Inhibiting Undesirable Effects of Mutual Trust in Net-Based Collaborative Groups

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Abstract: Experimental studies have demonstrated the effectiveness of the knowledge and information awareness approach by Engelmann and colleagues for improving computer-supported collaborative problem-solving. This approach informs group members about their collaborators' knowledge structures and underlying information visualized by digital concept maps. In our study, we investigated whether this approach may reduce undesirable effects of mutual trust. Trust is an important influencing factor with regard to behavior and performance of groups. High mutual trust can have a negative impact on group effectiveness because it reduces mutual control and, as a result, the detection of the others' mistakes. In an empirical study, 20 triads collaborating with the knowledge and information awareness approach were compared with 20 triads collaborating without this approach. The members of a triad were spatially-distributed and collaborated computer-supported. The results demonstrated that the availability of the knowledge and information awareness approach overrides the negative impact of too much mutual trust.

1. Challenges of our Information Age

The need for collaboration, especially for experts in different fields of knowledge, is ever rising in our information age, and certainly the distribution of experts around the world is not a real problem these days: These experts do not have to share the same physical space to work together on common tasks; instead, for this purpose, they can use current computer technologies such as video chatting or collaborative writing tools.

There are many advantages of computer-supported collaboration, for example, the mentioned spatial flexibility (Engelmann, Dehler, Bodemer, & Buder, 2009). However, this is not easy to achieve in an effective way: There are many reasons why interaction problems, especially regarding communication and coordination, often occur in a computer-mediated environment (Janssen, Erkens, Kanselaar, & Jaspers, 2007): One problem is the reduced contextual information, that is, missing information (e.g. non-verbal signals) which would be available in a face-to-face setting (Kiesler, Siegel, & McGuire, 1984). Another difficulty for virtual groups is that the members often do not know each other before they have to collaborate on a common task, and therefore, they do not know what their collaborators know. However, different lines of research have demonstrated the importance of knowing what the collaborators know (cf. Engelmann & Hesse, 2010): Research on *Audience Design* (e.g., Dehler-Zufferey, Bodemer, Buder, & Hesse, 2011) gives evidence that individuals adapt their texts depending upon the addressee. According to the *Knowledge Imputing* approach (Nickerson, 1999) effective communication requires a sufficient amount of correct knowledge about the communication partner's knowledge. If one overestimates the partner's knowledge, the partner might not even be able to understand statements (Nickerson, 1999). Studies on the *Theory of Transactive Memory System* (Wegner, 1986) confirm that the groups whose members know who is an expert on which topics achieve more in group tasks (e.g. Liang, Moreland, & Argote, 1995).

However, prior research has shown that it is not easy to acquire correct knowledge about the collaboration partner's knowledge (cf. Engelmann & Hesse, 2010): This knowledge was derived from both behavioral and categorical information as well as from the interaction with the collaboration partners. During this process, a lot of perception or evaluation mistakes can slip in (cf. Krauss & Fussell, 1991; Nickerson, 1999). In addition, according to the theory of transactive memory system (Wegner, 1986), sufficient common time is required to acquire this knowledge. Furthermore, there are situations in which the possibilities of acquiring knowledge about the partners' knowledge are strongly restricted (Engelmann & Hesse, 2010), for example, in a computer-supported collaborative setting with spatially distributed group members, who must deal with reduced contextual information (Kiesler et al., 1984).

2. The Approach for Fostering Knowledge and Information Awareness

In order to find a solution for the need for and the problem of acquiring knowledge about the collaboration partners' knowledge in computer-supported collaborative settings, Engelmann (née Keller) and colleagues developed an implicit approach, called the *Approach for Fostering Knowledge and Information Awareness* (Keller, Tergan, & Coffey, 2006). They defined knowledge and information awareness as being informed about the collaborators' knowledge structures and information underlying these structures (e.g. Engelmann & Hesse, 2011). The approach for fostering knowledge and information awareness provides the spatially distributed group members with their collaborators' knowledge structures and their collaborators' information underlying these structures, both visualized by means of digital concept maps.

