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Abstract:

Lack of motivation is a serious problem in wiki-based collaboration process. The original wiki is designed to hide authorship information. Such design may hinder users from being aware of task conflict, resulting in undesired outcomes (e.g., lack of motivation, and suppressed knowledge exchange activities). This research-in-progress tries to motivate students to participate in wiki-based collaborative learning project by increasing awareness of task conflict. Two tools were proposed to solve problems caused by lack of task conflict clues, such as low level of motivation, content trust, knowledge exchange, and sense of audience. A field test was executed to evaluate new designs. We propose to invite active participants from the field test and use focus group interview to explain how awareness of task conflict motivates participation in collaborative learning. This research-in-progress has the potential to lead to various theoretical and practical implications. For example, the results will enhance the literature on task conflict and user motivation, help platforms design motivation mechanisms.

Keywords: wiki; design science research; e-learning; collaboration; task conflict

1   INTRODUCTION

Wiki is a kind of collaborative writing system to be used for creating shared documents. In recent years, wikis have been deployed in various contexts[1] to support collaborative learning (Forte et al., 2007). In wiki-based learning project, learners are usually required to jointly write and edit articles through constant negotiation and coordination with their co-learners (Larusson et al., 2009). Therefore, learners can acquire new knowledge and skills of collaboration. The educational value of wiki has been discussed in past literature (Cress et al., 2008).

However, deployments of wiki systems to support collaborative learning, as well as public and enterprise wiki collaborations (e.g. Wikipedia) are plagued by lack of motivation (Ebner et al., 2008; Grudin et al., 2010). While motivation is considered as a critical factor which determines the success of virtual collaboration (Ardichvili et al., 2003), how to motivate learners to participate in wiki-based collaborative learning becomes a major issue.

In this *research-in-progress*, we sought to motivate learners through designing enhanced wiki tools. We select task conflict (different opinions regarding task issues) as an underlying concept of our design based on two reasons, first, wiki-based collaborations are often reported by literature regarding the issue of conflict (Arazy et al., 2011; Collier et al., 2012; Kittur et al., 2010). Previous studies suggested that a conflict in wiki pages is more likely to be a task-oriented conflict (Arazy, et al., 2011), because the most common arguments among wiki users involve opinions about the content (Kane et al., 2009). Second, although conflict is often criticized as having a negative effect on group collaboration (De Wit et al., 2012), research evidence shows that task conflict can be beneficial to collaboration (Dechurch et al., 2001). For example, task conflict can increase curiosity, which is an important intrinsic motivation (Jehn, 1994). Therefore, it is possible to enjoy the benefits of task conflict in collaborative learning.

Our approach utilizes the process framework for Design Science Research proposed by Hevner, et al. (2004) and Peffers (2007). The design science paradigm seeks to create innovative artifacts through which the analysis, design, implementation, management, and use of information systems can be accomplished successfully (Hevner, et al., 2004). It usually consists of six steps: (1) problem identification and motivation, (2) definition of solution objectives, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication. In this *research-in-progress*, problems of using wiki-based collaboration and the resulting solution objective are described in Section 2. Relevant literature is reviewed in Section 3, including the casual relationship between task conflict and participation, a brief introduction to self-determination theory (SDT), and wiki-related studies. The designed tools, a wide-scale field test, and a proposal for focus group interview based on SDT framework are described in Section 4. We discuss preliminary and expected result, limitation and implications in Section 5.

2   PROBLEMS AND POSSIBLE SOLUTION

Wiki systems have been used in many contexts, such as collaborative learning, management of business meta data, building an artifact, and supporting decision making (Grace, 2009; Hüner et al., 2011; Malone et al., 2010; Wheeler et al., 2008). As a result, the accumulated knowledge can be helpful to explain the reason why the students lack motivations in wiki-based collaborative learning. A summary of motivational issues in wiki-based collaboration is provided in Table 1.

The problems listed in Table 1 can be attributed to the lack of clues when a task conflict event occurs. The original wiki is designed to hide authorship information, and it presents only the latest version of an article. Such design can reduce social bias (Arazy et al., 2010), but it does not directly show clues like "is there any task conflict issue?", "who has conflicting opinions with me?", "what opinions does he/she hold?" and "when did he/she change my content?" Users who want to know these types of information should use the "page history" tool to compare every two versions of an article to find the

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[1] A list of education-oriented wiki projects can be found at *EduWikis* (http://educationalwikis.wikispaces.com)

answers. The process can be very time-consuming when the article has a long list of versions.

