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Easy Collaboration Process Support System Design for Student Collaborative Group Work: A Case Study

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Abstract

Collaborative case studies and Computer Supported Collaborative Learning (CSCL) play an important role in education now. Researchers find that Computer Assisted Collaboration Engineering (CACE) and Process Support Systems (PSS) can support the collaborative process well. There is little research indicates that what kind of CACE is useful to support the group case studies in the CSCL settings. In this paper, we design an easy and simple PSS to support college students' collaborative group case studies and find out whether the system can work well. We basically do the system analysis with the Seven-Layer Model of Collaboration (SLMC) model and CACE/PSS. Then the Discussion Platform for student case studies is developed with the agile method on the WAMP platform (Windows/Linux+ Apache+ Mysql+ Php). Finally, the PSS has been tested in a case study of a China university course throughout one semester by 9 student groups. Survey data has been collected to evaluate the system and generate conclusions.

1. Introduction

Case-based teaching and learning are increasing popular ways in education [1], especially in business education [2]. Case studies can provide students with opportunities for interpretation, analysis, inquiry, and problem solving [1, 3]. In case studies, students in fact engage in the types of processes that actually make collaboration a valuable learning activity [4].

CSCL (Computer Supported Collaborative Learning) [5, 6] refers to create a collaborative learning environment by using computer technology to stimulate students to discuss information and problems from different perspectives, to re-construct and co-construct knowledge or to solve problems. Nevertheless, CSCL also faced with some problems such as inefficiency and ineffectiveness [7].

Data from field experiments has shown that provision for support of collaboration processes, such as the Group Support System (GSS) technology, can improve the efficiency and effectiveness of collaboration [8]. However, researchers also find that how students can develop collaborative problem-solving skills is dependent upon technologies and case-based teaching principles [9]. In addition, people without specialized group process training often find it hard to use GSS tools effectively to reach their goals [10]. Although professional facilitators can significantly enhance effectiveness and efficiency of GSS [11], expertise facilitators are not feasible for CSCL since trained facilitators require a large set of tasks and responsibilities to help organizations optimize their productivity, which requires them to have complicated skills and extensive training [12].

In order to improve collaboration support, researchers find that Computer Assisted Collaboration Engineering (CACE) and Process Support Systems (PSS) are useful approaches that can provide teams with sufficient understanding of how to use those technologies to attain their goals [13].

Although there are many research in collaborative case studies, CSCL and CACE, there is little research indicate that what kind of CACE is easy to design and to be used by college students to collaborate in the case studies. Therefore, in this study, we try to perform the following tasks: 1) Design an easy and

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simple PSS to support university students collaborative case studies; 2) Develop the PSS with low cost and short developing life cycle; 3) Find out whether the designed process can be easy enough to support the CSCL and improve effectiveness and efficiency of the case studies.

In the following sections, we will first review the literature to present a more detailed description of the theoretical background, followed by the collaboration system design. We then talk about the case study and analyze the results from a quantitative approach. We conclude, by addressing the implications and limitations of our study, and present ideas for further research.

2. Background

2.1. Computer assisted collaboration engineering

According to Briggs et al. [13], there are at least three strategies to advance collaboration support. The first strategy is to simplify collaboration tools which often tends to only focus on specific collaborative activities rather than provides users with a complete collaborative work practices [14], such as Google Docs, Skype. All these mass market tools do not target the specific needs of a collaborating group [14].

The second strategy is to increase the transferability of facilitation skills. Researchers have documented some collaboration techniques that are readily transferable to non-professionals, such as thinkLets [14-16]. However, users have to figure out how best to support a particular thinkLet each time since there are little current collaboration technologies to support thinkLets directly [17].

The third strategy is to build facilitation support into the technology which is named Collaboration Engineering (CE) method. CE could be considered as a combination of facilitation and design, which aims to create collaboration processes by using collaboration support tools such as GSS without the professional facilitators [18-20].

To better fit the current requirements of the group by combing these three strategies, CACE is proposed, which provides collaboration engineers with a rapid application development (RAD) environment in which they design collaborative work practices and configure collaborative components into applications to support those work practices [13].

