Developing Rubrics for Assessing Questioning Ability in Ubiquitous Problem-based Learning

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Abstract

The purpose of this study is to develop rubrics for assessing questioning ability in ubiquitous problem-based learning (UPBL) labeled as a kind of collaborative learning. Computerized ecology observation competence assessment (CEOCA) was integrated into three trips of Chiku Wetland as validity indicator of rubrics. 32 elementary students were assigned to participte in the study to do field observation and on-line discussion. On-line records were used to explore students' questioning ability across seven months. The premilinary analysis results of reliability and validity for rubrics scoring reveal that the consistency of scoring is stable and the effectiveness of scoring is validated.
Keywords: scientific inquiry, Collaborating Learning, Ubiquitous Problem-based Learning, questioning

1. Introduction

For last decades, collaborative learning has been seen as an effective teaching methods and learning strategy [9][15]. Various collaborative learning techniques and instructional skills have been developed and applied in different learning scenarios, such as Jigsaw II [17] or learning together (LT) [9], for fostering learning and elaborating teaching. A large number of studies have showed the benefit to learners not only in improving the cognitive achievement but also the motivation and peer relationship[16].Recently, following the rapidly advancement of information technology, the computer-supported collaborative learning (CSCL) has become a potential direction to scaffold students' critical thinking and problem solving[6][10][11][13]. Many researchers believed that a computer system could serve as a moderator in collaborative learning activities[21]. Furthermore, mobile technologies have also become more popular used for collaborative science inquiry because the advantages of portability and information retrieval can occur at anytime or anyplace [7][8][19]. In the study, the smart mobile and the computer are both used for students to do ecology observation and scientific inquiry. Therefore, the collaborative learning task in the study is named as ubiquitous problem-based learning (UPBL).

Accordingly, learners can discuss with peers in different places simultaneously and search for relevant data or useful information on worldwide web. Several researches indicate the flexibility of this learning approach. For example, Hung, Hwang, Lee, & Wu [5] claimed that collaborative learning can effectively improve the 5th graders' skills of refining scientific questions in ubiquitous problem-based learning. In the study, we mainly focus on the questioning ability within the collaborative competence. Many researchers have been indicated that questioning ability is not only an integral part of scientific inquiry, but also one of the higher- order learning processing skills which is structurally embedded in the thinking operation of critical thinking, creative thinking, and problem solving[2][4]. Chin & Osborne[1]even suggested that for students who learn science, their questions have the potential to (a) direct their learning and drive knowledge construction; (b) foster discussion and debate, thereby enhancing the quality of discourse and classroom talk; (c) help them to self-evaluate and monitor their understanding; and (d) increase their motivation and interest in a topic. Because

the importance of questioning, we try to assess the ability in collaborative scenario. Some researches also have been evaluated learners' collaborative learning competence by classroom observation or peer questionnaire, some even just concentrates on the products or cognitive process performance [3][12] [14] [18].

Based on the described above, the main goal of this study is to develop rubrics for assessing questioning ability in ubiquitous collaborative learning scenario. On the other hand, we will do preliminary analysis of reliability and validity for the rubrics.

2. Method

2.1. Participants and procedures

There were 32 fifth and sixth graders participating UPBL study. The participants were divided into 8 groups. Three UPBL field observation activities were arranged within 5 months (as shown in Table 1). The UPBLS was developed under the assumption that most students will start with intuitively interesting questions, which may not be workable or science relevant. It is expected that, via discussing, collecting data and sharing ideas, the students will be able to successfully interactive with other team members, refine their question, and finally solve the group's problems (see Figure 1).

For the observation purpose, each participant was equipped with a smart phone, which was used to interact with the learning system as well as gather data to accomplish the PBL tasks. Most participants enjoy using the equipment to record, take notes and photos, search for data from the e-library, submit what they observed in the field, and share findings with team members. After each field observation and discussion, the participants were asked to finish learning diaries on the websites, based on what they have collected and learned.

