

# The Design and Implementation of User-Trust Based Social Review Method and System in Online Learning

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**Abstract**—Homework review is a crucial process of learning in which teachers can assess the learning condition of students and the whole class. Accordingly, teachers can make adjustments for further teaching. However, there are some key problems which make homework review a pressure for teachers, such as large amount of assignments versus teachers' limited time. Under this condition, teachers could not give personalized, immediate and knowledge points based feedback. These result in negative effects on students. Thus, this study proposes a social review method to help teachers review homework more efficiently and timely, while giving social participants with particular credibility in specific subject access to homework review. The credibility is determined by 3 factors including user score, knowledge level of the subject and the review credibility. After the review the result will be visualized. Based on the method mentioned above, a social review system was designed, developed and used in a photographic course. The result indicated that the system was easy to use and satisfied teachers' and students' demands. In addition, the findings demonstrated that this system facilitated the learning process by increasing the effective interactions, reducing the irrelevant interactions and formed some new interaction patterns among students.

**Index Terms**—Social review; Homework; User trust (*key words*)

## I. INTRODUCTION

Homework review is an important event in education area. From that, teachers can overview the condition of the whole class and special students, therefore, they can adjust the instruction accordingly [1]. In recent years, personalized evaluation and immediate feedback have been more emphasized [2]. Under this condition, teachers are confronted with the needs to review homework more detailed and feedback more timely. Thus, they are faced with greater pressures because most teachers must review all homework thoroughly to give fair, personalized and knowledge point based feedback. As there are usually up to 30 students in one class and each teacher usually teaches more than two classes, teachers might spend at least 2 or 3 hours reviewing students' homework supposing each student's homework cost 2 or 3 minutes. Adding the pressure of routine lesson preparation and instruction, it is quite difficult for teachers to give immediate feedback [3]. Even worse, teachers could not provide detailed analysis and problem feedbacks showed in students' homework. Accordingly, this will affect the quality and efficiency of the

homework review [4]. Recently, many researchers have come up with the view that peer assessment can help solve the above mentioned problems, such as improving personalized assessment, process oriented and immediate feedbacks [5]. Moreover, some studies demonstrated that there is no significant difference between peers' and teachers' assessment. These results promote the wider use of peer assessment [6]. However, there are many problems when conducting peer assessment. Different students have different learning levels and assessment levels. For this reason, they might not fully understand the meaning of the assessment rubrics and the result they present would not be so credible [7][8]. As to assure the accuracy and authoritative of homework review, teachers or domain experts are also needed. In order to cope with the above mentioned problems, we referred to crowdsourcing method [9]. Crowdsourcing is a method which allocates the work of specific individuals or organizations to the open public [10][11]. Wikipedia and freebase are all successful examples of crowdsourcing. In academic area, there are also incredible examples of crowdsourcing such as the picture recognition, sex recognition through faces and video or emotion annotation [12]. More incredibly, a crowdsourcing based game named Foldit helped scientists solve a difficult problem about HIV in just 3 weeks [13].

These examples demonstrate the potential of crowdsourcing in solving difficult problems. In this study, the researchers come up with a crowdsourcing homework review method—social review, to reduce the pressure of teachers and ensure the authoritative during process-oriented homework review. We developed a system for conducting this method. Social review means the review process is open and social. Teachers are not the only authentic reviewers and during the process social members with particular domain knowledge and trust are also allowed to participate in the process to reduce teachers' tasks, as well as promote process oriented and timely assessment. More detailed, social reviewers are not confined to subject experts or teachers, students, parents and even the public who have knowledge of specific areas could all have access to homework review. During the period, mechanisms which could ensure the quality of the review are essential to the method [14]. And after the review, the system can give some incentives to the high-quality reviewer, such as increasing the

user score or the trust score in the platform, which will be helpful in promoting social members' participation [15].