Problems	Context	Demonstration	Source
(A) Generation of content trust not well supported	General	"does not offer ... how the article content has evolved into its most current form...how much the content can be relied upon"	(Adler et al., 2008)
(B) Knowledge exchange activities not well supported	General	"users may not be aware of changes of content when the content they contributed is modified by others"	(Wu et al., 2013)
(C) Limited sense of audience	Education	"having an audience who can comment on what is written directly supports efforts to write clearly and to write well"	(Forte et al., 2006; Light, 2011)
(D) Limited feedback	Enterprise	"he believed, communicated to staff that their contributions mattered"	(Holtzblatt et al., 2010)
(E) Limited authorship	General/ Education	"this design is less suitable when users are motivated primarily by self-promotion and career-advancement"	(Arazy, et al., 2010; Chi, 2008; Wheeler, et al., 2008)

Table 1.   Problems of wiki usage mentioned in literature

For issue (A) mentioned in Table 1, if users are able to know the details of changes in the content that they are interested in, they would have more confidence in the quality of the information. For issue (B), knowledge exchange activities would be facilitated if the wiki system could give users information about content changes as well as corresponding editors. For issue (C) and (D), the sense of audience can be enhanced by providing peer feedback in the form of content changes. Peer feedback can be beneficial to collaboration in many ways, such as increased quality of the group project, increased interaction, better personal knowledge learning, higher satisfaction, and increased sense of belonging (Phielix et al., 2010). For issue (E), making users' social actions transparent and content authorship visible can motivate users to contribute (Arazy, et al., 2010; Blau et al., 2009; Preece et al., 2009).

Since each version of a wiki page is confirmed and submitted by a user, for design purpose, we consider the content differences between two versions of a wiki page as reflections of task conflict. Our definition of task conflict extends the classic definition of task conflict, which emphasizes opinion differences. Moreover, our definition is similar to *peer feedback*. But *peer feedback* is usually a one-to-one collaboration process where one gives reviews to another (a clear receiver), while task conflict in wiki is a many-to-many communication process that everyone edits each other's work to improve the quality of a wiki article (Zammuto et al., 2007).

Regarding the design of enhanced functions, several assumptions for new functions can be proposed: First, by highlighting modifications (conflicting content), users can quickly be aware of a conflict event and identify whether this event is related to them. As a result, they may be motivated to express opinions. Second, by providing a paragraph-based revision history, users can focus on a specific part of the content and reduce the time and effort to locate relevant revisions from a huge list of revisions. Third, by providing a complete edit history of the content, users can generate a sense of community and know exactly the evolution of opinions and which editors to communicate with. Fourth, by providing word-based content authorship, users can quickly identify whether others have modified the content they contributed, and fulfill their needs of content ownership.

3   LITERATURE REVIEW

3.1   Task conflict and participation

The phenomenon of conflict has been studied for many decades. Conflict itself has been categorized into three types: relationship, process, and task conflict (Jehn et al., 2001). Relationship and process conflict refers to disagreement on inter-personal issues and approaches to the task, respectively. Task conflict only refers to disagreements on ideas and differences of opinions about the task. Task conflict

is void of the intense interpersonal negative emotions that are usually linked with relationship conflict (Jehn, et al., 2001).

The studies on relationship and process conflict have had largely consistent findings, indicating that these two types of conflict are usually harmful to group performance (De Wit, et al., 2012). In contrast, the consequences of task conflict seem to be more complex. Groups experiencing task conflict can obtain better decision understanding, quality of decision, and decision commitment, since task conflict encourages a diversity of opinions and positively affects members' relational outcomes (e.g., psychological meaningfulness, availability, and safety) (Gibson et al., 2003; Zhang et al., 2009). However, task conflict is also found to have a negative effect on group performance due to the influence of unsolved task issues. Besides, a high level of task conflict can trigger relationship conflict and reduce member satisfaction (Simons et al., 2000).

