A Case Study of Team-based Problem Solving Processes: Comparison between Successful and Unsuccessful Teams

Du-hong PENG¹,*, Dian-zhi LIU², Mu-ye HE³ and Dong-qing SONG⁴

¹College of Education and Public Management, Suzhou University of Science and Technology, Suzhou, China, 215011
²School of Education, Soochow University, Suzhou, China, 215123
³Deptartment of Education Science, Lijiang Teachers' College, Lijiang, China, 674100
⁴College of Educational Science, Liaocheng University, 252000

*Corresponding author

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Abstract. The goal of current study was to compare the differences between successful and unsuccessful teams among their problem-solving process. According to the results that “completely/correctly solving” (successful), “part solving or completely wrong”(unsuccessful), 3 typical teams were selected from 11 teams randomly, and coded the whole discussion text with Nvivo8. The results showed that: (1) The success or failure of team problem solving was not necessarily related with interaction time, length and frequency. (2) Whether a team could solve the problem or not within limited time depended on the quality of team members’ promotion reciprocally. To capture the correct ingredients, discard the wrong ones, and then refined and sustained the others’ right thoughts would decide the final result. (3) Successful team was closely monitored peer thinking, and it had outstanding performance on capturing the important cognitive contribution of their companions and keeping advancing. (4) During the process of the team interaction, individual cognition was greatly influence by the quality of team’s support.

Introduction

The world is consisted of problems, problem solving is the essential consist of human lives. There is a great deal of research focusing on individual problem solving processes (e.g., Kim,2015; Fischer et al., 2015; Ramirez et al., 2016), in contrast, team-based problem solving has not been paid much attention. Modern organizations rely increasingly on the use of diverse work teams (Bar et al., 2008). Parallel with the increased popularity of teams in organizations, teams are now common in schools in various ways, including Teacher Assistance Team (Chalfant, Pysh & Moultrie, 1979); instructional support team (Kovaleski & Glew, 2006); student assistance team(Rankin & Aksamit, 1994); student entreprenue team (e.g., Harms,2015); specific problem-solving team (e.g., Gelzheiser,2009). Teams are considered more effective in task performance than isolated individuals. In addition, it related to improved learning, higher order thinking skills, higher grades and better preparation for the workplace (Shimazoe & Aldrich, 2010).

Despite their growing used and advantages, teams do not always perform productively and effectively as it should be. In team interaction situations, conflict, frustration, and stress can not be completely avoided, which can hinder the performance (Hackman, 1987). In addition to structural elements, there are processes within teams that help account for real differences in outcomes (Brannick et al., 1995). The prevalent framework of team effectiveness is inputs, processes and outputs of the team (Barrick et al., 1998). Though much influential research has explored variables of team’s “input” or the factors influence the “output”, the process of team cooperation still remains substantially understudied. Recently Willenbrock et al. (2015) took videotapes for 30 problem solving team meetings from two organizations and coded the verbal behavioral interactions of leaders and team members over the course of their entire meetings. However few research laid on
school-based problem-solving team processes, especially trying to analyze the content of discussion during the entire problem solving process. Therefore, in both organizational and educational studies, there is an increasing demand for studies to better understand team processes.

A team can be regarded as three or more individuals who interact to achieve common goals and accomplish productive outcomes (Erickson et al., 2015). In this study, we aimed to examine, in an observational case design, the whole process of team-based problem solving. Team success can be evaluated by the results which the members solve a challengeable problem cooperatively. As Driskell et al. (1987) described effective teams as “productive, cohesive, and resistant to performance degradation under stress.” In terms of the results of problem solving, we differentiated them into successful team and unsuccessful team. The questions guiding the study were: (1) What are the main differences during team process between these two kinds of teams? (2) what kinds of high-level cognitive interaction during team problem solving process lead to team’s success or failure eventually? We tried to provide the detailed description and comprehensive information of team problem solving processes, by comparing and analyzing the successful and unsuccessful teams’ processes of the whole discussion.

Method

Participants

In the study there were 11 undergraduate teams consisted voluntarily and randomly having finished the challengeable task “Borderline of death”. According to the extent of the problem solving, we selected one team completely solved the problem as successful team, one partly solved the problem and one completely not solved the problem, the later two as unsuccessful teams from the 11 teams randomly. Thus the document which would be analyzed came from 3 teams, 9 undergraduates (each team has 3 students) in total.

