Abstract—In traditional problem-based learning (PBL) activity, tutors play an important role in the learning activity. They have to build the teaching materials, learning objectives, and learning objects based on the knowledge map. And then, they input learning objectives and guide students to start learning process by inspired questions. Therefore, their duty in this kind of activity is to facilitate learning by supporting, guiding, and monitoring the learning process. In this manner, many researches built the online learning system to facilitate the PBL process for both tutors and students. Generally, those systems can be divided into two types: web-based system and mobile-based system. However, these two types use stateless communication protocol which is possible to leak the instant monitor information for tutor to grasp the learning process situation of students. Without the real-time monitor, tutors cannot provide proper learning supports according to students’ learning situation and responses in PBL activity. This paper presents a mobile instant messaging system taking into account learning logs which helps tutors monitor the process of PBL. With the help of this system, tutors can adjust the learning guides during the learning activity instantly.

Keywords—Problem-based Learning (PBL); Computer supported learning; Instant Messaging System

I. BACKGROUND AND OBJECTIVES

With the advancement of technology and the Internet, smartphones is indispensable to modern basic equipment. Accordingly, mobile instant messaging software has generally get great attention in recent years. The software supports message pushing, photo sharing and multiplayer chatting. Besides, the instant messaging software integrates message push service with geographic information perception on smartphone, which brings various research topics and applications. In research [11], a multimedia mobile learning system is presented to support auxiliary collaborative learning. The author combines pictures, recorded video, audio and sketch into learning activity and brings various interactions for students to learn. Due to the wireless feature of mobile devices, the devices are designed to support learning outside. In reference [12], a mobile butterfly-watching learning system is proposed to support learners by offering a new pattern of outdoor mobile learning activity. Besides, a sensing technology-enhanced mobile learning system is developed to provide students with extra function to observe and recognize target learning objects in the real world [13]. The above researches use mobile learning system to support field learning guidance. With the improved functionality on mobile devices, motion-sensing technology is deployed in educational purpose learning system [14]. Accordingly, mobile learning system is improving with its advanced technology to apply various learning activity.

Message push service provides the feature of message-delivery guarantees which means the message received acknowledgement can be retrieved and analyzed in server side. However, the log information in public instant messaging service cannot be easily obtained from server side. Therefore, this research develops a private mobile instant messaging service and applies it in PBL activity to bring the extra value for tutors to monitor the process of the learning activity. In PBL activity, a problem is provided which can be solved according to students’ different innovation and solutions. In the context of PBL, a good problem should be authentic, meet students’ level of prior knowledge, and engage students in discussion. In this process, tutors should be aware of the learning situation so that tutors can provide necessary guidance for students to discuss and solve the problem. In order to
provide tutors with instant messaging service and real-time monitor on the learning process, we developed an educational mobile messaging system for computer-supported PBL activity. With instant monitor of each message delivery in learning activity, tutors can grasp specific learning situation and attitude of students and then provide proper learning guides in dynamic manner.

II. LITERATURE REVIEW

In the past few years, many researchers have studied the key features of PBL and its applications on e-learning activity. Besides, instant messaging system has been applied popularly in daily communication and collaboration work. The literature review of PBL and instant messaging system will be illustrated in the following section.

A. Problem-based Learning (PBL)

A problem based learning approach is designed for solving open-ended problems in groups of students. Problem based learning activity usually includes designing a problem, analyzing how to solve the problem, teaching the related knowledge for solving the problem, and helping the students to consolidate the knowledge and then have the ability to solve similar problems [5]. Therefore, tutors should be aware of students’ instant learning responses during a problem based learning activity and provide real-time assistance for students. In reference [4], the author used problem based learning in a software engineering class for students to improve the understanding of concepts. In this activity, the author observed how the students were handling the problem in class and help students use prior experience to solve the problem. One of the conclusions from the research reveals that the tutor is present as a facilitator or guide which means tutors should be involved during the problem based learning activity and provide guidance in time. In research [1], a PBL platform in mobile learning environment was built for tutor to perform learning activity. Tutors need to design problems, provide information and clues then students study through high-level learning activity. However, there is no information about how tutors obtain students’ learning responses during the learning activity. Reference [2] designs a web-based problem based learning platform to compare with traditional problem based learning and conventional treatment. The learning output was analyzed and reported on the web-based platform without the learning logs of students’ online behavior. In this approach, tutors cannot get the instant learning responses from students. With the advantages of cloud infrastructure, reference [3] develops a cloud based e-learning system to build a problem based learning environment for the students. Students are divided into groups and they are provided with a realistic problem and also the list of technical skills needed to solve the problem by making discussions on the system. The conclusions reveal that heterogeneous student groups have better performance compared to homogeneous student groups. The performance is evaluated based on the course feedback which is collected from the system. However, it also lacks of real-time monitor during the learning activity and the tutor has no opportunity to provide guidance in time.

