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# Teamwork in the Balance: Exploratory Findings of Teamwork Competency Patterns in Effective Learning Teams

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**Abstract:** Teamwork is an important life skill and competency for 21<sup>st</sup> century learners. It also contributes to effective learning teams. In this exploratory study, we examine the different levels of team effectiveness and describe the varying patterns of teamwork competency dimensions from students' online problem-solving chatlogs. We employed two types of measures for a holistic understanding of team effectiveness, namely, task performance scores and learners' perception of how effective they are as a team. Teams were categorized into four levels of team effectiveness based on the measures. A content analysis of teamwork competency dimensions was also performed. Our findings revealed the need for balance in teamwork competency behaviors for effective learning teams. Insights from the findings could lead to design principles for interventions to nurture teamwork competency in our 21<sup>st</sup> century learners.

**Keywords:** teamwork, 21<sup>st</sup> century skills, effective learning teams, chatlog, CSCL

## Introduction

Teamwork is one of the important 21<sup>st</sup> century competencies for learners of this day, yet learning how to become more competent at it can be challenging. Amongst the difficulties is that the concept of teamwork is not easily identified or measured in the classroom. Nevertheless, past research has acknowledged transportable measures of teamwork. However, these have tended to focus on learner perspectives rather than their interactions. There has been limited research that identifies teamwork competency measures through the interaction and dialogue of teams. In line with CSCL research that focuses on the interactions paradigm (Dillenbourg, Baker, Blaye et al., 1996), we examine the chatlog of learning teams for teamwork competency dimensions. Moreover, synchronous chat is considered a useful medium as it allows teams to spend more time in deep reasoning and distributes participation (Sins, Savelsbergh, van Joolingen et al., 2011). As part of a larger study, a six dimensional teamwork competency model for learning teams was developed from past literature and pilot studies (Koh, Hong, & Seah, 2014) namely: coordination (COD) - organizing team activities to complete a task on time; mutual performance monitoring (MPM) - tracking the performance of team members; team decision making (TDM) - integrating information, selecting the best solution, and evaluating the consequences in a team; constructive conflict (CSC) - dealing with differences in interpretation between team members through discussion and clarification; team emotional support (TES) - supporting team members emotionally and psychologically; and, team commitment (TCM) - identifying with and being involved in team goals.

Teamwork is complex and research is still ongoing on the conditions and processes of effective teams (Näykki, Järvelä, Kirschner et al., 2014). Team effectiveness can be measured through performance scores and perception surveys. In this current study, we employed both types of measures for a holistic understanding of team effectiveness, i.e., task performance scores and learners' perception of how effective they are as a team. Teams can be categorized into different levels of team effectiveness. Several papers have compared effective teams with ineffective ones in order to characterize and identify behaviors of effective teams (Soller, 2001). Similarly, this exploratory study will examine different levels of team effectiveness and describe the varying patterns of teamwork competency. We ask, what are the teamwork competency patterns of various team effectiveness levels? Identifying these patterns can help teams to become more aware of their processes and subsequently adjust their team behaviors and learn to become more effective teams.

## Method

### Activity and dataset

An online collaborative problem-solving activity was created as one of the programs in the Project Work curriculum. The participants were 14 year-old, Secondary Two students in a Singapore Secondary School. In randomized teams of 3 or 4 in a class, students used synchronous group chat to solve the tasks. Prior to the problem-solving task, students were given an icebreaker task to help them get to know their team members and familiarize them with the chat system. For the problem-solving task, students had to discuss online and collaboratively find a solution to a dilemma scenario of a factory run by a student's father which was polluting the environment and affecting the health of the elderly in a nearby hospice. Students were given about 45 minutes in class to solve the task in teams, after which they responded to a survey.

All the students in the Secondary Two level who had the Project Work subject were invited to participate in the study. This resulted in 76 teams. For this analysis, we focus on 34 teams as content analysis for these teams have been completed; the coding for remaining teams is still in progress. These 34 teams have a total of 9778 chat lines ranging from 71 to 487 lines per team and an average of 287.6 lines per team.

### Team effectiveness measures

Team effectiveness was measured through task performance scores in the problem-solving task and self-reports of team members. The last answer given by a team in the chatlog was extracted as the final answer, which was used to measure task performance score. This final answer was marked by a teacher based on a rubric which evaluated the solution's understanding of the task requirement and coverage extent.

For the self-report measure, three items from the team effectiveness scale (Van den Bossche, Gijsselaers, Segers et al., 2006) were used. Individuals rated this on a 5-point Likert scale with 5 being strongly agree. This was then aggregated at the team level, and averaged within the team.