Task

We chose the “Borderline of death” (Five pirates have to divide 100 diamonds according to a certain rule promoted by themselves) from many problem solving tasks for its complexity, exploring, clearing and demanding cooperation. And then we tested the task by 142 undergraduates. It indicated that 87.3% students responded it was very difficult. Only 2.1% students figured out the answer completely. Then we tested the task with 6 undergraduate teams to make sure that it is appropriate to 2-3 individuals in a team.

Coding and analyzing framework

During the tests of the problem task, we also collected students’ key right or wrong thoughts, questions and so on(See Table1 and 2), which were used as the coding and analyzing framework in the study.

<table>
<thead>
<tr>
<th>Key Words</th>
<th>Definition</th>
<th>Example Lists</th>
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<tbody>
<tr>
<td>Key proposals</td>
<td>The discourse or proposal that a directly promoting role in problem solving</td>
<td>[c:when assigned by play no.3 he must be 50 If only 3,4,5…no.5 is 50, give no.4 nothing]</td>
</tr>
<tr>
<td>Key questions</td>
<td>The question that directly related to problem solving or promote others’ think</td>
<td>[b: the third? a: assign a little to no.5, but how much? ]</td>
</tr>
<tr>
<td>deviating proposal(or doubt)</td>
<td>Proposal, words or doubtin relatively common error thought</td>
<td>[a: but I think the scheme that the 1st one formulated is must be…his assignment must be smaller than others’, if not ,you won’t get the agreement from others. ]</td>
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Table 2. The plot marker that emerged after critical discourses.

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<th>Emergent Polits</th>
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<td>Corresponding typical plot marker after the emergent of the critical discourse's</td>
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<tr>
<th>The emergent of Critical disposal</th>
<th>Ignore, denial, repeat or existence question (mutual understanding plot - negative) Identity, add, refined (mutual understanding plot - positive)</th>
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<tbody>
<tr>
<td>the emergent of key questions</td>
<td>No response, no answer, wrong solutions (mutual support plot - negative) answer, hint, interpretation and explanation (mutual support plot - positive)</td>
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<tr>
<td>the emergent of deviation or error proposal</td>
<td>Identity, add, supplement (mutual monitoring plot - negative), question, denial (mutual monitoring plot - positive)</td>
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Procedure

The study began with task choosing and testing. After pre-research we tested student teams in a quiet classroom. In the first stage, students solved individually for 20 minutes, and in the second stage, only when they cannot solve the problem they began to try together as a team (if some student solved the problem successfully in the first stage, then the team was dismissed). The whole discussing processes were video-taped. In the end transcript the tape of the whole discussion of the selected teams to text.

Results

Case 1: Completely Solving the Problem

Background of the Team. The team members were sophomore from institute of sociability, this team was a typical one who completely solved the problem in relatively short time. In the stage of individual problem solving (20 minutes), all of them didn’t solve the problem. Member B and C’s thoughts were completely wrong, member A had some correct thoughts but he couldn’t advance his own thoughts to solve the problem. The length of the discussion: 1902 words, 105 discourse in total (A:36, B:35, c:34).

The Typical Plots of Team Interaction. In the process of team interaction, key proposal emerged twice. They were all identified and refined (mutual understanding plot-positive); key questions emerged 4 times, 3 of them were answered or hinted effectively (mutual support plot-positive). Wrong proposal emerged 9 times, 6 of them were questioned and denied (mutual monitor plot-positive).

With the Change of the Individual Idea as the Clue. From the change of the individual answers and idea, we can see that A and B is totally wrong at the stage of individual problem solving (If reasoning with his idea, he won’t solve the problem for ever, it have been revealed in the previous test); C has found the relationship of the 1, 3, 5, but it far away from member assignment(it is another challenging difficulty to assign the members, many teams can’t complete the reasoning about “Benefit maximization”). At the stage of cooperation, A, B, C changed their previous thinking by absorb the rational elements of their companion cognitive, especially C’s idea inspired B’s thinking, B and C promote each other, A understand his companion immediately and organized the discussion timely—shown the role of good organization and leadership spontaneously.

