Can Social Comparison Alter the Impact of Socio-Cognitive Conflict on Academic Performance?

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Abstract

Many tasks in today's society are performed in groups, and teamwork is common in educational systems at all levels. While it has been shown to have many benefits, previous research has demonstrated that it may not always work to the advantage of every student. Two underexposed facets of teamwork are that team members have many opportunities to face conflicts and compare themselves with teammates. Socio-Cognitive conflict occurs when individuals are confronted with different ideas that other group members embrace. Social comparison can be defined as the process of thinking about information about one or more other people in relation to the self. In this study, we examined the interactive influence of socio-cognitive conflict and social comparison on academic performance. The findings showed that the positive learning effects of socio-cognitive conflicts were strengthened when there were upward-identifying comparisons. We concluded that the social comparison was important to consider when designing socio-cognitive conflicts teamwork because of its constructive and destructive consequences.

Keywords

Social Comparison, Socio-cognitive Conflict, Academic Performance, Multi-agent Intelligent Tutoring System

1. Introduction

1.1. Socio-Cognitive Conflict

Supporting students becoming critical thinkers is one of the long-lasting essential themes for educational psychologists. There are various definitions and views on critical thinking, but one of the common central features of critical thinking may be that it involves high levels of cognitive engagement where students "think deeply about the arguments and counterarguments" [1]. Such critical thinking can be promoted by peer collaboration, because it may increase individual conceptual understanding of subject matter by constructing explanations for contradictory information with peers, which requires high levels of cognitive engagement [2].

Researchers, therefore, have designed a variety of instructional interventions or models based on peer collaboration to promote students' cognitive engagement for conceptual change [1]. Many conceptual change interventions or models have been based on Piaget's idea about conceptual change or cognitive development, which suggests that conceptual change arises from the dissonance or disequilibrium that exists between current beliefs and new experiences. Accordingly, in such instructional interventions, confronting someone holding an opposing point of view during social interaction (e.g., peer argumentation) induces both social (i.e., the disagreement between two persons)

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and cognitive (i.e., each individual doubts her or his own answer) conflicts, and therefore such disagreement is called "socio-cognitive conflict" [3].

Importantly, to induce such a state of mental imbalance and thinking about alternative perspectives (i.e., counterarguments), simply putting two people together is not sufficient [2]; instead, argumentation is a necessary component. Argumentation is an activity in which individuals "attempt to strengthen or weaken the acceptability of one or more ideas, views, or solutions through engagement in reasoning" [4]. Indeed, argumentation has been identified as a promising instructional practice across different domains including science, mathematics, social science, and even physical activities [1-2, 5].

These learning benefits, however, are not guaranteed by all forms of peer argumentation. Instead, there are some important characteristics that differentiate unproductive and productive peer argumentation. For instance, just finding erroneous ideas in each other's reasoning is not sufficient for a good understanding of the concept, but identifying, accepting, and integrating more plausible ideas into one's own understanding is also necessary. Asterhan addresses this point as productive and effective argumentative discourse for learning, and cognitive development should not only be critical but also constructive [2]. This type of ideal argumentative discourse, one that balances critical reasoning and collaborative construction, is introduced by different researchers with various names, including 'deliberation', 'collaborative argumentation', 'exploratory talk', 'critical discussion', 'co-constructive, critical argumentation', and 'constructive controversy' [1-2, 4-5]. The benefits of this ideal argumentative discourse for learning apply across not only educational domains but also contexts such as peer-managed classroom discussions or computer-assisted dyadic interactions [1, 6].

Unfortunately, in educational settings especially it is often challenging for students to focus only on collaborating with others to solve the problem, or epistemic issue. In peer learning, students are not only concerned with understanding the cognitive issues, but they are also concerned with different social issues (e.g., competence threat) that can hinder students' productive peer argumentation and, in turn, diminish learning gains. Socio-cognitive theory posits that there are two different ways that this socio-cognitive conflict is regulated, and prior research has shown that students' different regulating styles are associated with different academic achievement [2].

On the one hand, when individuals are uncertain about the validity of different points of view (the "cognitive" issue: "Is my answer correct?") [7], they tend to regulate the socio-cognitive conflict in an epistemic way by focusing on the task and on understanding the problem. When individuals engage in epistemic regulation, they are more likely to consider the validity of each other's answers and try to integrate their diverging views to better understand the task or problem. Hence, epistemic regulation is associated with cognitive progress [3]. On the other hand, when individuals are uncertain about their own competence relative to a confronting partner (the "social" issue: "Is my partner more competent than me?") [8], they tend to regulate the socio-cognitive conflict in a relational way by focusing on social comparison and on defending their competence. When individuals engage in relational regulation, they are either more likely to confirm their viewpoint in order to win an argument and demonstrate their competence, or they are more likely to conform to the other's viewpoint in order to avoid showing their incompetence [8-9]. Overall, relational regulation is associated with less cognitive progress as compared to epistemic regulation.