Concept maps are a well-established kind of knowledge visualization representing conceptual knowledge by means of hierarchically ordered concepts (in form of labeled nodes) and relations between the concepts (in form of labeled links) (Novak & Gowin, 1984). Digital concept mapping technologies moreover allow for adding nodes with links for accessing further information (e.g. Alpert, 2005). Concept maps are, therefore, well suited for fostering knowledge and information awareness.

Several experimental studies have confirmed that not only knowledge and information awareness can be quickly acquired by being provided with the collaborators' digital concept maps, but also that this approach improves collaboration and collaborative problem-solving of spatially distributed group members (e.g. Engelmann, Tergan, & Hesse, 2010; Engelmann & Hesse, 2010). Collaborative problem-solving fosters learning (e.g. Hausmann, Chi, & Roy, 2004). In addition, the experimental results have shown that this approach may also assist in overcoming important collaboration barriers: The study by Engelmann and Hesse (2011) provides evidence that the knowledge and information awareness approach fosters sharing, discussing, and cognitive processing of unshared information. In the study by Schreiber and Engelmann (2010), it was shown that this approach furthers the development of a transactive memory system. In the study by Engelmann and Kolodziej (2012), it was demonstrated that also in unstructured group situations self-created concept maps for fostering knowledge and information awareness may reduce the needed collaborative problem solving time and, therefore, the coordination effort within the group. In the current paper, we will focus on investigating a collaboration barrier having to do with the concept of mutual trust.

3. The Impact of Mutual Trust on Behavior and Performance of Groups

Trust is an important influencing factor with regard to behavior and performance of groups (Salas, Sims & Burke, 2005). Changes in the situation can have an impact on the role of trust in groups (e.g. Kramer, 1999). For example, the role of trust is dependent on the degree of structure in the situation (Dirks & Ferrin, 2001; Jarvenpaa, Shaw, & Staples, 2004): In situations with a low degree of structure, trust has a direct effect on group variables. In such situations, it is difficult to interpret the others' behavior. Therefore, their behavior is interpreted depending on the amount of trust that the group members have in each other. In situations with a moderate degree of structure, trust is a moderating factor. Factors for interpreting the others' behavior are given; however, trust influences how these factors are interpreted. In situations with high structure, the others' behavior can be directly evaluated. Trust is not used to interpret the others' behavior and, therefore, does not have any impact on group measurements.

In situations in which trust has an effect on group variables, the following relations are to be expected: In numerous publications (e.g. Jarvenpaa, Knoll, & Leidner, 1998), it is argued that mutual trust is an important influencing factor for group effectiveness. This was also confirmed by several empirical studies (e.g. Kanawattanachai & Yoo, 2002). Further empirical studies, for instance by Aubert and Kelsey (2003) as well as Jarvenpaa et al. (2004), have shown that trust has an effect on group efficiency, but not on group effectiveness.

These contradictory results could possibly be explained by another influencing factor, namely, correctness of individual performances: If group members with high mutual trust work without mistakes, this should result – according to Aubert and Kelsey (2003) as well as Jarvenpaa et al. (2004) – in a faster and, therefore, more efficient collaboration, since it is to be expected that high mutual trust reduces mutual control. When free from errors, high mutual trust should not have an impact on group effectiveness. However, if group members with high mutual trust make mistakes, these mistakes might not be discovered due to the reduced mutual control caused by having high mutual trust. This should lead to reduced group effectiveness (cf., Jarvenpaa et al., 2004; Dirks & Ferrin, 2001). Due to the fact that efficiency is defined as effectiveness per time, the time saved while performing the task has to be very high in order to obtain good efficiency with low effectiveness. Therefore, it is expected that low effectiveness will lead to poor efficiency.

Contrarily, low mutual trust should increase mutual control and, therefore, the needed time; that is, it should reduce group efficiency. However, there is a good chance that the mistakes of the collaboration partners will be discovered. As a consequence, higher group effectiveness can be expected.

Due to the fact that, compared to face-to-face collaboration, computer-supported collaboration is often accompanied by various difficulties (e.g., Janssen, Erkens, Kanselaar & Jaspers, 2007), it is most likely that the group members will make mistakes. For example, while creating their own concept maps visualizing their own knowledge structures, group members could "forget" to include parts of their knowledge or visualize some elements wrongly. As these knowledge representations were used as a starting point for net-based collaboration, these mistakes could decrease group performance. The following argumentation refers only to collaborations in which mistakes appeared.