Table 1. The research stages for UPBL

Date	Stages	Activity
2010/11 to 2010/12	Anchored Instructions	a. Introduce of Chiku Wetland b. Application of smart phone c. Operation of instruments
2010/12 to 2011/1	Inquiry Activities1	a. First trip to three different location of Chiku Wetland to Investigate the characteristics of water b. sharing initial thoughts about the inquiry problems
2011/1	Test 1	1st CEOCA Administered
2011/1 to 2011/3	Inquiry Activities 2	a. Second trip to Chiku Wetland b. Sharing revised inquiry plans and measurement data
2011/4	Test 2	2nd CEOCA Administered
2011/4 to 2011/5	Inquiry Activities 3	a. third trip to Chiku Wetland to execute their plans b. sharing their preliminary results and revised plans
2011/5	Test 3	3rd CEOCA Administered
2011/6	Oral presentations	Face to face discussions

2.2. The Ubiquitous Problem-based Learning System (UPBLS)

The group task is the central working area in UPBLS. It provides the basic function for editing the notes, diaries, and reports. Besides the central group task area, UPBLS provides three functions: On-line discussion function for helping students reflect, clarify, stimulate, and monitor their inquiries (see Figure 2), Green Lab developed by a research team in Linnaeus University, Sweden for presenting and sharing the collected data, such as salinity, ph value, dissolved Oxygen of water, turbidity and temperature in three different areas (see Figure 4) [20], and an e-library for helping the students to refine their problems via searching for information when describing and recording the findings about the creatures of the ecology environment(see Figure 3). The UPBLS works as both a learning tool and a collaborating tool. With the assistance of UPBLS' functions, students initiate their intuitive problems, and then refine them to workable problems, finally shape up scientific problems.

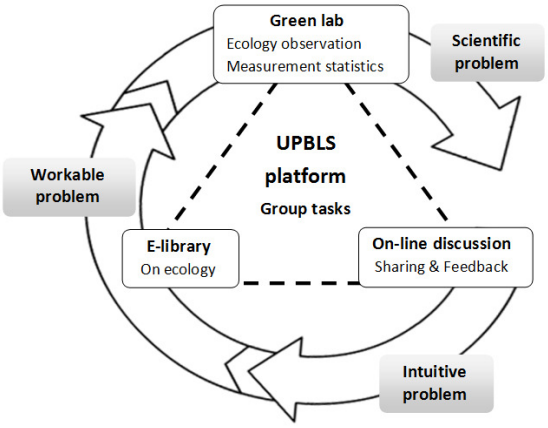

Figure 1. A triangle model for UPBLS design.

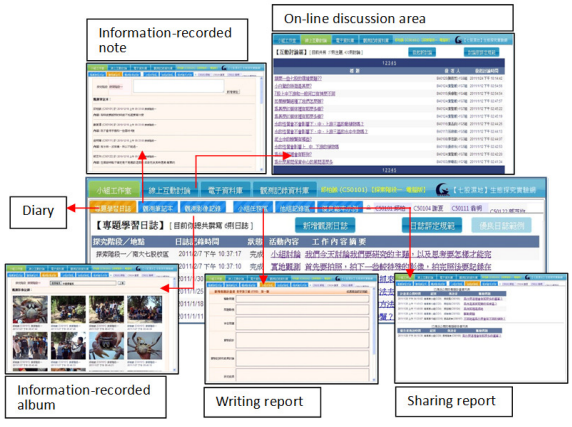

Figure 2. The interface of group tasks and on-line discussion

Figure 3. The interface of E-library

Figure 4. The interface of Green Lab

2.3. Computerized ecology observation competence assessment (CEOCA)

In this study, CEOCA, developed by Hung, Hwang, Lin, Hung and Wu [22], was integrated into field inquiry activities to investigate the characteristics of students' scientific inquiry ability and progress. The facets included in CEOCA are knowledge, observation, concept mapping of wetland ecology. Participants were administered CEOCA for 3 times.