In short, one may expect the ways of socio-cognitive regulation to be differentiated depending on one's perceived competence on a task and the perceived context in which the socio-cognitive interaction takes place. Another theory - social comparison theory [10] - is well positioned to identify different types of social contexts and to describe how these different social contexts, or social interdependence, can determine group processes and outcomes, which could lead to better understanding of the relations between different social interdependence and different kinds of concerns and conflict regulating styles in interpersonal contexts.

1.2. Social Comparison

Productive peer argumentation is challenging for a lot of students even with specific guidance for critical argumentation [2]. An underexposed facet of peer learning is that students have many opportunities to compare themselves with teammates. To a certain degree, such comparisons are destructive. When working with others, one's concern about looking stupid to others, or concern about

providing incorrect answers (misinforming others), can inhibit productive argumentation and, in turn, suppress learning and cognitive development. But social comparisons also have the potential of being functional and motivating. For example, individuals who watch well-performing teammates can learn from them how to improve their own learning performance, and individuals who notice that they are performing better than other group members may derive satisfaction from their superior performance.

Despite social comparison being a social phenomenon, most research on social comparison has been restricted to the implications of social comparison for the individual or for intergroup relations. Little research has examined the implications of social comparison for processes within learning groups. The lack of interest in intragroup comparison is particularly notable because social comparison theory was founded originally in the study of group processes [10].

While Festinger assumed that individuals are motivated to actively search for social comparison for reasons of self-evaluation (i.e., in order to reduce uncertainty about one's own attitudes and abilities) [10], Brickman and Bulman suggested that under certain conditions, individuals are motivated to actively avoid social comparison (e.g., when comparison with a high performer is too threatening for one's self-esteem) [11]. We argue, however, that when students study closely together in a group, they can hardly avoid social comparisons. This is due to them being more or less interdependent, and inevitably confronted with the attitudes, abilities, looks, performance, and personalities of other people. These social comparisons will induce thoughts that will be related to group learning processes and outcomes.

Individuals can compare themselves with persons who are performing better than they are (i.e., upward comparison), as well as with persons who are performing worse than they are (i.e., downward comparison). Upward comparison can induce identifying thoughts such as "I can do that as well," or contrasting thoughts such as "I can never perform like that." Likewise, downward comparison can induce identifying thoughts such as "That may happen to me, too," or contrasting thoughts such as "I do that much better" [12]. Such thoughts reflect how constructively one thinks and feels about oneself and the comparison target after social comparison. The upward comparison process is generally a better incentive for self-improvement than the downward matching process [12-13]. Indeed, viewing others performing slightly better than themselves may lead people to set higher personal standards which can motivate efforts to improve themselves, and by doing so, they improve themselves.

It follows from social comparison theory that socio-cognitive conflict learning may vary as a function of social comparison. Under positive interdependence, individuals focus on resolving epistemic conflicts, whereas under negative interdependence individuals focus on protecting self-competence. In other words, individuals' main concern during socio-cognitive interactions may differ depending on how individuals perceive social interdependence. In the present experimental study, we examine how the socio-cognitive conflict and the social comparison process are associated with learning outcomes in a multi-agent intelligent tutoring system context in which a participant and two pedagogical peer agents generate ideas in an argumentation group.

2. Method and Results

2.1. Undergraduate Participants

107 undergraduates at a general university in China were recruited to participate in exchange for extra course credits. They all had no related learning experience in the research method (experimental material). Five volunteers were dropped from the dataset because their finishing time of the experiment was over 3 standard deviations above average time. This resulted in a final sample of 102 participants (69 females and 33 males, mean age = 21.26 years).

2.2. Mixed Design

The study involved a 4 (Socio-cognitive Conflict as the within-subjects factor: true-false, false-true, false-false, true-true) x 3 (Social Comparison as the between-subjects factor: upward-identifying comparison, upward-contrasting comparison, no comparison) mixed design. Participants received all four types of socio-cognitive conflict in a Graeco-Latin Square order and were randomly assigned to

one of the social comparison conditions. Proportional academic performance was computed as (posttest - midtest)/(1 - midtest).

2.3. Socio-cognitive Conflict Manipulation

Similar to D'Mello et al. [14], socio-cognitive conflict was operationalized by varying contradictory information in agent agreement and information correctness during the trialogues (three-party conversation: a participant and two pedagogical peer agents) phase. In the control condition, both animated agents agreed on the correct information (true-true), while in the other three experimental conditions, two agents either disagreed with each other or agreed with the incorrect information. After both agents presented their respective opinions, one of them would ask the participant to express himself. The contradiction between the agents' opinions was expected to trigger the participant's socio-cognitive conflict (see Fig. 1).