Aubert and Kelsey (2003) have shown that trust is lower in computer-supported collaborative groups compared to face-to-face groups. Thus, virtual group members have a higher need for mutual control. However, because of the computer-support mutual control ability is limited. In such situations, mutual control is very effortful. However, as in the study presented in this paper, there are possibilities that allow for mutual control in such virtual groups.

4. Experimental Study

The goal of the study was to investigate the impact of mutual trust depending on the availability of the knowledge and information awareness approach on group effectiveness and group efficiency of solving problems in virtual groups.

4.1 Hypotheses

Without being provided with the knowledge and information awareness approach (control condition), as already mentioned, it is to be expected that trust will affect group effectiveness: A variance regarding the amount of trust also appears in virtual groups despite lower mutual trust in virtual groups compared to face-to-face groups (Aubert & Kelsey, 2003). If mutual trust is high, it is to be expected that there is low mutual control, and therefore, mistakes will not be detected. In reference to our study, the group members would not check whether the contributions of the others are correct. This should decrease group effectiveness and – because of its relation to effectiveness (see above) – efficiency. However, even if mutual control is effortful in computer-supported settings, low trust should lead to mutual control, for example, by asking their collaborators if they are sure that their contributions are correct. This should reduce efficiency, while effectiveness should increase a bit. (Due to the mutual control difficulties, it is to be expected that not all mistakes will be detected.).

In addition, it is to be expected that by direct access to the collaborators' knowledge and information, the availability of the knowledge and information awareness approach (experimental condition) will facilitate mutual control. The ability for easy mutual control can therefore be given also in virtual groups. In prior studies (e.g. Engelmann & Hesse, 2010), it has been confirmed that the knowledge and information awareness approach is used if it is available. Therefore, there should not be an impact of mutual trust on mutual control; that is, there should be mutual control independent of the amount of mutual trust. Consequently, it is expected that the amount of mutual trust will not have an impact on group effectiveness and group efficiency. Due to the fact that first, the collaborators' contributions are checked and, therefore, their mistakes will be detected, and second, because the process costs of mutual control are low, an effective and efficient group performance is expected, compared to groups that collaborate without the knowledge and information awareness approach.

To sum up, we hypothesize the following effects under the assumption of the existence of individual mistakes included in the individual concept maps:

Hypothesis 1: Regarding group effectiveness as criterion, we expect a significant interaction between mutual trust and condition. In more detail, we expect that in the experimental condition, trust will not have an impact on group effectiveness, whereas in the control condition, high trust will reduce effectiveness because of less mutual control and, therefore, less mutual correcting of mistakes.

Hypothesis 2: Regarding group efficiency as the criterion, we only expect a main effect for condition in favor of the experimental condition; that is, the experimental condition will be more efficient compared to the control condition. We expect neither a main effect for trust nor an interaction of trust and condition on group efficiency.

4.2 Method

In the experimental study, an experimental condition consisting of 20 triads being provided with the knowledge and information awareness approach was compared to a control condition consisting of 20 triads collaborating without this approach.

4.2.1 Participants

Participants of the study were 120 students (84 female, 36 male) of a German university from different fields of study with an average age of 23.74 years (SD = 3.47). They volunteered to participate for payment. The participants, collaborating in groups of three, were randomly assigned to a control or an experimental condition.

The composition of the groups regarding gender were equal between the conditions; that is, both conditions had the same number of groups with no, one, two, or three women. The members of a group either did not know each other or hardly knew each other: There was no significant difference between the conditions regarding the degree of acquaintance among the members in a group ($F < 1$).

4.2.2 Setting and Materials

The members of a triad were spatially distributed and collaborated computer-supported. They communicated by using Skype (only audio). The experimental environment consisted of several shared and unshared working windows of CmapTools, a digital concept mapping software developed by the Florida Institute for Human and Machine Cognition (USA). The study was held in German. Therefore, for this paper, all contents have been translated into English.