2.2. Collaboration systems

There are produced hundreds of articles on the use of group support systems (GSS) to improve group effectiveness and efficiency [8, 21-22]. However, few tools support complete collaborative work practices [23]. As users of collaboration technology are not educated in the principles of collaboration science, Briggs et al. [24] propose that the next generation of collaboration technologies could present users not just with tools, but with well-designed work practices and they call the practice centric technologies as Process Support Systems (PSS). In 2010, Briggs et al. [13] then put forward facilitator-in-a-box approach, or CACE/PSS, where fully documented collaborative applications encapsulate effective work practices and guide teams through step-by-step group activities. Field results suggest that the CACE approach reduced collaborative application development time [13]. Then, Mametjanov et al. [23] present Action-centered Rapid Collaborative Application Development and Execution method (ARCADE) which enables rapid development of collaborative applications that is 10^4 times faster than conventional GSS development practices. In 2012, Collaboration Support System (CSS) is proposed which combines CACE for creating Process Support Applications (PSA) with a PSS [25].

A rigorous theoretical approach to the design of collaboration technology and process can help us avoid intuitive design choices and we can use a technology in ways to deliberately cause better (or worse) outcomes [26]. Therefore, we will use the theoretical method to design our simply collaboration systems for students case studies.

Table 1. Key concepts mentioned definitions

Concepts	Definitions or explanations
CSCL (Computer Supported Collaborative Learning)	Create a collaborative learning environment by using computer technology to stimulate students to discuss or to solve problems. [5]
GSS (Group Support System)	Socio-technical systems consisting of software, hardware, meeting procedures, facilitation support, and a group of meeting participants engaged in intellectual collaborative work.[22]
CACE (Computer Assisted Collaboration Engineering)	A CACE provides collaboration engineers with a rapid application development (RAD) environment in which they design collaborative work practices and configure collaborative components into applications to support those work practices.[13]
PSS (Process Support Systems)	The outputs of the CACE are PSS software applications that support specific work practices and documentation for the work practices and the PSS applications that support them.[13]
PSA (Process Support Applications)	A conceptual approach toward packaging collaboration expertise with collaboration technology. [25]
CSS (Collaboration Support System)	Combines a CACE environment for designing and building PSAs with a PSS, a runtime environment for acquiring, managing, and using PSAs. [25]

Table 1 provides definitions about some key concepts mentioned in this paper.

3. Collaboration system design

The architecture of the “facilitator-in-a-box” strategy consists of two parts: design and execution [13]. In the design stage, we first use a Seven-Layer Model of Collaboration (SLMC) [24] to afford a multidimensional separation of concerns to collaboration system. Then we consider the five elements of CACE tools to design our simple case studies support platform—Discussion Platform. We then show our UDM-based data store and stress how the PSS is easy enough to develop and cost acceptable for students case studies.

3.1. SLMC and CACE

We use the Seven Layer Model of Collaboration (SLMC) [24] to define some important concerns.

- Goals: the Discussion Platform aims to enhance efficiency, effectiveness and satisfaction in collaborative case studies.
- Products: it will create both tangible products (such as case solutions) and intangible products (such as tangible products or gaining multiple perspectives).
- Activities: sub-tasks will at least include planning, idea generation, idea organization and idea evaluation.
- Patterns of Collaboration: Generate Reduce, Clarify, Organize, Evaluate, and Build Commitment
- Techniques: It mainly consists of planning, brainstorming, category, voting, deleting, evaluating, time keeping, and synchronous text communication techniques. These basic techniques can be organized to use as thinkLets.
- Tools: in our PSS we will use the simple Discussion Platform as the tool.
- Scripts: we will tailor the thinkLet script or replace it completely, yet still invoke the same patterns of collaboration. The participants can also download their meeting record scripts from the website.

Following are the elements of CACE [13] and our easy solution to develop Discussion Platform.

Table 2 shows the elements of CACE with descriptions.