B. Instant Messaging System

Instant Messaging System is growing tremendously in recent years and there are lots of successful applications on Internet. As a message push service, the communication protocols of those applications are not the same. Google Talk, a combination VoIP and IM system, uses Extensible Messaging and Presence Protocol (XMPP) to implement the communication of two end clients. XMPP enables the near-real-time exchange of structured and extensible data between two or more network entities. There are many research focuses on the development of Instant messaging System based on XMPP. B. Xuefu and Y. Ming design a web-based Instant messaging System for enterprise internal applications based on XMPP [8]. The result of the research shows a good integration between instant messaging and enterprise application system. Reference [9] develops a resource-efficient location-based mobile Instant messaging system to broadcast messages across a particular region based on location information. The base protocol of the research uses XMPP to save resources both on the server and mobile devices compared against the general architecture. Another famous protocol for development of Instant messaging System is Advanced Message Queuing Protocol (AMQP). The popular implementation of AMQP is RabbitMQ which is a message broker software. Therefore, the proposed mobile instant messaging system integrated with RabbitMQ to support guaranteed message delivery. The feature of instant messaging system provides a new way for peer communication so that the system is broadly applied in learning activity for educational purpose [6][7]. Besides, with the concept of message broker, instant messaging system is exploited and used for system administration purpose [10]. The proposed research concept uses the same idea to collect the ‘learning activity log’ of students in server side. With the analysis of those log data, tutors can get detailed learning activity information and provide suitable guidance in time.

III. RESEARCH DESIGN

A. System Design

This research aims to build a mobile instant messaging system to develop a situation awareness PBL environment for both tutors and students. The proposed system is developed based on AMQP which guarantees the message delivery and acknowledgement. Accordingly, the learning activity instant log include lots of learning data such as message reading timestamp, message reading frequency, message reading geographic information, reading and response time different, learner group response information and learner group geographic information which can be retrieved and analyzed in the proposed system for tutors during the learning activity instantly. Figure 1 shows the detailed system architecture.

The proposed mobile instant messaging system provides the communication function for tutors and students. Tutors can use this tool to perform PBL activity by means of instant chat and guidance. During the learning activity, the system can record the message delivery time and send back the message read time to server. If the student uses mobile device to participate the learning activity, the system can collect the GPS coordinate when the communication take place. In this approach, the system can obtain the message and its related
geographic information. Furthermore, the system can identify the message read time and response time difference which provide more learning situation for tutors as teaching reference.

Fig. 1. Design of the proposed mobile instant messaging system

B. System Architecture

The system is deployed on Windows 7 platform. Tomcat software is responsible for web server communication and RabbitMQ software is in charge of message delivery service. Tomcat and RabbitMQ are installed in the same machine and the internal communication depends on HTTP APIs. There are two client interfaces in the system, web console and mobile device. Both two client interfaces receive message from server side by HTTP and AMQP protocol. In this manner, web console and mobile device can communicate with each other through the message delivery service from server side. The detailed process of each component is shown in Figure 2.

Fig. 2. System architecture of the proposed research.

C. Using Example

The proposed system is designed to assist the process of PBL activity and to obtain the instant learning responses. Followings are the screenshots of the learning activity in different client interface.

Fig. 3. Web-based discussion page in server side.