As this is an exploratory study and our data was slightly skewed, we performed a series of median-splits to classify teams into effective and less effective teams. This resulted in four levels of team effectiveness:

- Level 1: Low task performance score and low self-report team effectiveness items
- Level 2: Low task performance score and high self-report team effectiveness items
- Level 3: High task performance score and low self-report team effectiveness items
- Level 4: High task performance score and high self-report team effectiveness items

We emphasized the performance score over the self-report as this is a slightly more objective measure. Table 1 provides the descriptive statistics of team effective measures and team effectiveness levels.

**Table 1: Team effectiveness descriptive statistics and level means**

Team Effectiveness Measures	Mean (n=34)	SD (n=34)	Min (n=34)	Max (n=34)	Level 1 (n=12)	Level 2 (n=7)	Level 3 (n=11)	Level 4 (n=4)
Task performance score	1.59	0.82	1.00	4.00	1.00	1.00	2.55	2.00
I am satisfied with the performance of our team (EFF1 team average)	4.02	0.55	2.50	5.00	3.81	4.50	3.77	4.48
I would want to work with this team in the future (EFF2 team average)	3.68	0.68	2.25	5.00	3.52	4.29	3.23	4.35
As a team, we have learned a lot (EFF3 team average)	3.76	0.61	2.50	4.75	3.56	4.35	3.40	4.35

### Teamwork competency coding scheme

The coding scheme is illustrated in Table 2 along with subcategories and examples. This coding scheme was theoretically informed as well as surfaced from the data. Each chat line was coded for presence or absence of each of the 6 dimensions; each line could be coded for multiple dimensions. Two researchers performed the content analysis; they coded 9 teams together and split up the other teams between them. Disagreements were discussed and agreed upon to create the final coding for the team. Cohen's kappa ranged from .714 to .964 while Krippendorff's alpha was .713 to .964 for the last 3 teams suggesting adequate levels of intercoder reliability. The coded dimensions were aggregated per team then averaged by team size as teams had different numbers of members. Table 3 reports the mean coded dimensions per team member.

**Table 2: Teamwork competency coding scheme examples**

Teamwork Dimension	Examples
<i>Coordination (COD)</i>	
Organize activities to complete task on time	"faster, only 10 minutes more"
Ask team members who is in the team	"Who else?" "Jane is in this team"
Coordinate logistics of task	"Type the answer"
<i>Mutual Performance Monitoring (MPM)</i>	
Give clarifying feedback to help in the team's performance	"Check this Wikipedia link"
Ask team members to contribute to the task	"John, what's your solution?"
Steer conversation back to task	"Shut up please"
<i>Team Decision Making (TDM)</i>	
Give ideas related to the task	"Move the factory"
Ask any task-related question	"Can the elders move?"
Exchange information about the task problem	"The source of the pollution..."

*Constructive Conflict (CSC)*

Explain and give reason for disagreement  
 Add on to ideas (Elaborate on ideas)  
 Propose different ideas

“Because its expensive and not easy”  
 “Also, the fishes still die”  
 “How about we move the elders”

*Team Emotional Support (TES)*

Greet and introduce oneself  
 Express positive emotions and emoticons  
 Appreciate team member (Give credit)

“Hello, How are you”  
 “ Good ☺”  
 “John’s answer is good”

*Team Commitment (TCM)*

Express confidence in own team’s ability  
 Show togetherness through ‘We’ language  
 Hold own team in higher regard compared to other teams

“We can do it”  
 “We need one final answer”  
 “Our team is better than Jane’s”

**Findings and discussion**

Using descriptive statistics to examine the teamwork competency dimensions of the four team effectiveness levels, we found some interesting patterns. Table 4 reports the averages of teams and Figure 1, the bar chart.

Table 3: Coded teamwork dimensions descriptive statistics

Dimensions per member in team	Mean	SD	Min	Max
COD	10.17	5.04	2.25	18.67
MPM	5.06	2.82	.67	11.00
TDM	16.25	10.97	2.50	43.50
CSC	15.49	10.80	2.00	43.00
TES	11.74	4.44	4.00	20.33
TCM	4.31	3.08	.50	12.75

Table 4: Coded teamwork dimensions averages of Team Effectiveness Levels

Team Effectiveness Level	1	2	3	4
COD mean	10.38	9.01	9.92	12.25
MPM mean	4.93	5.02	4.99	5.71
TDM mean	18.86	12.70	16.45	14.08
CSC mean	17.69	12.23	15.92	13.35
TES mean	12.68	11.56	10.94	11.46
TCM mean	4.90	3.65	4.11	4.23