Case 2: Partly Solving the Problem

Background of the Team. The team members were sophomore from institute of sociability, this team was typical because they didn’t solved the problem completely in a limited time. In the stage of individual problem solving, all of them didn’t solve the problem. It takes them 43 minutes to solve the question through teamwork. The length of the discuss: 6827 words, 281 discourse in total (a:105, b:109, c:67).
The Typical Plot of Team Interaction. The typical plot analysis showed that at the beginning of the group discussions, B’s reasoning in a forward to the key proposals under the premise (or ideas), "left 4.5, he agreed that there will be half a man", and recognition; but the flashed Cognitive contributions to the key words not to be caught. Meanwhile, each member had both the reasonable inference and the wrong ingredients that may have less clarity and consistency in the bud. Fellow team members who could grasp the idea of the emergence of the right to help identify and promote germination relatively weak. Resulting in the key proposal was flooded, not spark thinking. Instead, the proposal to make the team into a deviation from the difficult hard to answer, the result of exploration into the long.

Changes in a Single Principal Thinking for Clues. From a single subject ideas change and influence each other to see, A suggest the most number of correct and wrong advices, but, she had never get out off the 5th 3 alley. But, the B C fails to point out the loopholes to help their breakthrough. In contrast, B is mainly to understand A’s meaning, basically have no breakthrough. If B or C have more monitoring and support, they may be get out of a dilemma, and then make their team solve the problem successfully. In contrast, C is more of a effort to keep up with the discussion of A and B, and he have repeatedly put forward some clarified questions. At the same time, based on B’s knowledge-based contributions A does not forward it enough. So that, team members fall in trouble many times because of the wrong reasoning of key issues, and then in chaos. If each of them in other “recent development” a little coaching, they could guide to a clear process and finally success.

Case 3: Solving the Problem Completely Wrong

Background of the Team. The team members were sophomores who came from School of Social Sciences. This team was a typical team that they didn’t solve the problem even prolonged long time. A, B and C’s thoughts of the question were wrong in the first stage. The discussion time for this team was: 80 minutes. The length of discuss: A total of 13,297 words; a total of 504 words(A 185 discourse, B 224 discourse, C 95 discourse).

The Typical Plot of Team Interaction for Clues. A typical plot analysis of team interaction showed that, at the beginning, the team discussion has controlled. With the depth of the discussion, the team has more deviation or error propose, and more weaker monitoring. Team members could not to deny peer cognitive processing errors so that grabbed the wrong direction together. At the same time, very few key proposals within the team emerged, the occasional reflection and also failed to obtain the correct capture and confirmed.

Changes in a Single Principal Thinking for Clues. B and C with the wrong ideas into the whole discussion process, they basically did not change and give up their wrong idea, that is, the cycle distribution of ideas B, the preservation thought of C. A proper characterization of the problem based on the correct level of the judge to answer, in the process of cooperation, A have the impact of wrong representation and reasoning by other team members. Thus the team finally came out all the conclusion that give gems to pirate1.

Discussion

There wasn’t Necessarily Connect between Team Success in Problem Solving and Interaction Time, Frequency and Length

The analysis of completely wrong answer cases finds, team members are discuss based on false representation. Representation is a central element of problem solving. Thus, the problem representation on the lack of monitoring is the cause of the failure of cooperation to solve. No correct answers emergence is the root causes of failure of cooperation to resolve. In the process of the completely wrong answer team’s discussion, we can see that there is no properly idea emerge. We can see that, a team which can solve the problem needs right idea and a number of correct thinking, without thinking, though the time of discussion very long, interactive frequency and
better atmosphere, also "useless", 3 one can not be a wise gay. Several completely wrong team all in this problem. Team members which are in a wrong direction has not come out, going around, all around the final head dizzy. Between members and not simply the same time challenged, abandoned or deny the idea of the existing errors. That is, even if they failed to provide the correct replace idea, but if provide a firm denial, questioning, may also help to improve the process. In short, completely wrong team failed to effectively monitor the off point which is appears repeatedly, so that the team grabbed the wrong direction, repeatedly processing, even if the team has made it clear before the error, then went back to the error, is always thinking on Blind faith, eventually ended in failure. The team problem-solving process of problem solving reflects that there were closely related to the emergence of key proposals, on the contrary, it has less relevant with the length of time and interaction, and the degree of interaction (such as participation, conflict frequency, input level). This inspired us that team interaction must be based on the right direction. When individual faced with difficulties which are higher than his cognitive, and interact with the higher levels of people may be the better effect, so as not with the serious deviation characterization of the problem, and the more interaction the more confusion.