Figure 1: Screenshot of learning interface.

2.4. Social Comparison Manipulation

Like the within-group factor of socio-cognitive conflict, the between-group factor of social comparison was also manipulated during the trialogues phase in the experiment. We operationally defined the social comparison (i.e., upward identification and contrast) as follows. Students were asked to compare themselves upwardly by the following sentence (translated from Chinese): "The peers in your small learning group are top students of the class, and perform very well in argumentation." Following this introduction, there were two items on identifying thoughts: "Learning with these superior peers, you can do that as well" and "That's the way you're going to do it, too"; and two items on contrasting thoughts: "Although learning with these superior peers, you may hardly perform like that" and "You may hardly attain that." The validity of the three types of social comparison that we distinguish in the present study has been supported by a series of recent studies [12].

2.5. Procedure

All research content and procedures were presented via a multi-agent intelligent tutoring system environment developed for the purposes of this study (see Fig. 1 for a screenshot). The experiment occurred over five phases (total 2.5 hours): the participants (1) took a pretest for prior knowledge, (2) acquired research method knowledge through multimedia learning to identify the contradictory information in later trialogues, (3) took a mid-test to assess control over academic performance in multimedia learning, (4) attended eight trialogues (each about one concept) that offered contradictory and social comparison contexts to induce the participant's socio-cognitive conflict in between-group different atmospheres, and last (5) took a post-test to check each one's overall academic performance. Each trialogue in the fourth phase began with a description of a research method practice case. Participants read the description and then discussed it with the agents. The research methods contents mainly consist of fundamental design principles (e.g., random assignment and control groups).

2.6. Academic Performance Measurement

We tested the learning content about eight concepts of research methods covered in eight trialogues three times, including pretest, mid-test, and post-test. The academic performance served as the dependent variable and was used to assess the benefit of socio-cognitive conflict induction, indicated by the score gap between the post-test and mid-test. Each test had 24 multiple-choice questions with three questions per concept. The three types of items were based on the first three levels of Bloom's Taxonomy (knowledge, comprehension, and application). Three alternate test versions and assignments were counterbalanced across participants.

2.7. Results of Academic Performance

Table 1: Means (*M*) and Standard Deviations (*SD*) of Academic Performances.

	UIC ($N = 34$) *M (SD)*	UCC ($N = 34$) *M (SD)*	NC ($N = 34$) *M (SD)*	Total ($N = 102$) *M (SD)*
True-False	.43 (.16)	.3 (.12)	.26 (.2)	.33 (.18)
False-True	.4 (.12)	.31 (.1)	.27 (.2)	.33 (.16)
False-False	.16 (.13)	.24 (.12)	.21 (.11)	.2 (.12)
True-True	.29 (.12)	.18 (.09)	.2 (.09)	.23 (.11)

Notes. UIC = Upward-Identifying Comparison, UCC = Upward-Contrasting Comparison, NC = No Comparison.

To test which condition of social comparison benefited the participant's academic performances and whether these effects were dependent on the different socio-cognitive conflict occurrence, we ran a 4 (Socio-cognitive Conflict) x 3 (Social Comparison) mixed-model analysis of variance (ANOVA), with repeated measures on the factor of Socio-cognitive Conflict. This analysis yielded a significant interaction between socio-cognitive conflict and social comparison, $F(6, 297) = 8.69$, $p < .001$, $\eta_p^2 = .15$. Simple-effects analyses suggested that participants experiencing socio-cognitive conflict under the true-false condition reported more learning gains in the upward-identifying comparison group than both of the upward-contrasting comparison (Table 1, $M_{UIC\text{-}UCC} = .13$, $SD = .04$, $p < .01$) and control group ($M_{UIC\text{-}NC} = .17$, $SD = .04$, $p < .001$). The same significant learning gain pattern was also showed in both of the false-true ($M_{UIC\text{-}UCC} = .1$, $SD = .03$, $p < .05$; $M_{UIC\text{-}NC} = .13$, $SD = .03$, $p < .001$) and true-true condition ($M_{UIC\text{-}UCC} = .11$, $SD = .02$, $p < .001$; $M_{UIC\text{-}NC} = .09$, $SD = .02$, $p < .01$). However, socio-cognitive conflict experience under false-false condition only showed better performances in the upward-contrasting comparison group ($M_{UCC\text{-}UIC} = -.08$, $SD = .03$, $p < .05$) than the upward-identifying comparison group.