2.4. Rubrics for assessing questioning ability

The scoring rubrics of questioning ability are divided into four parts: positive question posing, assistance in question posing, positive question correcting, and assistance in question correcting, as shown in Table 2.

Table 2. Scoring Rubrics for questioning ability

Dimensions	score	Content and Example
Positive Question Posing		
positive learning interaction	1	Posing questions that can promote learning, Such as: strategies for collaboration Ex: what can we do when group members argued?
actual question	1	Posing questions that are based on prior knowledge or observation Ex: what does wetland function ?
procedural question	2	Posing question about scientific experimental sequence Ex: How to measure the humidity of soil
science concept question	3	Posing questions that are based on scientific concept Ex: Does the humidity of ditch affect the subsistence of crabs?
Assistance in Question Posing		
positive learning interaction	1	Posing questions that can promote learning, Such as: strategies for collaboration Ex: RE: Does anyone know how to measure the humidity of soil? I advise u can consult the expert
actual question	1	Posing questions that are based on prior knowledge or observation Ex: Does the answer differ from what the creature in wetland need?
procedural question	2	Posing question about scientific experimental sequence Ex: RE: how to measure the amount of Dissolved oxygen? Can we steam the oil, then use the instrument to measure the water steamed from soil?
science concept question	3	Posing questions that are based on scientific concept Ex: RE: how many kinds of fish in the pond? Why do u take this question as inquiry problem?
Positive Question Correcting		
accuracy/ elaboration	3	Posing question or provide information that can help focus the learning content Ex: we have finished measuring the edge length of pond, but how to measure the depth of pond?
promotion/ continuity	3	Posing question or provide information that can help the group elevate or extend the inquiry problem Ex: what's the difference of water quality in different area? Because we found the water quality is different in two areas.
Assistance in Question Correcting		
accuracy/ elaboration	3	Posing question or provide information that can help focus the learning content Ex: You should study the habituation of the crabs before realize the species of crabs
promotion/ continuity	3	Posing question or provide information that can help the group elevate or extend the inquiry problem Ex: RE: so we should insert the Dissolved oxygen meter into the soil? Then we can measure the Dissolved oxygen? No, it cant work! Dissolved oxygen meter is used for water ! not for soil!

3. Result

The main analysis focus on reliability and validity of rubrics developed for assessing questioning ability. In the study, performance on CEOCA is defined as scientific inquiry ability. It is found that growth of scientific inquiry ability ranges from M=.31 to M=.80; moreover, the result of scoring by rubrics shows that the scorer reliability (r=.92) is high. On the other hand, a significant correlation (r=.48 to r=.95, p<.01) between questioning ability and three times scientific inquiry ability is obtained. The correlation coefficient suggests that appropriate validity for questioning scores by rubrics. Furthermore, the correlation between two abilities increases following the CEOCA administered after each activities. The increasing correlation can provide a reasonable pattern for two abilities as validate evidence.

4. Conclusion

This main purpose of this study is to develop effective rubrics for assessing the questioning ability of students

participating in the ubiquitous problem based learning. The results show that the preliminary findings support previous research. As literature mentioned, questioning ability is undoubtedly an essential component of high order thinking skills for learning tasks and as a key stage in the problem-solving process. Therefore, it is necessary to develop the rubrics for assessing the ability in the ubiquitous learning environment. Just like assessment, rubrics should also play a crucial role in helping students improving questioning ability according to score rule specifically defined. Students will benefit from the clear demand of rubrics to improve skill of questioning. To verify the effectiveness of rubrics, analysis of reliability and validity is essential. The results suggest that scorer reliability is acceptable to claim the consistency even different raters applied the rubrics to assess the question ability. The validity of rubrics is verified through reasonable correlation matrix with inquiry ability assessed in different time. Both evidences imply that the rubric is a stable and effective tool for assessing questioning ability. In the future study, it can be implemented for more students to check the stability.

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