Four kinds of controversial opinions on relationships between task conflict and participation can be extracted from the literature. Firstly, participation can generate task conflict due to opinion differences (Kankanhalli, 2006), freedom to participate and to express ones' opinions (Paul et al., 2004), value diversity (Jehn, 1994), different opinions on team goals, importance of task characteristics or actions (Weingart et al., 2008), and perceived informational and value dissimilarity (Hobman et al., 2003). Secondly, participation could reduce task conflict since information exchange/sharing behaviours improves mutual understanding (De Dreu, 2006; Moye et al., 2004), group value congruence (Jehn et al., 1997), trust (Cronin, 2004; Lin et al., 2010), and team spirit (Rose et al., 2004). Thirdly, participation can be motivated by task conflict because members' interaction (e.g., communication frequency) and critical evaluation of conflict issues (or resolution) are stimulated (De Dreu et al., 2003; Liang et al., 2012; Son et al., 2011; Yan, 2011). Finally, task conflict may reduce motivation to participate because it increases stress, tension and dissatisfaction (Gamero et al., 2008; Jehn, 1994; Shaw et al., 2011).

As summarized above, the complexity of the relationship between task conflict and participation calls for deeper investigation of the interaction between them.

3.2   Motivations: Self-determination theory

Self-determination theory (SDT) defines intrinsic and extrinsic sources of motivation. There are distinct forms of extrinsic motivation: external regulation, introjection, identification, and integration (Ke et al., 2010). External regulation refers to the intention of achieving a desired result or avoiding an undesired one (Ke, et al., 2010). With introjected motivation, the regulation has been taken in by individuals but has not been accepted as their own (Ke, et al., 2010). When it comes to an identified motivation, people feel greater freedom and volition because the behavior is more congruent with their personal goals and identity (Ke, et al., 2010). The action will be behaved as personally important. Furthermore, integrated regulation is the most autonomous form of extrinsic motivation. It occurs when regulations are fully assimilated to the actors and strongly embedded in their behaviors.

Internalization is the central idea of SDT (Deci et al., 1991). It emphasizes that there is a smooth transition between internal and external motivation (Deci et al., 2000). People's motivation can begin from no motivation to motivation that is not all internalized (e.g. feel forced to), to completely internalized (believe it is important), and finally to automatically internalized (e.g. fun) (Sheldon, 2013). SDT suggests that providing people with senses of autonomy, competence, and relatedness will facilitate internalization of external motivation.

3.3   Motivations to participate in wiki-based collaboration

Users' motivations to participate in wiki-based collaboration vary across different contexts (e.g., public, enterprise, education). For public wiki settings, such as Wikipedia, since there is usually no external rewards, intrinsic and internalized extrinsic motivations play an important role in motivating participation; for example, fun and enjoyment, commitment to community, desire to learn, altruism, reciprocity, reputation and autonomy (Baytiyeh et al., 2009; Kuznetsov, 2006; Moore et al., 2007; Nov, 2007). Businesses usually place a high value on knowledge sharing. But business employees are not

always willing to share specific information in wiki because of the extra cost of sharing, information sensitivity, etc (Holtzblatt, et al., 2010). In an enterprise wiki, it is reported that employees used the wiki usually because they wanted to get rewards, find work-related information, or share personal experience rather than knowledge (Lykourentzou et al., 2011; Stocker et al., 2011). Moreover, reputation is also a significant motivator (Munson, 2008). In education, factors such as usefulness, interesting are found to be motivational drivers (Cubric, 2007), however, students who would like to enjoy wiki-based learning experiences need to conquer the anxiety about receiving criticism from others (Wheeler, et al., 2008).

Many tools have been designed to increase users' motivations. For example, Arazy, et al., (2010) designed an embedded tool to show page-level statistics information and help users build their community influence; e.g., a pie chart shows the proportion of contribution from every editor. Similarly, the WikiDashboard designed by Pirolli, et al., (2009) also shows each editor's influence over the article. Other researchers incorporate technologies such as ontology to facilitate users' editing activities (Wu et al., 2008). However, many design studies cannot well address how their designs influence users' motivations.

4   ARTIFACT DESIGN AND EVALUATION

Original wiki (wiki-A) only shows content text. We propose two different designs in this study (Fig. 1). The first design (wiki-B) is a dialog box triggered by a "view history" link, which is located at the end of every paragraph in a wiki article page. This tool has two different sub-functions, namely paragraph-based revision history and word-based content authorship. Paragraph-based revision history highlights the added/deleted content between every former and later revision (the revisions can be sorted by "revision sequence" in ascending and descending orders), and it also shows information about corresponding editors to facilitate further communication (clicking the name of an editor will trigger the navigation to the editor's talk page), and displays the degree of conflict (popularity) of this paragraph. Word-based content authorship shows the author of a word or sentence.