The domain was concerned with rescuing a fictitious type of spruce forest and consisted of 13 concepts, 30 relations between the concepts and 13 pieces of background information (in parts divisible into sub-elements), each linked to a concept. These elements were evenly distributed among the three group members in a way that each member had the same amount of shared and unshared concepts, relations, and background information aspects. The shared elements were shared with either one collaborator or both collaborators.

Online questionnaires and instructions: An online questionnaire for assessing several control measure items (e.g. experience in working with computers and in groups) and for measuring the amount of initial mutual trust was included. For measuring mutual trust, several items taken from Amelang, Gold, and Külbel (1984), from Jarvenpaa, Knoll and Leidner (1998), as well as from Jarvenpaa et al. (2004), were used that were translated into German and partly adapted to our experimental setting. The 15 control measure items and the 13 items for assessing mutual trust were designed as multiple-choice items with five-point rating scales, ranging from complete agreement to no agreement. Examples of these items are: "I can create visualizations by means of a computer" (control measure item) and "In contact with strangers, it is better to be careful until they have provided evidence that one can trust them."

An online knowledge test was used to measure the knowledge of group members regarding their own and their collaborators' knowledge on particular relations and concepts. It consisted of 24 multiple-choice test items. These items were classified with regard to who possessed the requested knowledge, resulting in four types of items: (1) items asking for one's own unshared elements, that is, items measuring knowledge that one had alone in his/her individual map, (2) items asking for the collaborators' unshared elements, that is, items measuring knowledge that only one of the collaborators had, (3) items asking for shared elements that one shared with one of the collaborators, that is, items measuring knowledge that one had together with one of the collaborators, and (4) items asking for shared elements of the collaborators, that is, items measuring knowledge that only the two other collaborators had. For each item the participants stated whether they were certain that they had answered it correctly (rating scale with three possible answers: low, middle, and high certainty). In order to assess the knowledge and information awareness referring only to the collaborators' knowledge and information only the categories 2 and 4 are relevant.

A second online questionnaire was used to evaluate the study, that is, to assess among other things aspects of collaboration and mutual control as well as to subjectively rate the quality of the group performance. In addition, in the experimental condition, only the usefulness of the knowledge and information awareness approach was assessed. Again the items were designed as rating scales with answer categories ranging from one point for no agreement and five points for complete agreement. The questionnaire contained 50 items in the control condition and – due to the additional items – 56 items in the experimental condition.

The group members were provided with paper-based instructions on how to use CmapTools and with paper-based instructions to explain all the phases of the study and the tasks to be completed by the group members.

4.2.3 Procedure

After informing the participants about the set-up of the study and obtaining their signed letter of agreement to take part in the study, the three members of a group were sent to separate rooms each equipped with a desk and a computer. They began the study by individually filling out the online questionnaire for assessing several control measure items and their initial mutual trust. After that each group member practiced using CmapTools. In the subsequent phase, the group members were informed that they should imagine that they were three experts who would have to mutually rescue a spruce forest. They were told that in order to rescue this forest they would have to solve two problems, namely, which pesticide and which fertilizer they would use. The fertilizer problem could only be solved correctly if the pesticide problem was solved correctly. The groups were told that there was only one solution for each problem. They were told further that they should imagine that in the past they had taken some notes regarding these problem domains and that –based on these notes – they had to create their own digital concept map visualizing their own knowledge and information. They had 20 minutes to create their individual concept map. This was enough time for each group member to finish the individual map. The log files of creating the individual maps (by CmapTools) were recorded. After that the members of the experimental groups were additionally provided with their collaborators' individual concept maps for 5 minutes. In order to control the time in the individual phase, the members of the control groups had 5 more minutes for viewing their own individual map.

Then the collaborative problem solving phase started which lasted 35 minutes. In this phase, the groups had to solve the two problems for rescuing the forest. In order to accomplish this, they had to compile their individual conceptual knowledge by creating a digital group concept map together in a shared working window. The background information aspects were irrelevant to the problem, but this was not known to the group members. The group members could speak with each other by using Skype. Besides the shared working window, each member of the control condition had access to their own individual concept map that they had created in the individual phase (see Figure 1, on the left). The members of the experimental condition were additionally provided with their collaborators' individual concept maps visualizing their collaborators' conceptual knowledge and background information (see Figure 1, on the right).