Table 2. Elements of CACE

Elements of CACE	Descriptions	Discussion’s easy solutions
Technique Editors	A collaboration engineer can draw an item from the techniques repository and use it to instantiate automatically an activity for the group.	The collaboration engineer has a control panel which contains several basic techniques such as launching a poll, announcing results.
Logical Design Editors	A collaboration engineer can define and model the group goals, as well as specify steps a group must follow to achieve their goals.	When the meeting room is created, the collaboration engineer can input schedules and limited time while in the meeting these schedules can be reset.
Physical Design Editors	A collaboration engineer can quickly create a customized application tailored to a group’s precise needs for each activity in a work practice.	The collaboration engineer can use buttons in the control panel to customize process in each step.
Screen View Editors	A collaboration engineer can decide which tools and controls should appear where on the screens of people in a particular role for a particular activity.	Since case studies group is small and only have two roles: collaboration engineer/facilitator and participants, we decide omit screen view editors to simply the website design. However, in the Discussion platform, you can see who is on the meeting now
Documentation Engine	A collaboration engineer can document collaborative work practices.	Everyone can download the document from the Discussion Platform which contains practitioner scripts, participant instructions, agendas, ideas and categories, etc.

3.2. Simple data store

As the collaboration systems are highly interactive systems, where many users often manipulate the same data objects at the same time, a database management system (DBMS) is a good way to guarantee integrity of data and reduction of conflicts [27].

Figure 1 provides a skeletal view the ER diagram reference A Universal Data Model (UDM) which dynamically create and store arbitrary relational data in a fixed set of database tables [23]. There are just seven entities in the database and their relationships are extremely simple. However, it can meet with all requirements of the Discussion Platform.

3.3. Low cost and simple developing method

Actually, the Discussion Platform is developed by third-year college students majoring in information system program. In order to make the PSS easy to develop and has a short development cycle, the team uses agile method [28]. Each time when the Discussion Platform have been tested in case studies, the feedback will be collected and the develop team will start to improve the PSS to guarantee it will meet with the requirements when students are doing collaborative case studies. The first version of the Discussion Platform is developed within 32 working hours with three team members.

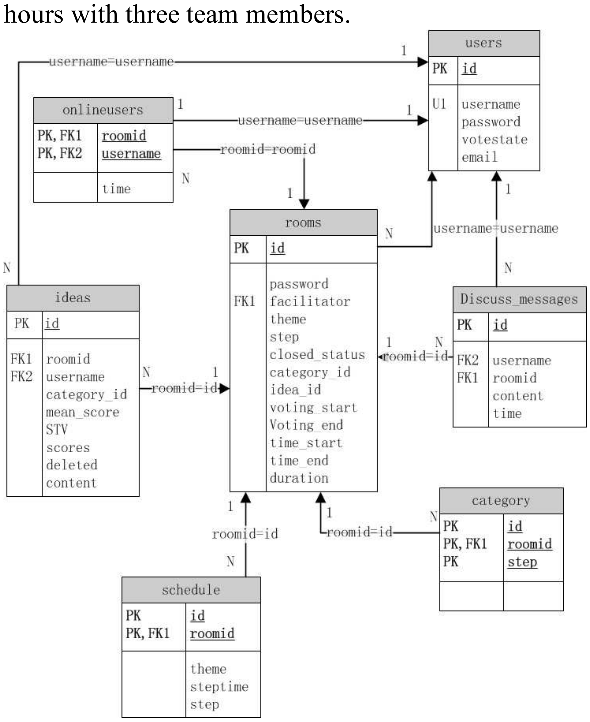


Figure 1. Database relationship diagram

In China, most college students live in campus which has been embedded with the campus intranet and internet. Each PC could be allocated with a unique IP address. Most students use Window systems and Web browsers in their personal computers or laptops. Therefore, the Discussion Platform is developed to be run in WAMP environment, which is a free and powerful Web application platform. WAMP means Windows/Linux, Apache, Mysql and Perl/PHP/Python, a group of open source software which is commonly used to build dynamic Web sites or servers. Although they are independent programs, they now have an increasingly high degree of compatibility because they are often used together.

By using WAMP, each student can use his personal computer as a server easily. If only one facilitator open his own PC server and tell their team members about the URL or IP address, everyone can log on the Discussion Platform easily by using Web browsers such as Internet Explorer, Chrome, Firefox. All data will be recorded in their local database in their PC server. Therefore, the Discussion Platform is not only easy to develop, re-develop and use, but also simple enough to be installed by everyone.

In our experiments stage, we just install the Discussion platform in the module pubic server which can help us to collect data about students' case studies processes. Figure 2 shows the experiments procedures.