In this paper, we firstly designed and developed the social review system and then conducted an experiment in a photographic course in a university in Beijing, China to identify the effects of the system. The effects contain three parts: 1) Do the method and system have a positive effect on students' learning process? 2) Do the method and system reduce teachers' pressure? 3) Is this system being of good usage or ease of use? To answer the first question, we conducted user behavior analysis from the knowledge building view to demonstrate whether social review system would change the behavior of students, for students' learning outcomes could be reflected through their interactions [16]. And with the 2nd and 3rd questions, a questionnaire on students' satisfaction and experience is adopted.

II. DESIGN AND DEVELOPMENT OF SOCIAL REVIEW SYSTEM

The system was designed based on Learning Cell System (LCS, <http://lcell.bnu.edu.cn>) [17][18], a ubiquitous learning platform which can support students' online collaborative learning and collect students' behavior in order to provide adjusted services [19]. LCS has eight features including modularity, dynamic, openness, cohesive, social, evolvable, shareable and contextual. Openness and social are the most important to this study. In LCS platform, homework can be assigned as learning activities. Students participate in all activities the teacher arranged in order to complete the homework. The function of the social review system is to review (grading and feedbacks) the homework assigned in LCS. Social review system contains five modules: homework and reviewer set module, mobile-terminal based homework submit module, homework storage module, user-trust-based homework review module and homework feedback report module. The framework of the system is shown in Figure 1.

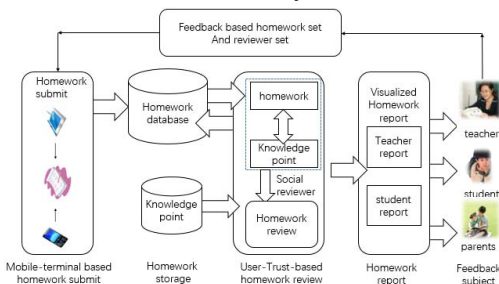


Figure 1. Framework of Social Review System

III. PREPARE YOUR PAPER BEFORE STYLING

A. Homework and Reviewer Set Module

In this module (shown in Figure 2), teachers assign homework based on the feedback of the homework report and set some social reviewers for the following review. At the same time, each homework question or activity is related to one or more required knowledge points, which are preset in the system. During the homework set process, several kinds of homework forms are provided such as traditional work (subjective question and objective question) and activity work

(releasing work, creating a concept map, learning reflection and curation). From the pre form, teachers can have a summative view of the students' learning and from the latter form teachers could have a more detailed view of the students' learning. For example, the releasing work activity requires students to submit a work designed based on what he/she learnt in the class according to the teacher's demand. As the work was designed by each student, it could reflect the student's understanding level of the related knowledge points in this class. For this reason, the teacher could know the students' learning condition from a more process-oriented view. Reviewer set process is a core process and it can be quite flexible. Not only teachers can be reviewers, but also domain experts, students, even parents and social members who have reached particular user-trust-value can be assigned the role of social reviewer. However, their trust-scale in the review will be different according to the user-trust-value in LCS platform. The way to compute the user-trust-value will be introduced in the following parts. Figure 2 shows the details of this module, apart from reviewer set, the teacher must set the review rules. The rules include how many times each work should be reviewed, the max-value of error the review allowed (MError), the min-score representing the student have master the knowledge point and the scale of each part in the homework.



Figure 2. Rule set of social review

B. Mobile-Terminal Based Homework Submit Module

When teachers have assigned the homework, students can complete it with various terminals, including PC, mobile phone and pad. Students can either do the homework via mobile devices or hand writing. For some subjects, like math, if it is not so convenient to complete the work with mobile devices, students can complete it via hand writing, take a photo of it, and then submit to social review system.

C. Homework Storage Module

When homework is submitted by the previous step, the storage module will reserve it into the database and connect it to related knowledge point. Homework storage and management module is mainly to store the homework items, the detail of students' homework and the assessment result of homework. For item storage, the system will save the homework number, item number and related knowledge point. This kind of storage relates the homework item with specific knowledge point and makes it possible to evaluate the homework with knowledge-based process assessment method. Moreover, the storage of questions and homework items help teachers build a user-based question database for future use. And the detail storage is mainly responsible for saving the homework submitted by the students. The assessment results storage records the scores of homework given by the reviewers.