In this collaborative phase, log files of creating the group maps (by CmapTools), as well as video and audio files (by Camtasia), were recorded.

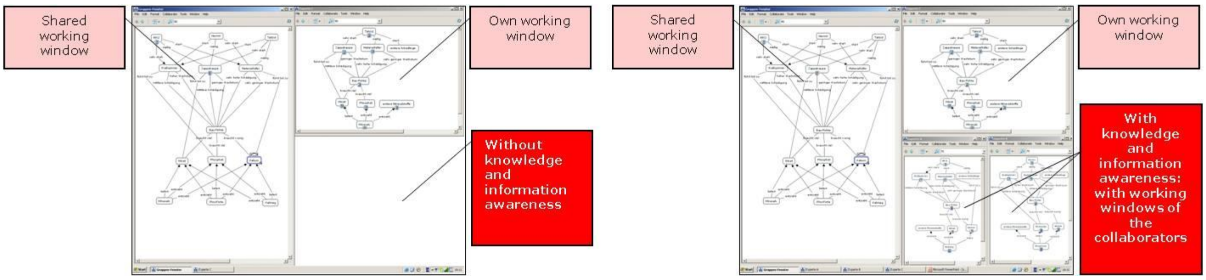

Figure 1. Collaborative phase (left: control condition; right: experimental condition).

4.3 Measures

To answer the hypotheses, besides the two conditions, the following measures were used as predictor measures:

A factor analysis with Varimax rotation with the 13 trust items included in the questionnaire on control measurements resulted in two interpretable factors (cf. Bortz, 1999), namely, "general skepticism regarding others" (in the following this will be called initial skepticism) and "trust in others due to experience" (in the following this will called initial trust). As expected, there were no significant differences between the conditions regarding these factors (for initial skepticism: $F < 1$; for initial trust: $M_C = 0.16$; $M_E = -0.16$; $F(1, 38) = 1.06$, $MSE = 1.00$, $p = .31$).

Regarding the quality of the problem solutions of the groups as criterion measures for group effectiveness, we differentiated between two dependent measures, namely, solving the pesticide problem correctly and solving the fertilizer problem correctly. If a group solved the pesticide problem correctly, one point was given; if the wrong pesticide was chosen, no points were given. Analogous to this, if a group solved the fertilizer problem correctly, one point was assigned; if the wrong fertilizer was chosen, no points could be attained. The interrater agreement for both measures was Cohens' $\kappa = 1$ indicating a perfect match (Cohen, 1960).

Regarding group efficiency, the following measures were differentiated: Because in this study effectiveness was determined as a dichotomy variable (solved vs. not solved), to determined efficiency measures, only those triads were included that solved the pesticide problem and/or the fertilizer problem correctly. Two measures were differentiated: The variable "efficiency of choosing the correct pesticide solution" refers to the collaboration time needed to decide on the correct pesticide solution. The variable "efficiency of choosing the correct fertilizer solution" refers to the collaboration time needed to decide on the correct fertilizer solution. The interrater agreement was $ICC = .96$ for efficiency of deciding on the correct pesticide solution and $ICC = .96$ for efficiency of deciding on the correct fertilizer solution (two-way mixed single measures, cf. Shrout & Fleiss, 1979).

5. Results

The experimental condition in which the group members were provided with the knowledge and information awareness approach was compared with the control condition in which the group members collaborated without this approach. All analyses presented here are based on the group level, because of both the dependent variables were variables on the group level and the individuals in a group are not independent of each other. This means that also the trust variables were calculated as group means in order to use them on the group level.

The inclusion of a covariate was not necessary because we did not find significant differences between the conditions regarding the control measures. As a manipulation check, it was analyzed whether our knowledge and information awareness approach fostered the acquisition of knowledge and information awareness: Accordant with the results of prior studies (e.g. Engelmann et al., 2010), the knowledge test resulted in a significant higher knowledge and information awareness value for the experimental condition compared to the control condition ($M_C = 18.77$ $M_E = 22.87$; $F(1, 38) = 7.41$; $MSE = 22.66$; $p = .01$; $\eta_p^2 = .16$). This value was calculated as the sum of item categories 2 and 4 each weighted by the correctness certainty (see Section 4.2.2).
Due to the fact that we were interested in interaction effects between condition and variables of trust, moderator analyses were conducted following Aiken and West (1991). The necessary requirements for conducting regression analyses were tested each time: All analyses met the global test statistic (cf. Peña & Slate, 2006).