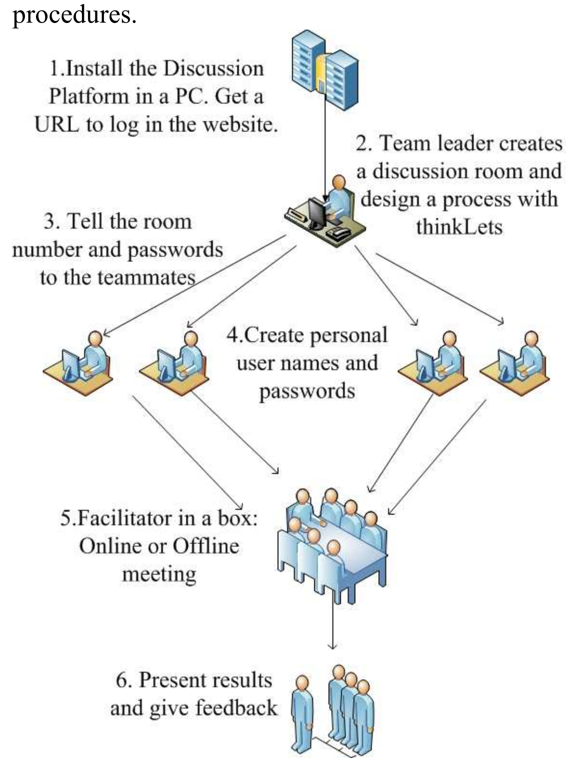


Figure 2. Experiments procedures

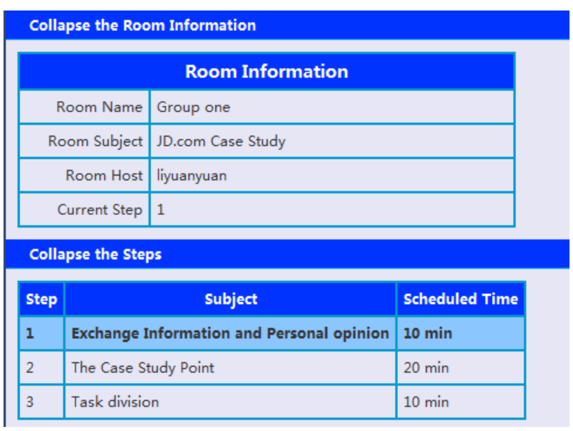
Students can register their own usernames on the Discussion Platform and group leaders/ facilitator can create their own discussion rooms. When the group intent to the do the collaborative case study, their will log on a specific discussion room with the unique room ID and password which are set by the group leader. The group leader will also set some important information such as customized room names, subjects, passwords and discussion schedules when he creates new discussion rooms, so the case studies can follow schedules step by step. The group leader can use Operating Buttons (such as voting, time keeping, move to next step) to design their own collaborative process.

In order to save space, we use a collapsible design, so users can collapse some modules if they are not going to use them. The first version of the Discussion Platform just has five modules in a discussion room. The Operating Buttons module is only visible in the team leader's interface, which help the team leader to start a vote, end a vote, announce vote results, go to next step, end the countdown, start a countdown, modify information of current step and modify subject of the room.

In Figure 3, it shows the Operating Buttons module.

Figure 3. Operating buttons module

The Room Information module will show the room name, subject and the leader's username to the team member. The information module is just like an announcement board which can be changed immediately. The Steps module shows which step the room is in and the Subject and Scheduled Time which can also be changed immediately. These two parts are shown in Figure 4.


Collapse the Room Information

Room Information	
Room Name	Group one
Room Subject	JD.com Case Study
Room Host	liyuanyuan
Current Step	1

Collapse the Steps

Step	Subject	Scheduled Time
1	Exchange Information and Personal opinion	10 min
2	The Case Study Point	20 min
3	Task division	10 min

Figure 4. The room information module & the steps module

In the Chat Box & Idea Generation Box module, you can chat with others, see who is online now, pay attention to the countdown and create the new ideas in formal. The new idea created will show in the idea module which is separated with the chat box. Please see Figure 5.