#### D. User-trust-based Homework Review Method

User-trust-based homework review method is the key module, which realizes the user-trust-based homework review to ensure the quality of assessment [20]. The quality assurance process of peer assessment and self-assessment in traditional MOOC system is so complex that many reviewers suffer from the heavy pressure [21]. The review process in this system is shown in Figure 3. There are two ways to ensure the quality of assessment. If the homework is reviewed by teachers or experts, the result will be directly stored into the database. If the homework is reviewed by social reviewers, the result will need to be weighted by the quality assurance mechanism. As all users have trust values in the LCS platform, the formula to calculate the average score of current homework is  $uScore = \sum (S_i * Trust_i) / (\sum Trust_i)$ . The  $Trust_i$  means the trust value of reviewer  $i$ , and  $S_i$  means the assessment score of reviewer  $i$ . The formula of calculating review error is  $ErrorA = \sum (S_i - uScore) / N$ .  $N$  is the total number of reviewer.

If the  $ErrorA$  of one homework is less than  $MError$  set in the first module, the assessment results will be stored in database. Otherwise, reviewer with higher trust level (teacher or expert) will be invited to review this homework. As the result is based on users' trust, the higher is the user's trust, the higher privilege of the user in the review. Meanwhile, when the user's trust value exceeds the lower critical value of the expert's confidence (default is 0.9), the normal social reviewer can be upgraded to an expert. In this system, the user's trust is determined by the user score in LCS (score), the average of his or her homework (evaluate) and the assessment accuracy to other people's homework (review). The formula to measure the trust value is  $Trust = 0.3 * score + 0.3 * evaluate + 0.4 * review$ . The score is calculated based on the ratio of the user's score to the lower critical value of the expert reviewer's score. If the expert reviewer's lower critical value is 6000 and the user's score is  $userScore$ , then the value of score is  $userScore / 6000$  (if more than 1, the value is 1). The evaluate is based on the quality of user's previous homework. If the mean stands for the average score of user's all homework and the total stands for the score of expert's homework, then the user's evaluate is  $mean / total$ . The value of review is mainly measured by the accuracy of the user's evaluation behavior. If the total number of homework assessed by the user is  $n$ ,  $m$  stands for the number of homework whose review error is less than  $MError$ . Then the user's review is  $m/n$ . Through the above-mentioned rules and the quality assurance mechanism based on the users' trustworthiness, this social review system realizes the intelligent quality assurance in students' homework review.

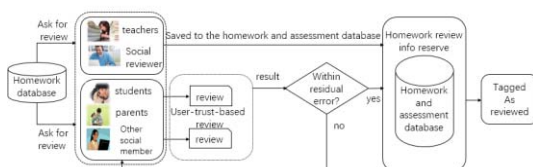


Figure 3. The process of social review

#### E. Homework Feedback Module

Homework feedback module will adaptively and timely generate assessment report for students, parents and teachers. In the report, all feedbacks would be visualized according to different roles. For students, the assessment report mainly focused on the individual performance based on knowledge. For teachers, it focused on not only each student's personal learning, but also the whole class. And for parents, the report only demonstrated the score and ranking of students. Student's visualized result is shown in Figure 4. Students can compare their own score (both total and detailed knowledge) with the whole class (the red color domain represents the class and the blue color domain represents individual).

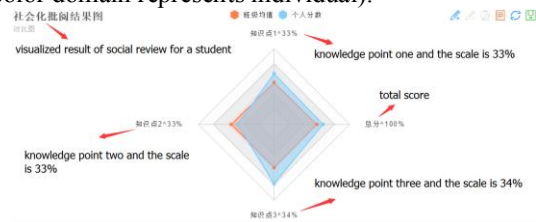


Figure 4. Visualized report for students

## IV. METHOD

### A. Participants

1) In this study, the researchers conducted an experiment in an undergraduate course, Technology and Arts of Photography, in a university in Beijing, China. This course is an offline course, but the homework is assigned, submitted and evaluated online, as well as the discussion about the learning content. All 24 students in the course participated in the experiment, they should do the homework the teacher assigned while they can also anonymously take part in the social review and discussion freely. At the same time the teacher and two graduate students who are familiar with photography act as the regular social reviewers (one graduate student's user score is 7520 as an expert reviewer and the other's user score is 5417 as a high trust level reviewer). Before the course, the researchers told students the detail of the experiment and all of them agreed to participate into the experiment.