5.1 Group Effectiveness as Criterion Variable

The regression analyses with effectiveness measures as the criterion variable as well as condition, initial trust, and their interaction as predictor variables led to the following results:

The regression analysis with the solution of the pesticide problem as the criterion variable revealed no significant conditional effect for initial trust (b = .04, SE = .09; β = .09, p = .62) or for belonging to a particular condition (b = -.02, SE = .07; β = -.04, p = .78), adjusted R^2 = -.018, $F(2, 37)$ = 0.66, p = .52. However, as predicted, a significant interaction between condition and initial trust appeared (b = .25, SE = .09;β = .50, p < .01), adjusted R^2 change = .153, F change (3, 36) = 3.35, p = .03: Simple slope analyses indicated, as assumed, that higher initial trust significantly impaired the solution of the pesticide problem of the control condition (b = -.21, SE = .08; β = -.42, p = .02). In the experimental condition trust had, as expected, no significant effect on the solution of the pesticide problem (b = .29, SE = .15; β = .60, p = .06), but in contrast to our hypothesis, a marginal effect indicating that high trust marginally increased the group effectiveness.

Regarding the measure "solution of the fertilizer problem" as criterion variables, no significant effects resulted. In addition, the regression analyses with effectiveness measures as the criterion variable, as well as condition, initial skepticism, and their interaction as predictor variables, did not result in significant interactions. Therefore, these results are not reported.

5.2 Group Efficiency as Criterion Variable

The regression analyses with efficiency measures as the criterion variable, as well as condition, initial trust, and their interaction as predictor variables, led to the following results:

Accordant with our hypothesis, the regression analysis with efficiency of choosing the correct pesticide solution as the criterion variable revealed a significant main effect for belonging to a particular condition (b = .-193.78, SE = 93.74; β = -.40, p = .05): The experimental groups needed less time for finding the correct pesticide solution compared to the control groups (M_C = 19:56, SD_C = 7:21, M_E = 13:15, SD_E= 7:55). As expected, we did not find a significant main effect for initial trust (b = -.127.96, SE = 117.38; β = -.23, p = .29), adjusted R^2 = .16, $F(3, 21)$ = 2.50, p = .09, nor did a significant interaction between condition and initial trust appear (b = -180.10, SE = 117.38; β = -.32, p = .14).

In line with this result, the regression analysis with efficiency of choosing the correct fertilizer solution as criterion variable also revealed, as assumed, a significant main effect for the belonging to a particular condition (b = -166.27, SE = 63.20; β = -.50, p < .05): The experimental groups needed less time for finding the correct fertilizer solution compared to the control groups (M_C = 22:40, SD_C = 4:42, M_E = 17:16, SD_E = 5:23). As predicted, we did not find a significant main effect for initial trust (b = 33.07, SE = 78.99; β = .09, p = .68), adjusted R^2 = .15, $F(3, 23)$ = 2.52, p = .08, nor did a significant interaction between condition and initial trust appear (b = -16.43, SE = .78.99; β = -.05, p = .84).

The regression analyses with efficiency measures as the criterion variable, as well as condition, initial skepticism, and their interaction as predictor variables, did not result in significant interactions. Therefore, these results are not reported.

6. Discussion and Implications

Our initial point was the conflicting empirical findings regarding the impact of mutual trust on group performance. While some researchers have demonstrated that trust has an effect on group effectiveness (e.g., Kanawattanachai & Yoo, 2002), others have pointed out that trust has an effect on group efficiency, but not on effectiveness (e.g. Aubert & Kelsey, 2003). In this paper, we argued that these conflicting findings could be explained by including "the amount of individual errors made by group members" as a further factor. We argued that in CSCL-settings, we must expect that group members will make mistakes due to the difficulties caused by the use of collaborative technology (cf. Kiesler et al., 1984; Janssen et al., 2007). In addition, compared to face-to-face situations, in CSCL-settings, the mutual trust is lower, and therefore, the need for mutual control is higher, while mutual control is much more effortful. Hence, we concluded that in CSCL-settings with increasing mutual trust, mutual control will be increasingly reduced, and as a result, it is likely that mistakes will not be detected, decreasing group effectiveness. In contrast, with decreasing trust, we expected increasing mutual control and, therefore, increasing effectiveness.