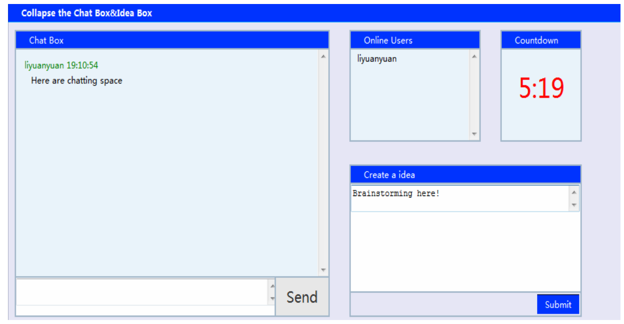


Figure 5. Chat box & idea box module

In the ideas module, you can see the new ideas you create before with creator's username. When the facilitator starts a vote, you can choose a score range from 1 to 5 here. When a voting result is announced you can see these ideas will be ranked by mean scores and standard deviations. You can also move ideas to new categories in this module (see Figure 6).

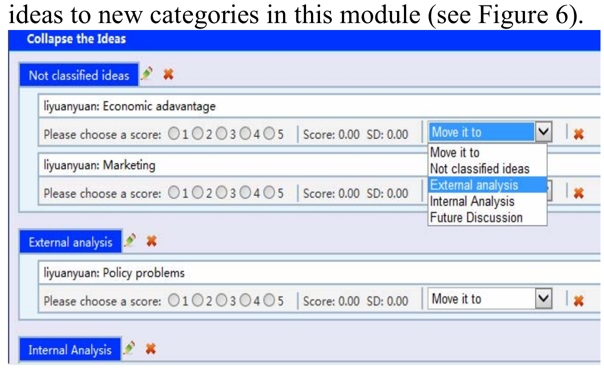


Figure 6. The ideas module

During the meeting, members can choose log out, exit the room or download the meeting record from links.

4. Case study and validation

In order to validate that the untrained college students could do team collaboration successfully supported by Discussion Platform, we conducted a case study of undergraduate students in an e-business course at a university in China. In this case study, students only learned the basic CE knowledge in their course, but had no prior experience with the Discussion Platform.

This case study design refers to previous similar research [28-31]. The 41 undergraduate students (17 of them are male) were divided randomly into 9 groups to collaborate for the same case study throughout one semester. Each group was composed of 4-5 students. The aim was to help students to connect theoretical principles to situated problems by analyzing a Chinese e-business website. In this case, students had to collect information about the website by their own, find out problems and give solutions based on the theories and using thinkLets. They were required to give a presentation about the problems finding in the mid-term and write an analysis report about the problems and solutions before the final exam. In other words, the case study task lasted for a whole semester for 4 months. Students were required to gather information (news, reports, and data) about a target E-business Company and gave completed reports about case studies results.

As group work process often include different activities like sense making, goal setting, product definition, solution generation and evaluation, negotiation, decision making, planning, co-production, and action review [13], we will not design all collaboration processes for students. Instead, we provide them with some course materials with how to use thinkLets on the Discussion Platform and how to design a reusable process by their own. In class, students learned more details about some basic thinkLets [32] like *FreeBrainstorm* and *Onepage* (to motivate the generation of many ideas), *BroomWagon* (to reduce the items to the key ones by voting), *FastFocus* (to move from having less to having more shared understanding of concepts) and *Crowbar* (to discover and discuss the reasons behind disagreement on certain issues).