The second design (wiki-C) assigns different background-colors to words (or sentences) based on the computation of severity of task conflict. For example, when a sentence has been modified by users many times in a certain period, the background color of this sentence will be set to dark red. As the content is not gradually edited by users, the background color of the content will be changed to lighter colors. Unlike the previous tool mentioned above, this tool can reflect a direct and detailed view about the distribution of task conflict issues and related information (e.g., last editor, activeness) as soon as users visit the wiki article page.

The evaluation of the proposed two designs uses the focus group method, as modified to suit Design Science Research (Tremblay et al., 2010). The basic idea of the modification is the introduction of Exploratory Focus Groups (EFGs) and Confirmatory Focus Groups (CFGs). EFGs are used to iteratively refine the proposed design and the question draft, while CFGs are used to demonstrate the utility of the design in a field setting (Tremblay, et al., 2010). The steps of the modified focus group method used in this study are: (1) The authors proposed two preliminary designs and topics that need to be addressed, a pilot focus group was organized to help anticipate the issues of managing the focus group interview, including length of interview, generation of the initial questions, and evaluation of the moderators' style. The data gained from the pilot focus group are not used for further analysis. (2) A rolling interview guide (Stewart et al., 2007) is utilized for EFGs. The first EFG is organized to test the designs and give suggestions on both questions and coding schema. Based on its outcomes, the quality of design is improved, and the interview guide is refined. Then, the second EFG is organized to re-test the designs, based on its suggestions, the designs and interview guide are refined until their final version is reached. (3) The field implementation is conducted. A wide-scale survey is used to confirm the effectiveness of the new design and students' willingness to solve task conflict. Classic focus groups interview will be used to get a deeper understanding of student's wiki experience under the influence of the two new designs.
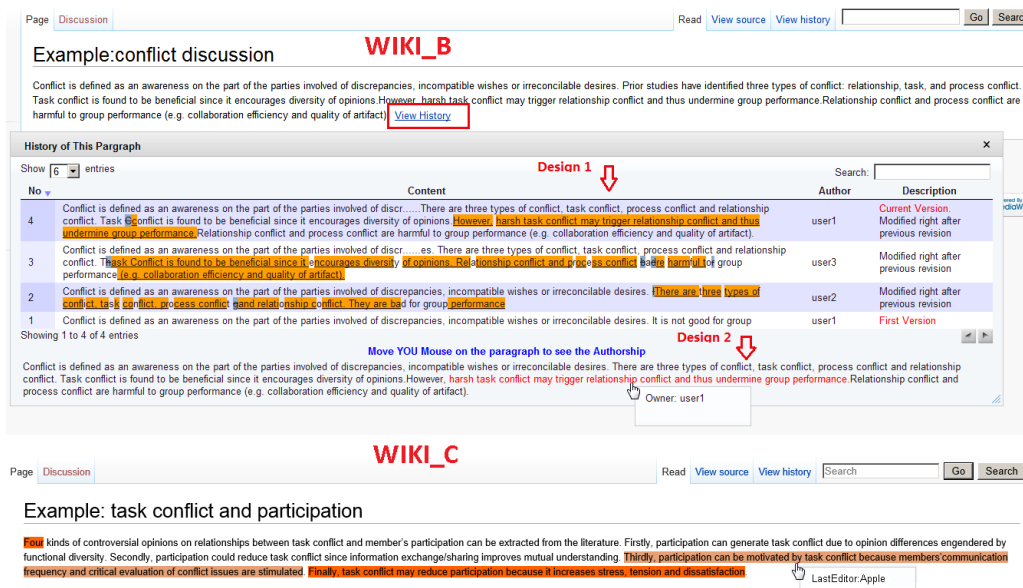
Figure 1.   *Example articles shows in modified Wiki (Wiki-B and Wiki-C)*

4.1   Design refinement and outcomes of EFGs

Both wiki-B and C were deployed. These two wikis shared the same databases. A pilot focus group (6 Ph.D students) is organized to give initial suggestion of design improvements and create question draft. The first EFG group contains 4 master students and its 1 hour interview gives further suggestions on design and question draft. Next, the second EFG group contains 4 undergraduates, and almost no suggestions were gained on the two designs, and small suggestions were gained for questioning route. Therefore, the test for two designs and questioning guide were accomplished. The survey questions are sent to all participants in the field test to gain evaluation results from a wide general. And the interview questions are used in CFGs interview to measure users' wiki experience.