### B. Procedures

During experiment of this course, there are two periods. One is the experiment period and the other is the control period. Each period corresponds to a chapter according to the instruction schedule. The experiment period corresponded to the second chapter-technology of photography and the control period corresponded to the third chapter-skills of photography. As the contents and applications of the two chapters are similar, the researcher chose the two chapter. During the experiment period, the teacher should assign a work upload activity (submit photographic works) as homework under the social review environment. When someone has submitted the homework, social reviewers would receive it in the waiting list and can then mark and give comments to it. Then the student could see the feedback timely and accordingly communicate with peers or experts on LCS platform. It should be noted that,

in this experiment, the regular social reviews were the teacher and the two graduate students. Though the students were also included as social reviewers, they can choose to review the homework freely. During the process, the teacher could also view the homework condition such as who have completed the work and the detailed homework report of the class or a single student. Moreover, students can communicate with each other in related lessons in this chapter freely. And compared to the experiment chapter, the control chapter only assign the work upload activity (submit photographic works) as homework under general homework review environment. After one homework was submitted, only the teacher would review the homework and give feedbacks. Similarly, the students could see the feedbacks when the teacher have reviewed his/her homework and they can also communicate on LCS platform. After the experiment, a questionnaire was used to test if the system is of good usage and ease of use. At the same time, students' online comments were collected to analyze the interaction behaviors with and without social review.

C. Instruments

**Coding scheme:**In this study, the researchers mainly use the comment interaction behavior to measure students' participation and knowledge construction level. The coding scheme developed by Gunawardena, Lowe and Anderson is widely used [22]. The scheme divided the knowledge construction process into 5 phases: 1. sharing and comparing information about the learning content, 2. discovery and exploration of dissonance or inconsistency, 3. negotiation of meaning and co-construction of knowledge, 4. testing and modification of the proposed synthesis and co-construction, and 5. agreement statement and applications of newly constructed meanings. The five dimensions illustrate five different contributions. However, in collaborative learning, there are many behaviors which are irrelevant to the learning tasks. So this study added the 6th dimension to describe these behaviors. The first 5 dimensions describe the meaningful interaction and the last dimension describes the irrelevant interaction. The coding scheme is shown in Table 1.

All comment behaviors during the photographic course was collected and coded according to the coding scheme. Two doctoral students coded these comments according to the coding scheme to ensure the consistency. The value of Kappa is .741, which suggests the coding is of good credibility.

Table 1: Coding scheme for knowledge collaborative construction behavior

Code	Descriptive Dimension	Examples for Behavior
S1	Sharing/comparing of information	Creating or sharing the new points of view (such as definition) or resource. Such as Focus can divide into AF and MF.
S2	Discovery and exploration of dissonance or inconsistency among	Discover or propose the confusion to a question or phenomenon. Such as I'm so confused of the AF

S3	participants Negotiation of meaning/co-construction of knowledge	concept. Negotiation or complementary of one concept. Such as if you use small depth of fields, you'd better choose AF because...
S4	Testing and modification of proposed synthesis or co-construction	Statement of the problem in using the platform. Such as why I could not download the xx resource?
S5	Agreement statement(s)/application of newly constructed meaning	Agreement of one point of view. Common sense. Such as focusing is a quite important thing in photography.
S6	Other interactions with no relations with the reading task	Irrelevant information. Such as, very good. I have got a lot from it. Or other things do not have relation with the learning content.