Whether the Team Had the Emergence of Correct Idea or not Was not the Key to Solve the Problem Successfully

Some scholars have pointed out that when the subjects are exploring the problem space, and he did not know the direction is correct, or even do not know the linear structure of the problem space. Therefore, subjects were always change their direction of movement in the process of exploration, which showed that they often "undo" the operation has just returned to their previous state. In the end, after a certain time they will suddenly to find the right direction, from one position to the target state to solve the problem, this is “final path” without repeating the sequence of operations called by Reber and Kotovsky. In their view, " final path," represents the subjects received some critical problem-solving strategies (cited in Guo Xiuyan, 2003, p.415). However, in the team problem solving, when the emergence of a right or key proposal in the team, not necessarily solve the problem successfully. The "partial solutions" cases 2 shows that the most critical problem-solving ideas have emerged, so the team got some answers to the questions, but because of the key proposals did not advanced and the lack of adequate monitoring, the team did not succeed. For example, A’s proposal or words containing both right and wrong parts, but peers can not figure them out, questioning, denial and abandon some of its mistakes, while capture, seize, and promote the correct part, so the key of processing emerge many times but can not been retained, while the information in A and B’s cognitive processing chain is not connected properly and push forward, on the contrary, covered by error or deviation proposal. This also shows the lack of enough members support.

We can see the quality of the team to promote each other from a single body’s thought changes. Case 2, A major gain the support of B, such as the team is recognized the relationship of the last three Pirates, A is reasoning between 3,4,5 pirates, and B promote the discussion of the test view on the maximum possible benefit. However, C did not keep up with the discussions within the team, not to say that fellow "recent developments" in advance. Such as did not consider the Pirates 4, but C still thinking in front of this line that have been identified. Therefore, whether team members can achieve "Everybody made a little" and "put together on the part of the“ cooperation, decided the success of solve problem in a given time.

Members’ Mutual Monitoring and Mutual Advancing was Crucial to Succeed in Team-based Problem Solving

From cases 1 that can give "full answer" in short period of time, we can see that the team problem-solving process has key proposal, key question, and wrong proposal. But the key proposal emerge of problem-solving, the members play outstanding performance in understanding, team members pay close attention to each others’ thought, did not ignore the circumstances of the key proposal, especially play more decisive negative on deviation or error. Such as the 9 times wrong suggestions emerged in the team, and 6 of them have denied. In team task, individuals can organize
their own characterization used other members’ feedback, making it more accurate. Because of the feedback is unbiased, timely and multi-directional, so the team members have the ability to detect the error and corrected, individual can easy access to accurate and comprehensive information, so that the recognition continuous optimization. In case 1, the team members better detected errors and change their perception by peers, and better be the right companion component of cognitive processing and further processing of nutrients as their own, and then make an effective thing, show mutual monitoring and the outstanding features of continuous promoting.

However, the reason why the team solve the problem more than 20 minutes, because a member has the right ideas, that is, from a personal background, C at the phase of the individual answers, give the answers "30,0,35,0, 35 ", which we can guess, he capture the relationship between 1,3,5. However, in his view of team discussion, he continued to complete the answer is not easy. The directions of individual ideas’ changing was closely related to the team.

It could be seen from the case1, A and B make the wrong ideas in the stage of answer alone, but in the team discussion the error become clear and correct. It can be seen from the case 3, that A had the basic right original characterization of the question, and showed a weak monitoring misrepresentation in peer problems at the beginning and last of the discussion, as discussed in depth, A’s correct judge based on original problem representation had disappeared. We can see from the case 2, although A and B in the cooperation of discussion the mutual understanding of their reasoning is better, but failed to point out the biggest obstacle or errors in cognitive processing of companions, so that, A and B had been hit by a key problem that problem cannot be solved. If other members in the give some support, it will make problems become clear. So individual cognitive activities and team and team support all has the very big relations. It is reasoned that the individual cognitive processing changes may be completely different in different team. Vague or incorrect understanding may become more clear and correct though a team, it also may become more and more confused by a team.

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