4.2   Field test: online collaborative learning projects

All three wiki systems (wiki-A, B and C) are deployed. The procedure of the collaborative learning is briefly described as follows: (1) two 10-minute speeches are presented to make the participants understand how to use wiki, and how to distinguish different types of conflict, since this study only focuses on task conflict. (2) Participants are randomly divided into 2 or 3 groups equally. Each group is assigned with a discussion topic. The group task is to collaboratively write a high quality discussion paper that is expected to include the opinions about the topic from every possible perspective. (3) In each group, one half of the participants use the original wiki, while others use modified wiki. (4) All the discussions start simultaneously and last for two weeks.

We conducted two times of collaboration. Wiki-A and B were used for the first round of collaboration (Collaboration-A). 322 undergraduate students agreed to participate. All students were equally divided into three groups, and the discussion topics selected for these groups were *pirated software*, c*omputer related occupational disease* and *online gaming*. The second round of collaboration (Collaboration-B) used wiki-A and C. 116 undergraduate students were willing to participate. All students were equally segmented into two groups, and the discussion topics for these two groups were *game-based learning* and *traditional learning versus e-learning*. These two collaborations were taken in two classes from two universities respectively due to implementation constraints.

Extra course credit would be given to participants as a return. Only basic wiki operation skills are required to reduce the probability of generating process conflict. And policy of anonymity was adopted to reduce the risk of generating relationship conflict.

Since focus group studies often face concerns of small-scale participants, we develop two questions in a preliminary survey sent to all participants in the field test. These two questions reflect how the

participants notice conflict, and their willingness to solve conflict. Questionnaires were sent out immediately after each collaboration was finished. 301 and 108 valid responses were received from Collaboration-A and B respectively.

As is shown in Figure 2, in Collaboration-A, 95 students (62.9%) using wiki-A noticed conflict, while 143 students (95.3%) using wiki-B noticed conflict, including 113 students (75.3%) who noticed conflict from the new design. In Collabroation-B, compared to the 31 (59.6%) students who used wiki-A and noticed conflict, the percentage of being aware of task conflict among students who used wiki-C is much higher (53 students, 94.6%). And 52 students (92.8%) noticed conflict with the new design.

For the question about how participants reacted to the conflict events, in Collaboration-A, 49 students (16.3%) did not want to solve the conflict, 157 students (52.2%) were willing to solve the conflict issues only when they were involved, and the remaining 95 students (31.6%) were willing to solve the conflict issues whether involved or not. In Collaboration-B, 26 students (24.1%) did not want to solve the conflict, 61 students (56.5%) were willing to solve the conflict only when they were involved, and 21 students (19.4%) were willing to solve the conflict issues whether involved or not.

In summary, most of the participants were willing to solve conflict issues, and the new designs could be helpful for users to identify conflict during collaboration.
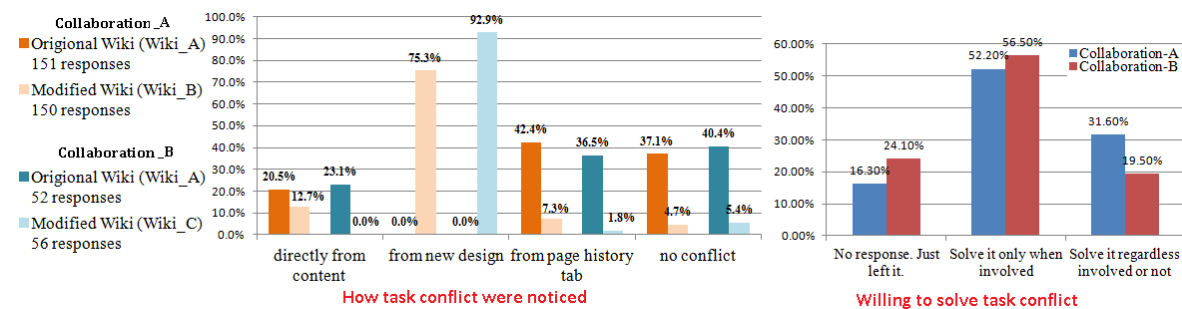

Figure 2.   Summary of wide-scale survey results

4.3   Proposal for Focus group interview

We will use focus group interview to understand how awareness of task conflict (specifically, our two new designs) influences students' motivation in collaborative learning. By considering suggestions from literature (Crowley et al., 2002) and field test settings, we decide to setup six focus groups (two from every wiki) consisting of 6-10 participants each. Since we adopted policy of anonymity, we could only conduct an open call for focus group through email in wiki. We will send out invitation letters to the 30% most active participants in three wikis in two collaborations (130 invitation letters). We will select responders based on their profile and telephone conversions. We will assign an instructor to lead the conversation in each group. The conversations will follow a pre-tested protocol. Each session will last for about 90 minutes. All conversations will be recorded after gaining permission from subjects. Transcripts will be coded and analyzed with Atlas.ti 6, using the framework approach. The framework approach uses both theoretical background (e.g. SDT in this study) and objectives for guidance and inductive analysis which reflect originality.