**Questionnaire of usage and ease of use:** The questionnaire was revised from a widely used questionnaire [23]. It is 5-point questionnaire with 13 items. 1-6 test the cognitive usage of the system and 7-13 test the ease of use.

V. RESULTS AND DISCUSSION

After coding, researchers analyzed the comment data. For experimental chapter, there are 4 lessons and the total number of comments is 314, 78.5 for each lesson. For control chapter, there are 197 comments for all 6 lessons, 33 for each lesson. So with social review, learners have more interactions related to the learning content. For the 6 dimensions in the coding scheme, the comment data is shown in Figure 5. We can see in experimental chapter the total number of S1 interaction is 135, S2 is 28, S3 is 44, S4 is 11, S5 is 77 and S6 is 18. In control chapter, S1 is 95, S2 is 4, S3 is 8, S4 is 6, S5 is 41 and S6 is 44. As the first 5 dimensions describe the meaningful knowledge building, the experimental chapter had significant more comments than control chapter while in the last dimension, the control chapter exceed the experimental chapter. This result showed that the experimental chapter had more efficient and meaningful interactions during the learning process.

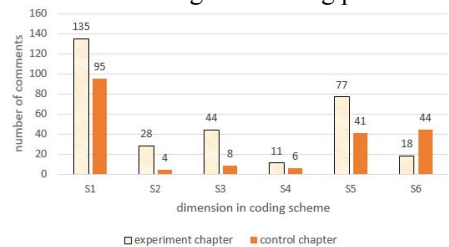


Figure 5. Comparison of number of comments between experiment and control chapters

At the same time, researchers coded the comment behaviors according to the time sequence and conducted an analysis with GSEQ, a software for the analysis of interaction sequences. The result is shown in Table 2 and Table 3. Result shows that

in experimental chapter, there are some typical behavior sequence ( $Z$ -score $>1.96$ ),  $S1 \rightarrow S1$ ,  $S2 \rightarrow S2$ ,  $S4 \rightarrow S4$ ,  $S5 \rightarrow S5$  and  $S6 \rightarrow S2$ (Figure 6). However, in control chapter, there is no significant behavior sequence. This demonstrates social review method had helped with the learning process. So the first question (if the social review system has positive effect on students' learning process) has been confirmed.

Table 2: Frequency Table

Frequency		S1	S2	S3	S4	S5	S6	Total
Experimental Chapter	S1	68	11	18	2	28	6	133
	S2	7	7	1	2	6	5	28
	S3	20	2	10	0	11	1	44
	S4	1	2	2	3	0	3	11
	S5	29	3	11	1	27	5	76
	S6	9	3	2	0	6	2	22
Total		134	28	44	8	78	22	314
Control Chapter	S1	41	2	4	4	16	26	93
	S2	3	0	0	0	1	0	4
	S3	4	0	1	0	2	1	8
	S4	2	0	1	0	2	1	6
	S5	18	2	1	0	11	7	39
	S6	24	0	0	2	9	12	47
Total		92	4	7	6	41	47	197

Table 3: Adjusted residual table (Z-scores)

Z-score		S1	S2	S3	S4	S5	S6
Experimental Chapter	S1	2.6*	-0.34	-0.21	-1.01	-1.33	-1.48
	S2	-1.98	3.13*	-1.67	1.62	-0.44	2.36*
	S3	0.4	-1.1	1.8	-1.16	0.03	-1.33
	S4	-2.29	1.1	0.41	5.3*	-1.94	2.68
	S5	-0.91	-1.75	0.13	-0.78	2.48*	-0.17
	S6	-0.17	0.81	-0.69	-0.79	0.27	0.4
Control Chapter	S1	-0.7	0.11	0.54	0.97	-1.18	1.28
	S2	1.15	-0.29	-0.39	-0.36	0.21	-1.13
	S3	0.19	-0.42	1.4	-0.51	0.3	-0.77
	S4	-0.67	-0.36	1.76	-0.44	0.77	-0.42
	S5	-0.08	1.53	-0.37	-1.24	1.27	-0.97
	S6	0.69	-1.13	-1.51	0.55	-0.32	0.31

