collaboration app for the collaborative work.

6.2. Limitations and future work

 Nonetheless, this study is just the first part of an ongoing research. Several limitations exist in this research. Firstly, all the experiments were conducted in Chinese context and the analysis of interviews were comments translated into English. That is to say, although many efforts were made to ensure the original meanings of the interviewees were clear to all the researchers on this study, some misunderstandings do exist. Secondly, as the research is conducted with targeted Chinese students from 6 Chinese universities, we may not have sufficient data to prove that it is also valid for most university students from different cultural background and countries. Moreover, according to the data analysis, the current application has some disadvantages. For instance, the user-interface needs to be improved for aesthetics and simplicity. More patterns of thinkLets or more functions like voice transmission can be added. It can be improved to run not only in Android System but also other operating system such as iOS and Windows.

Therefore, it would be valuable for future exploratory and experimental research to pursue the follow-on questions:

- How can we easily design a cross-platform mobile collaboration application?
- What are the differences between the mobile application and other computer support systems? And which is better in different positions?
- How can we apply CE and ThinkLets methods to the design of mobile applications better?

7. Conclusion

This paper is undertaken to design and develop an Android-platform-based application for students’ collaboration, using the methods of collaboration engineering and thinkLets. To evaluate the application, this paper conducted an experimental case study and drew a conclusion that the mobile application can improve the effectiveness and efficiency of students’ collaboration. As our first attempt to design a mobile app using collaboration research theories, it provides general satisfied answers. We have found some advantages and disadvantages of the current application and discussed the limitation of current work.

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9. References