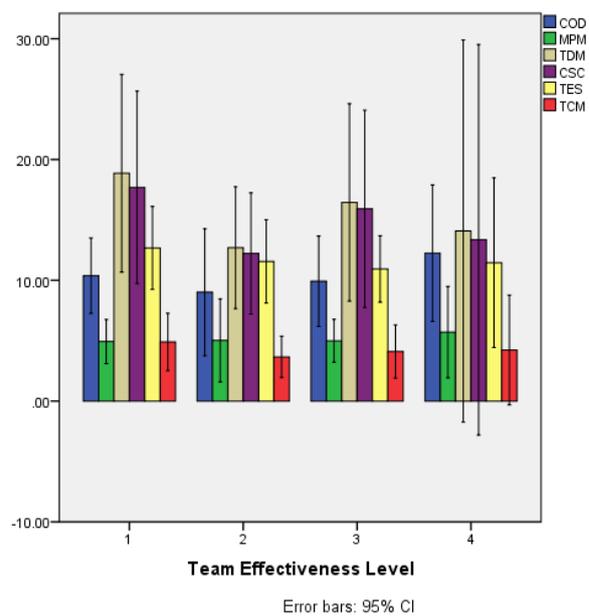


Figure 1. Bar chart of teamwork dimensions team averages of the four team effectiveness levels.

The level 4 category represents the most effective teams. This level had the highest MPM and COD means amongst the different team levels. Team chatlogs showed that team members engaged in behaviors like time keeping and steering each other back to task. They assigned tasks to members so that everyone played a part in solving the problem. This could suggest that MPM and COD are important aspects in effective teams. Also, for COD, TCM, CSC and TES, the amounts were quite similar per team member. This could suggest that a balance in the teamwork competency dimensions amounts characterize effective teams.

Level 3 teams did well in task performance but were not perceived as well by team members. Unsurprisingly, they had low levels of TES. The TES averages were the lowest compared to the other team effectiveness levels. An examination of the chatlogs revealed that in some teams, members had slightly different answers but one member of the team decided on the final answer and the other members acquiesced to the answer without showing strong support. COD was also relatively low and there was a wide gap between COD and TDM suggesting that while task ideas and elaboration were contributed, the team did not do much to coordinate the answer or want to complete the task on time.

Level 2 teams had low performance scores but high self-perceptions of team effectiveness. TES was the second highest among the four levels. While there were good amounts of TES, this level of teams had the lowest TCM, COD, TDM and CSC. The low TDM and CSC amounts indicate thin argumentation about the task which relates to the low performance scores. As for low TCM, this suggests learners were not that committed to the team’s outcome. There seems to be close TDM, CSC and TES amounts, however as compared to level 4 teams, this pattern is missing a similar amount of COD. This further suggests that it is not just a few dimensions, but that more (or all) of the dimensions have to be present in balanced amounts for effective learning teams.

Level 1 teams were the least effective teams. Among all the levels, they had the lowest MPM amounts. MPM reduces free-riders as members check on each other. This suggests the importance of MPM to help improve team effectiveness. This level also had the highest TDM and CSC suggesting that there were many ideas and disagreements. Interestingly, this level had the highest TCM. The chatlogs revealed that students used “we” language in their task discussion frequently suggesting that they were committed to the task but at the same time had disagreements with their team members. There is a very wide disparity between COD and TDM too, suggesting that they could not coordinate their final answer well. Although TES is the highest among all the team levels, TES is relatively less compared to TDM and CSC, suggesting more disharmony than support.

These team effectiveness patterns point to the importance of the different dimensions of the teamwork competency measure. We argue that it is necessary for the dimensions to be present in similar amounts. In other words, effective teams require a balance of the different teamwork competency dimensions. This corroborates findings by Soller (2001) who found that the effective team had a balance of all the active learning, conversation and creative conflict skills compared to the ineffective team which was unbalanced and was missing a skill category. The balance of teamwork competency dimensions could also be related to socio-emotional balance found to be important for effective learning teams (Näykki et al., 2014).

## Conclusion

Teamwork competency is a key lifelong learning skill and this study goes towards shedding light on effective teamwork behaviors. We note that our analysis is mostly based on descriptive statistics. We have performed a correlation analysis but no significant correlations were found. This is possibly because of the small sample size. Work is ongoing to content analyze more teams for further inferential analysis. Other work will also look into the relationship between the two team effectiveness measures. Nevertheless, this nascent finding of the need for balance in teamwork competency behaviors could lead to design principles for interventions to nurture teamwork competency for our 21<sup>st</sup> century learners. Although teamwork is complex, we are hopeful that new efforts can help enhance the clarity and power of teamwork.

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