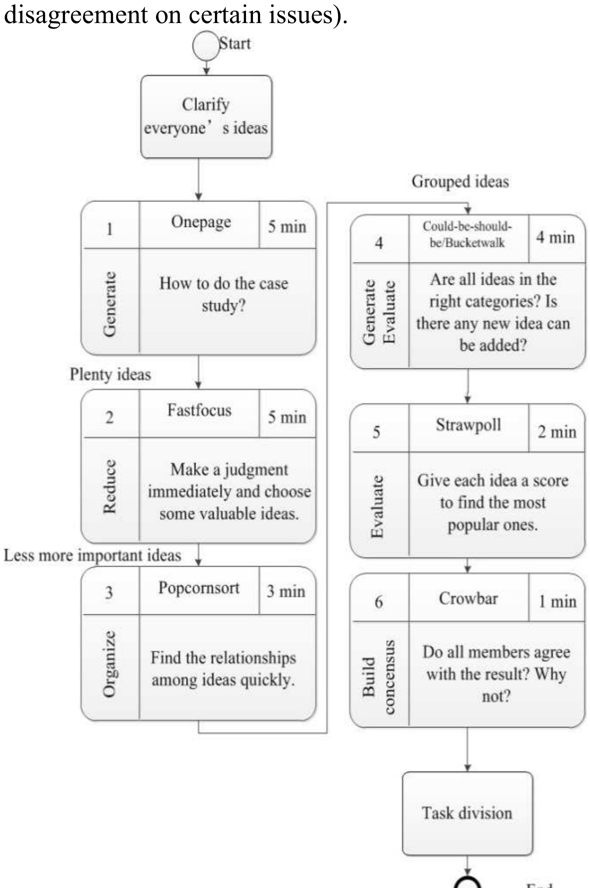


Figure 7. Collaboration process

Students will mainly use the Discussion Platform to do their case study together. Depending on their situations, students can choose either a face-to-face meeting or an online meeting with a synchronous text communication system in the Discussion Platform. Students can use their own computer and set their own time and place to complete the work. At the end of their first collaborative work, they will be asked to respond to a survey to report their experience.

Figure 7 gives an example of the collaborative process designed by the sample group 1. In their first meeting, the group leader/facilitator created a discussion room on the Discussion Platform and designed the following collaborative schedule. They used the face-to-face communication way, so they can clarify everyone's ideas about the case study in oral ways rather than the text typing. After everyone had exchanged materials they had collected about the case and expressed their opinions about the problems, the facilitator clicked buttons to start a countdown period and then said that the *Onepage* began and it would last for 5 minutes. When members noticed the countdown was working, they typed their ideas as much as possible. When the time was over, there were over 30 ideas. Next, the facilitator told the others that the *Fastfocus* stage required them to select 10 more important ideas and give them 5 score and give 1 score to other ideas within 5 minutes. Then the facilitator deleted ideas with low means. Before *Popcornsort* stage, the facilitator created some categories in the Discussion Platform according to the suggestions from members, so members could move the unclassified ideas to the specific items as quickly as possible. In the next stage, the facilitator asked one category after the other that whether all ideas were in the right category. In the *Strawpoll* stage, the facilitator start a vote and all members evaluate the classified ideas from score 1 to score 5 as the satisfaction increasing. In the *Crowbar* stage, the facilitator tried to build higher consensus and a task division was given in the end.

A total of 41 students used similar but some repeatable process designed by their own. We have then put a survey which mainly refers the work of Briggs et al. [25] . There are 40 students responded to a survey at the end of the study. Of those, 17 were male. Participants ranged in age from 20 to 24 years old, most of them are in year 3 and 3 students are in year 4(final year).

5. Results and discussion

Currently, we have just done an analysis about the experiments results and the in-depth interview analysis results will be shown in the future research. There are 22 questions which can be divided into five groups. All these questions are adapted from the work of Briggs et al. [25].

Satisfaction is an important consideration when fielding a new system because research shows that people who feel dissatisfied with a new system, even for nontechnical reasons tend to stop using it [33]. Therefore, the first two dimensions of survey are to measure their "*Satisfaction - with - process (SP)*" and "*Satisfaction - with - outcome (SO)*". Each dimension has 5 questions. "*Satisfaction - with - process (SP)*" dimension try to find out if these participants are satisfied with the collaboration process designed. "*Satisfaction - with - outcome (SO)*" dimension try to find out if students' outcome expectation has been met. In other words, we try to know if students can connect theoretical principles to situated problems and give solutions with the platform support and if the effectiveness and efficiency of the collaboration learning have been enhanced.

"*Tool Difficulty (TOOLDIF)*" dimension refers to how users perceive the difficulty of the platform which also contains five questions.

In "*Process Difficulty (PROCDIF)*" dimension, we used five semantic anchor items to investigate participants' perceptions of the degree to which aspects of the work process were easy or difficult.

In "*Adequacy of Guidance (GUIDADQ)*"dimension, we used two exploratory semantic anchor - questions to measure the degree to which participants found the guidance provided to them by the PSA to be adequate.