We further argued that our knowledge and information awareness approach counteracts this effect of trust. This approach provides group members with their collaborators' externalized knowledge structures and underlying information and, therefore, allows for easy mutual control also in virtual settings. Prior studies have shown that this approach is used if it is available (e.g. Hesse & Engelmann, 2010). Therefore, it was expected that the groups will check each other's work if provided with this approach, independent of their amount of mutual trust. Accordingly, it was expected that in the experimental condition, trust does not affect effectiveness.

To sum up, we expected a significant interaction between condition and initial trust on group effectiveness in a way that increasing trust will decrease effectiveness in the control condition, while in the experimental condition trust will not have an effect on group effectiveness.

The results of the presented study confirmed our hypothesis: In the control condition with increasing mutual trust, group effectiveness decreased. In the experimental condition, mutual trust did not significantly affect group effectiveness; however, there was a marginal effect indicating that high mutual trust marginally increased group effectiveness. The negative impact of mutual trust in the control condition can be counteracted successfully by the availability of the knowledge and information awareness approach. We explained this result with the fostering of mutual control when the knowledge and information awareness approach is available. The marginal effect may demonstrate that in the experimental condition mutual trust even fostered mutual control. Another explanation could be that the knowledge and information approach leads to a situation with high structure in which trust does not have an effect on group variables anymore (e.g. Dirks & Ferrin, 2001)

However, it is interesting to note that these effects were only found with regard to solving the pesticide problem, but not with regard to solving the fertilizer problem. A reason for this could be that the fertilizer problem could only be solved correctly if the pesticide problem was solved correctly; that is, solving the fertilizer problem depended more on solving the pesticide problem than on other reasons. In addition, it is also interesting that we only found this effect for the factor initial trust, but not for the factor initial skepticism. Initial trust was based on items such as “In most of the groups that I have worked with in the past, the group members trusted each other” or “In the past, I have worked mostly together with trustworthy people”. Therefore, it refers to the amount of general trust in others developed by prior experience. Initial skepticism was based mainly on items such as “One should be very careful if working together with strangers” or “In current times, with so much competition, you should be on the alert or someone will probably take advantage of you” and, therefore, refers mainly to a generalized skepticism about others, based more on a general attitude. This difference seems to be crucial: Initial skepticism seems not to be just the opposite of initial trust. There appears to be quality differences, at least with respect to our factors. Future studies are needed to explain this difference.

With regard to group efficiency, we expected for control groups with high trust also low efficiency because efficiency is dependent on effectiveness. For control groups with low trust, we also expected low efficiency due to much mutual control that takes time. For the experimental groups, we expected, independent of the amount of trust, high group efficiency due to the low process costs for checking the others.

This hypothesis was confirmed: In line with prior study results (e.g. Engelmann & Hesse, 2010), the experimental groups solved both of the problems faster compared to the control groups. As expected, neither a main effect for trust nor an interaction between trust and condition on group efficiency were observed. Together with the findings on group effectiveness, this result demonstrated that mutual trust may have an effect on group effectiveness, but not on group efficiency. This is accordant with Kanawattanachai and Yoo (2002) and Jarvenpaa et al. (2004). Thus, this paper also contributes to solving the conflicting findings in the literature regarding the effects of trust.

Our hypotheses were derived, among others things, from the assumptions regarding mutual control. However, in this study, we did not analyze mutual control. Future analyses could be based on the recorded discussions. However, in order to analyze mutual control in a better way, eye tracking is needed. Eye tracking results could contribute to further clarifying the postulated relations.

To sum up, this study demonstrated that the availability of the knowledge and information awareness approach overrides the negative impact of too high mutual trust that is to be expected especially in CSCL-settings. Additionally, this study further contributes to clarifying the impact of trust on group effectiveness and group efficiency in computer-supported collaborative situations depending on different situational factors such as being provided with a knowledge and information awareness approach or not.

7. References

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