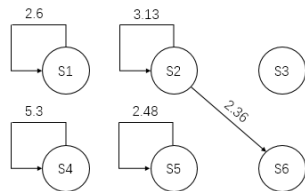


Figure 6. Behavior transitions in experimental chapter

More detailed, we can see there are more effective comment interactions and less irrelevant comments in the experimental chapter. This indicates that when there are timely and process-based feedbacks, students can have better reflection or discussion and contribute more to the learning content [17][24]. The interaction pattern  $S1 \rightarrow S1$  represents

when student propose a concept or a resource, this may cause more similar operation and promote interactions. And social review may promote the occur of this behavior because with timely and process-based feedback students can reflect timely and deeply [25].  $S2 \rightarrow S2$  and  $S2 \rightarrow S6$  patterns are very interesting and easy to explain. When a student's homework is evaluated, the student will be likely to propose confusions according to the feedbacks. And when the confusions are proposed, other students will be more likely to take part in the discussion, then there will be more questions proposed [26]. And at last, when all problems are solved, the discussion will come to an irrelevant topic.  $S4 \rightarrow S4$  reflects questions or answers with platform will cause more related questions or answers, this is for the complexity of the platform, many students would spend some time to communicate with students to get familiar with the system.  $S5 \rightarrow S5$  is clear because in lessons with lots of common sense, agreement comments will be formed easily. So social review system could have positive effectiveness on students' learning process.

For the second question, not only two preset social reviewer completed the review task, in each lesson there are about 5 students completed the task as social reviewers. So with these help, teachers' pressure can be reduced. And in the above mentioned questionnaire, the 5th question asked if this system will reduce the teacher's pressure and the average score is 4.4 which means the system performs quite good in reducing teacher's pressure. After the experiment, the researchers asked the reviewer for what reason do you think the system can help reduce the teachers' pressures. The answers include two factors. The most important one is the help of social reviewers and the other is the help of the visualized report.

As to the third question, the researchers used a questionnaire to test the usage and ease of use of the system. The researcher send questionnaire to all 24 students and received 11. After computing the means of the two dimension, all mean values are between 3.8-4.3. For cognitive usage, the mean is 4.21 and for ease of use, the mean is 4.01. This result demonstrates the social review system is of good usage and ease of use. So the system can reduce teachers' pressure, provide immediate, personalized and process-based feedbacks and promote the learning process of students.

VI. CONCLUSIONS AND SUGGESTIONS

Homework is an important process in evaluating students' learning. With the emphasize on personalized assessment and timely feedback, teachers are confronted with greater pressure. Because with limited time, teachers could not conduct process-based assessment on each homework or give immediate and individual targeted feedback. This caused the phenomenon that students know little about what they should do to improve their learning after seeing the feedback, especially with the delayed feedback [4]. Under this condition, the social review method and system is developed to help teachers review the homework and provide immediate and personalized feedback. The system contains 5 parts: homework and reviewer set module; mobile-terminal based homework submit module; homework storage module; user-trust-based homework assessment method;

homework feedback module. To verify the effect of the system and method, 3 questions were proposed. The result of this research has demonstrated the positive effectiveness of the system in promoting the learning process by increasing the interactions. Compared with the control chapter, the experimental chapter has more comment interaction and more forms of interaction pattern, such as  $S1 \rightarrow S1$ ,  $S2 \rightarrow S2$ ,  $S4 \rightarrow S4$ ,  $S5 \rightarrow S5$  and  $S2 \rightarrow S6$ . What's more, the meaningful interactions are significantly better in the experimental chapter while comments that are irrelevant to the learning content are reduced. At the same time, with more social reviewers participating in the review, the teachers' pressure can be reduced. At last, the questionnaire showed the social review system is of good usage and is ease of use.

Social review system has contributed much to students' learning process and teachers' homework review. It will be a good example for further researchers. However, in this study, the researcher only predicted the effectiveness from comment interactions, the final performance of the students is not considered. In further study, we will conduct an experiment with more students to verify this aspect.

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