Table 3. Exploratory measures of user's first time experiences

Label	Measure(1=negative; 5 =positive)	Questions Num.	Cronbach's Alpha	Neutral	Mean	STD	t
SP	Satisfaction - with - process scale	5	0.713	3.5	3.81	0.76	2.611 *
SO	Satisfaction - with - outcome scale	5	0.750	4.2	4.25	0.50	0.630
TOOLDIF	Perceived ease or difficulty of tools scale	5	0.784	4.4	4.13	0.66	-2.621 *
PROCDIF	Perceived ease or difficulty of work processes scale	5	0.676(0.728)	4.2	4.14	0.52	-0.734
GUIDADQ	Perceived adequacy of process guidance scale	2	-	4	4.23	0.62	2.296 *

*. Correlation is significant at the 0.05 level (2-tailed)

We first do an internal reliability test by using the Cronbach's Alpha coefficient [34]. In Table 3, most items have a Cronbach's Alpha coefficient higher them 0.7 (in PROCDIF group, if the fourth question is deleted, the Cronbach's Alpha coefficient can rise to 0.728). And the internal reliability of total 22 questions is 0.875, higher than 0.80, which means that the scale results have a high reliability.

In general, participants show their high satisfaction about the collaborative case studies since all groups item receive a mean score high than 3.8. Participants' reports of *Satisfaction - with - outcome* and *Perceived ease or difficulty of work processes* were not statistically significantly different than neutral. But participants' reports of the *Satisfaction - with - process* ($t=2.611, df=39, p<0.01$), *Perceived ease or difficulty of tools* ($t=-2.621, df=39, p<0.01$)and *Perceived adequacy of process guidance* ($t=2.296, df=39, p<0.01$) were statistically significantly different than neutral.

Pearson's Correlation Analysis revealed statistically significant relationships among some of the exploratory measures, as shown in Table 4.

Table 4. Pearson's correlations among exploratory measures

	SP	SO	TOOLDIF	PROCDIF	GUIDADQ	AGE	SEX
SP	1						
SO	0.214	1					
TOOLDIF	0.517**	0.366*	1				
PROCDIF	0.298	0.530**	0.426**	1			
GUIDADQ	0.010	0.524**	0.254	0.364*	1		
AGE	0.121	-0.03	0.122	-0.327*	-0.106	1	
SEX	0.047	-0.87	-0.133	-0..276	-0.151	0.256	1

**.Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

The analysis shows that, under the conditions of this study, *Satisfaction - with - process* was strongly associated with Perceived ease or difficulty of tools. The easier people reported the tools the more likely they were to feel satisfied with the process.

Satisfaction - with - outcome was statistically significantly related to Perceived ease or difficulty of tools, Perceived ease or difficulty of work processes and Perceived adequacy of process guidance which means that the easier people reported the tools, the processes and the more adequate of process guidance, the more likely they were to feel satisfied with the outcome.

Analysis also reveals relationships among *Age, Perceived adequacy of process guidance* and *Perceived ease or difficulty of work processes*. The higher one's age and the more adequate of process guidance, the easier one perceives of work processes.

In addition, we can't find relationships among Sex and other elements in this study since there are not any significant relationship between the Sex and other element's.

To sum up, we draw the significant relationships in Figure 8. These relationships shows that 1) the higher one's age and the more adequate of process guidance, the easier one perceives of work processes; 2) the easier people reported the tools the more likely they were to feel satisfied with the process; 3) the easier people reported the tools, the processes and the more adequate of process guidance, the more likely they were to feel satisfied with the outcome.

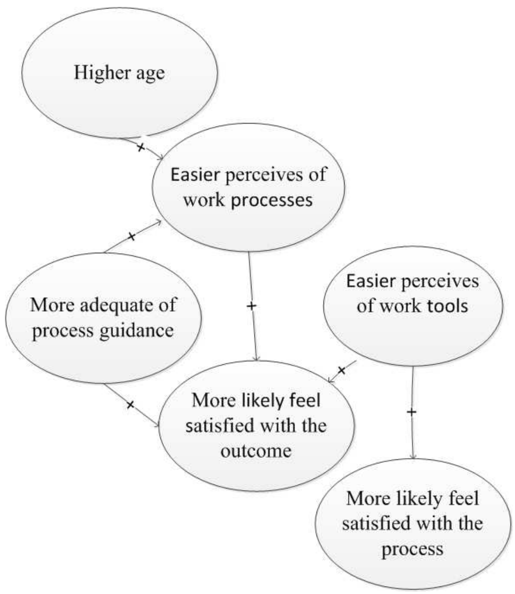


Figure 8. Findings of relationships in the evaluation

The primary design goal of Discussion Platform was achieved. Compared to the other GSS, the PSS allow untrained students to execute engineered collaborative case studies. From the experiments feedback, the Discussion Platform have four main advantages: 1) it is easy to design and develop with low cost and short life cycle; 2) it is easy to meet with students requirements by using an agile develop method; 3) it is flexible and allow students to design their own reusable processes (since undergraduate students have strong learning skills, they can often design more suitable collaborative processes for them than professional facilitators; 4) it is not only easy to use, but also easy to install the servers on the personal computer, which means you can own your own Discussion Platform easily.