IV. EXPERIMENT DESIGN AND RESULTS

Responses of students during learning and teaching activity are important for tutors in both traditional and computer-supported teaching contexts. They cannot provide proper learning guides for each group in PBL activity without knowing students’ learning situation and responses, especially in computer-supported learning environment. With real-time monitor on students’ message reading timestamp and message reading frequency, tutors can identify the concentration degree of students towards tutors’ guidance messages. Message reading geographic information and students’ group geographic information provide the information of students’ learning geographic preference. The reading and response time difference suggests the students’ enthusiasm towards the learning objectives while student group response information suggests the group enthusiasm towards the learning objectives. With real-time monitor of students’ learning situation, tutors can understand the learning attitude of students and then provide appropriate learning materials and teaching strategies for them.

Furthermore, we invite several experts to explore the proposed system and evaluate the effectiveness of the mobile instant messaging system by replying questionnaires. A total of 10 experts who have strong academic backgrounds, research experience and professional in the area of mobile learning research were invited to participate in the experimental assessment. The response portion of each question in the questionnaire was designed using a 5-point Likert scale. Typically, an item in a Likert scale is given as a statement and the invited experts need to respond the statement using a scale from 1 to 5, in which 5 stands for “strongly agree” and 1 stands for “strongly disagree”. The 5 level responses also stand for the score of each question thus we can calculate the mean value of each item. The questionnaire item and statement includes:

1. Help me monitor the responses of students in a PBL activity.
2. Help me acquire the learning activity information.
3. It is easy and convenient for me to understand the concentration degree of specific student.
4. It is easy and convenient for me to understand the enthusiasm degree of specific student.
5. The mobile instant messaging system provides the authentic context of the learning situation for me.

6. The mobile instant messaging system provides the organized learning groups information for me.

The responses data from experts were collected from online questionnaire system and it can be further analyzed and discussed. The statistical results were presented in Table 1. The 5th column describes the percentage of each item score that are greater or equal to 4.

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Variance</th>
<th>Score ≥ 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.350</td>
<td>0.735</td>
<td>0.541</td>
<td>85%</td>
</tr>
<tr>
<td>2</td>
<td>4.350</td>
<td>0.699</td>
<td>0.489</td>
<td>87.5%</td>
</tr>
<tr>
<td>3</td>
<td>4.275</td>
<td>0.784</td>
<td>0.614</td>
<td>80%</td>
</tr>
<tr>
<td>4</td>
<td>4.350</td>
<td>0.769</td>
<td>0.592</td>
<td>82.5%</td>
</tr>
<tr>
<td>5</td>
<td>4.425</td>
<td>0.675</td>
<td>0.455</td>
<td>90%</td>
</tr>
<tr>
<td>6</td>
<td>4.375</td>
<td>0.740</td>
<td>0.548</td>
<td>85%</td>
</tr>
</tbody>
</table>

The responses to Item (1) and (2) indicate that the proposed system helps tutors grasp the learning situation during the PBL. This reflects that the system can be used for an assistant learning tool in PBL activities. The responses to Item (3) and (4) indicate that the proposed system provides students’ learning attitude with real-time manner. This reflects that tutors can instantly understand students’ learning attitude and then provide the effective learning guidance. However, these two items are relatively low scored among all items. According to the interview with the experts after the questionnaire survey, it reveals that the concentration degree and enthusiasm degree cannot be evaluated only by the static analytic of response counts and response frequency. The response content should be further analyzed to understand the concentration and enthusiasm degrees of students. Finally, the responses to Item (5) and (6) indicate that the proposed system is effective to support the necessary function of authentic communication and the group responses information.

V. CONCLUSIONS

The studies of PBL keep increasing year by year. In a PBL activity, to monitor and understand the learning responses from students are necessary and important for tutors to provide instant guidance or help. For the sake, in this research, we build a mobile instant messaging system for computer-supported PBL activities. There are two major parts of this research: private instant messaging system development and tutors’ situation-awareness in a PBL activity. For students, they can obtain teaching materials which are relevant to learning objectives or discuss the learning concept through mobile devices based on the proposed system. On the other hand, tutors can retrieve students’ learning activity instant log via the proposed system. With the students’ instant learning log, tutors can get the clear view of students’ learning situation in a computer-supported PBL environment. The system is aimed to help tutors provide proper learning guidance and dynamically tune teaching strategies in a real-time manner. Finally, the questionnaire results support the situation-awareness feature of the proposed system. However, the results also indicate that students’ response content should be analyzed to get further explanation.

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