3. Discussion

Drawing on socio-cognitive conflict perspectives on group learning [3] and social comparison theory [10] in particular, we developed and tested the idea that learners facing socio-cognitive conflicts acquire more knowledge when they are in upward-identifying comparison. Due to using the between-group social comparison design, this study extended the preceding studies by addressing the issue of environmental boundary conditions of socio-cognitive conflict in learning. We also obtained additional evidence about the different impacts of the intragroup social comparison environment on the complex learning effects of socio-cognitive conflict.

More specifically, under the simple and clear socio-cognitive conflict condition (true-false and false-true), participants acquired more knowledge about scientific research content in the upward-identifying comparison group rather than both of the upward-contrasting comparison and control group. Apparently, upward identification leads to respect for the other, and this is accompanied by trustful feelings. Upward identification also reflects optimistic feelings that one has control over improving one's functioning, which seems to provide motivation to improve one's performance, whereas the other might serve as a model that provides instrumental information. This is in accordance with former research [12-13].

However, among the participants in the false-false condition of socio-cognitive conflict which were complex and obscured, the opposite learning effect for them was observed. That is, the academic performance was more salient in the upward-contrasting comparison than the upward-identifying comparison. The upward comparison does not always lead to better academic performance. When people blindly rely on the views of the better other instead of finding their own answers, this may obstruct learning. While thinking that one will not be able to become as good as one's teammate may inhibit motivation to learn from teammates but arouse the reflection on the task, which may facilitate learning.

To conclude, our study was one of the first attempts to study the social comparison in student-agents learning groups and how this comparison is related to socio-cognitive conflict learning outcomes. It appears that social comparison processes indeed are important to consider when socio-cognitive conflict work is designed to be performed in groups, rather than by individuals. Those processes have both advantages (e.g., learning from watching better-performing group members) and disadvantages (e.g., distrust, which is associated with contrast). By studying these kinds of group-related social comparison issues, we have brought back the study of social comparison where it was founded: within the domain of intragroup processes. Besides theoretical relevance, this may prove to be of much practical relevance. Since people are working in groups more and more, it is of great importance to know the positive and negative effects of social comparison in socio-cognitive conflict conditions where people cannot escape from social comparison.

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3.2. References

[1] E.M. Nussbaum, G.M. Sinatra, Argument and conceptual engagement. Contemporary Educational Psychology 28, (2003): 384-395.
[2] C.S.C. Asterhan, B.B. Schwarz: Argumentation and explanation in conceptual change: Indications from protocol analyses of peer-to-peer dialogue. Cognitive Science, 33 (2009): 374-400.
[3] C. Buchs, C. Pulfrey, F. Gabarrot, F. Butera, Competitive conflict regulation and informational dependence in peer learning. European Journal of Social Psychology 40, 418-435 (2010).
[4] M. Baker, J. Andriessen, S. Järvelä, Affective learning together: Social and emotional dimensions of collaborative learning. Routledge, New York (2013).
[5] D.W. Johnson, R.T. Johnson, Energizing learning: The instructional power of conflict. Educational Researcher, 38 (2009): 37-51.
[6] A.J. Saltarelli, C.J. Roseth, Effects of synchronicity and belongingness on face-to-face and computer-mediated constructive controversy. Journal of Educational Psychology 106, (2014): 946-960.
[7] J. Piaget, The equilibration of cognitive structures: The central problem of intellectual development. University of Chicago Press, Chicago (1985).
[8] N. Sommet, C. Darnon, F. Butera, To confirm or to conform? Performance goals as a regulator of conflict with more-competent others. Journal of Educational Psychology 107 (2015): 580-598.
[9] Z. Long, H. Gao, N. Dowell, L. Yang, X. Hu, Impact of Rejection Sensitivity on Socio-cognitive Conflict Learning in Intelligent Tutoring System Environments, In 19th International Conference on Artificial Intelligence in Education, London (2018).
[10] L.A. Festinger, A theory of social comparison processes. Human Relations, 7 (1954): 117-140.
[11] J. Suls, R.L. Miller, Social comparison processes: Theoretical and empirical perspectives. Hemisphere, New York (1977).

[12] B.P. Buunk, R. Zurriaga, V. Gonzalez-Roma, M. Subirats, Engaging in upward and downward comparisons as a determinant of relative deprivation at work: A longitudinal study. Journal of Vocational Behavior, 62 (2003): 370-388.
[13] J. Suls, L. Wheeler, Handbook of social comparison: Theory and research. Plenum, New York (2000).
[14] S. D'Mello, B. Lehman, R. Pekrun, A. Graesser, Confusion can be beneficial for learning. Learning & Instruction, 29 (2014): 153-170.