5   CONCLUSIONS

In this *research-in-progress*, two wiki tools, which increase student's awareness of task conflict, were introduced to solve the problems of both wiki usability and student's motivation. The main evaluation process followed the focus group framework proposed by Tremblay et al., (2010), a method adjusted for Design Science Research. One pilot focus group and two EFGs were organized in the design stage to support refinement of the two tools and the interview guide. In the field test, undergraduate students from two universities were invited to join wiki-based collaborative learning projects. One large-scale survey was conducted to provide data reflecting the effectiveness of the two designs.

5.1 Expected Result

According to SDT, first, we provided an autonomous, supportive style of administration during collaboration that only required basic wiki operation skills, and did not limit students' freedom to use the wiki. Second, the two new designs provided up-to-date peer feedback information about content. The positive effects of peer feedback have been discussed extensively in educational studies (Van Zundert et al., 2010). Third, since the two designs can directly reflect the interactions of community members, they provide students with a sense of audience and belongingness to group; thus, enhancing their commitment to the community. Therefore, we are expected to observe a successful internalization of motivations.

One focus group interview will be organized to gain a deeper understanding of how awareness of task conflict motivated users. We will map students' responses into SDT framework. We expect that we can categorize the responses into at least two topics: (1) students' motivation factors before using wiki, and after using wiki. And the change of motivational factors during wiki usage, and (2) task conflict awareness and reaction. Data related to these two views will be very helpful in understanding user's motivations and how design policies might maximum benefits of task conflict in online collaboration.

5.2 Limitations

This study has several limitations. First, we only use undergraduate students as subjects. Although undergraduate students represent a high proportion of collaborative learning users, ignorance of other kinds of students (e.g., middle school students) may cause sample bias and variance in the final result. Second, our field test adopts a relative loose policy on participation, and our focus group interview will only include active participants. Therefore, we cannot address free-riding problems well and we cannot explain free-rider motivations, as well as how our designs might impact their motivations. Third, the consequences of making task conflict transparency depend on wiki implication contexts. It has been reported that wiki systems may have very different profiles (e.g., anonymity versus non-anonymity) (Majchrzak et al., 2006). Therefore, the result of our study will not be able to explain how our two tools perform in other contexts (e.g., enterprise), especially where transparent task conflict is not welcomed. Since the two tools provide useful information to let users know about changes of content and provide other task conflict clues, we expect that these designs may be effective in different contexts. Finally, a longitudinal study is preferred to understand the progressive stages of motivational drivers. Our proposed focus group study may not be enough to explain the effects of task conflict on facilitating the internalization of motivations.

5.3 Implications

If this research-in-progress is implemented properly, it has the potential to lead to various theoretical and practical implications. For literature, first, we may observe a significant internalization of motivations during wiki usage under the influence of awareness of task conflict. Previous studies, however, have not fully explained how task conflict benefits a collaboration process. Second, many studies seem to neglect or partially address a group member's affective reaction to task conflict (e.g. curiosity to task conflict) when measuring the casual relationship between task conflict and certain constructs (e.g., participation). Similar to previous studies on areas such as information systems and marketing (Choi et al., 2012; Sun et al., 2006), we will explain user's reactions to task conflict from both cognitive and affective perspectives.

For practice, first, in contrast to the traditional way of using trust and reciprocity to motivate users' participation in designing online information systems (Vassileva et al., 2007), the two new designs proposed in this study offer a relatively fresh approach to achieve the same goal. Second, since the effectiveness of conflict management is based on how well such conflicts can be understood by group members (Kwahk and Kim, 1998), increasing the awareness of task conflict can help group members to be aware of task conflict at an early stage, track evolution of opinions, and negotiate with each other (active conflict management). Instead of designing complex conflict monitoring and resolution mechanisms, this method could allow conflict to be resolved in a self-organized way.

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