6. Conclusions

In this paper, we have developed an easy and simple PSS to support students' collaborative case studies based on the theoretical foundation of SLMC and CACE/PSS. Since CSCL of students' case studies may not need many functions in GSS, we simplify the theories and give a simple and easy solution to each requirement. We set up Discussion Platform with the agile method on the WAMP platform with low cost and short development life cycle. We have tested the Discussion Platform in a case study throughout one semester in a university in China. By analyzing our interview data, we were able to find out whether the designed process can be easy enough to support the CSCL. In addition, we have found some relationships after satisfaction measurements.

This paper primarily contributes to collaboration engineering research for collaborative student case studies. The primary theoretical contribution of this paper lays in the successful application of the system design method, which is a combination of the SLMC [24] and CACE/PSS [13]. In addition, from a more practical aspect, the proposed PSS can effectively combine strategies to improve collaboration and process support that we have identified in the literature, such as simplify collaboration tools, increase the transferability of facilitation skills and build facilitation support into the technology [14, 17-18]. Our research result shows that the easy and simple collaboration system is suitable for students to do collaborations. The Discussion Platform could present users not just with tools, but with well-designed work practices [24].

Compared to other tools which can support Collaboration Engineering, such as GroupSystem, EasyWinWin and Meetingsphere, The Discussion Platform is not only simpler, easier to use and cheaper to develop, but also creatively use the theory of SLMC and CACE/PSS. The Discussion Platform's simple structure make it has the minimum redundancy and everyone can make their personal computer as a simple server only if they has settled the install package of the Discussion Platform. Other team members can log in the platform when they have the URL of the server. In addition, the simple tool will has quicker internet speed than other tools mentioned before, since the server is always in the same network or LAN.

According to Briggs et al. [25], current general-purpose GSS are complex because they must be configurable to meet a wide variety of needs. Task-specific PSA tools could be simpler, providing exactly and only the capabilities required for the specific actions of the specific activity. We validate the design by quantitative method that the designed Discussion Platform is easy enough to use and the end users perceive high level of satisfaction with processes and outcomes. We validate the comments of Briggs et al. [25] about PSA that a "PSA approach might make it possible for a group of non - experts to approach a technology - supported collaborative work practice with no prior training, and execute it successfully". In addition, our study provides a successful implementation of the PSS tools and techniques. We also find that 1) the easier people reported the tools, the processes and the more adequate of process guidance, the more likely they were to feel satisfied with the outcome; 2) the higher one's age and the more adequate of process guidance, the easier one perceives of work processes; 3) the easier people reported the tools the more likely they were to feel satisfied with the process. Therefore, the future CACE/PSS design and research should pay attention to the ease of design, ease of use, guidance and target user's characters.

Nonetheless, our research has its own limitation. Firstly, the research is done in a special context of a China university and set the college students as the target user. In addition, Chinese college students are usually live in campus embedded with intranet, and they are easy to meet each other. However, the Discussion Platform may have lower speed if tested in the Internet by users in different locations. The current system is also very limited in the functions and interface. In addition, we also ignore the mobile connection in our experiments. Although students can log in the platform from mobile devices only if they have been connected to the campus network, we still omit mobile connection factor since it is actually not convenient without mobile client. We can develop mobile client for Discussion Platform in the future. Moreover, we have just done a quantitative analysis which omits suggestions about the platform from participant. Therefore, the study still needs further analysis by qualitative method such as interviews in the future. Additionally, we intended to conduct further studies on whether the designed system can improve effectiveness and efficiency of collaborative case studies in more cases. The future research will also try to further validate the results in different cultural and global contexts by conducting further experiments, interviews and surveys.

7. Acknowledgement

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