

# Three Common Group Formations in Online Collaborative Learning

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**Abstract.** With the widespread use of emerging computer technologies in teaching and learning, computer-supported collaboration as a beneficial teaching and learning strategy is now embraced in campus. Analyzing the influencing factors of individual participation is important to discover a more efficient group forming in terms of accomplishing collaborative learning tasks. Through the social network analysis approach on the collected data, this research has found that personality trait does affect a student's activeness and the group's mode. Three main group modes are discovered: Unipolar, Multi-Center, and Centerless-Flat mode. Multi-Center group mode is more stable and has higher average academic achievement than the other two modes. The research findings can be used to implement an intelligent tutoring system that can make recommendations for teachers on the better options of grouping students based on their personality traits.

**Keywords:** Social Network Analysis, Personality traits, Collaborative Learning, Social messaging app, Big Five Inventory (BFI).

## 1 Introduction

Research on cooperative and collaborative learning has provided empirical support for the cognitive, motivational and social benefits of group work [1]. Various empirical studies show evidences that group work and collaboration enhance students to engage with the learning materials and develop deep disciplinary understanding [2-3]. Some researchers realized that the group members' emotion influence their collaborative learning interactions in group [4]. Rehm and colleagues (2016) have done empirical study that contributes to the understanding of how the characteristics of group members influence their collaborative learning interactions [7]. They also find that participants who are more active have better learning performances.

This research aims to investigate the factors that may affect the group modes and learning effects while students working on the designed collaborative learning tasks. With the identified influential factors, a better group could be recommended to form so students will establish group awareness and grasp collaboration and communication skills better to solve known or unknown problems [5].

2

There have been studies proving that individuals whose social behavior is readily predictable from measures of personality traits [6]. Few studies analyze the model of team discussion and engagement in e-learning based on personality trait. The research team assumes that a group's learning outcome will be mainly depending on the communications and collaboration level the group members can achieve. Furthermore, students' personality traits like openness, conscientiousness, extraversion, neuroticism may influence their participation, activeness, and contribution to collaborative learning tasks in a group.

Therefore, this research has the following two hypotheses accordingly:

- Hypothesis H1: Individuals' personality traits affect their social behaviors in online discussion.
- Hypothesis H2: Individual's engagement level will be reduced when working on more complex collaborative tasks.

## 2 Empirical study

To verify the hypotheses and further understand the collaborative learning and interactions in the online groups. The experiment was conducted in second term during the academic year 2019-2020 with 7 Sophomore classes (N=370, 114 male and 256 female students) of Tax Law in South China Agricultural University (SCAU). At the end there were 216 valid responses collected from 56 male and 160 female students. This course was running on the Mosoteach Learning Management System<sup>1</sup> and included seven quizzes conducted at an interval of ten days in two months.

At the end of each chapter, collaborative learning task and group discussion were conducted. Different group modes were investigated and compared based on their group members' average quiz performance. In this study, the task complexity and difficulty levels are divided into three: simple, medium and difficult according to the three dimensions of element interaction, memory participation and logical inference.

Four collaborative tasks that have different difficulty levels are designed for the students to complete in groups within two and half months. Every couple of weeks a task will be given to the student groups. Table 1 lists the four tasks' complexity and purpose. Students will freely form study groups where each group has 6 to 8 members.

**Table 1.** Four tasks designed for the experiment

Task	Complexity	Duration	Topic
#1	Simple	March 3 - March 14	Animation production.
#2	Medium	March 17 - March 28	The learning & use of mind maps.
#3	Medium to Difficult	April 7 - April 21	Group discussion on "Value-Added Tax (VAT)".
#4	Difficult	April 28 - May 14	Teacher assigned discussion question.

<sup>1</sup> <http://www.mosoteach.cn>

In order to verify the two hypotheses, the participants' interactions within a group while working on the collaborative learning tasks and their personality traits are needed to be collected. The experiment uses the mobile app WeChat for group discussions. WeChat is a popular app in China and it is similar to all other social messaging apps in the world (e.g., Whatsapp, LINE and Telegram). The teacher will not participate in the group discussion so students can feel more comfort while talking to each other. At the end of a collaborative task, the group leader will send the screenshot of the group's discussion process to the instructor.

The research uses social network analysis on the interactions among group members to categorize groups into different modes accordingly. The research also adopts the forty-four 5-point Likert-scale items Big Five personality traits instrument to create an online questionnaire for participants filling out at the end of the experiment [8-9]. With the understanding of individual group members' personality traits, the research can further investigate the potential correlations between group's personality traits and modes.

### 3 Data Collection and Analysis

When the teacher received the screenshots of groups' discussion in WeChat from the group leaders, the teacher created Excel files to transcribe and store the interactions in a matrix form for all groups. The interaction matrix was then processed by social network analysis (SNA) approach with the iGraph<sup>2</sup> package of the R software, to generate a diagram for the interactive pattern. With SNA diagram the group members' status and interaction frequency can be told easily [10].

Three group modes had been found while students doing the collaborative learning tasks, they are: Unipolar mode where the student (either the group leader or another member) is the center and interacts with other group members; Multi-Center mode where two or more people are particularly active participating and become centers in the group; and, the Centerless-Flat mode where everyone participate more or less equally in the group.

For simplifying the analysis and comparison, this paper takes three groups (i.e., Group C, Group V, and Group A) as examples and explains the changes of students' interactions from simple to difficult tasks (i.e., from Tasks #2 to #4). Figure 1 shows the SNA diagrams of a Unipolar mode Group C doing the collaborative learning tasks. The student  $c_1$  (who is also the group leader) constantly asks the group members to answer the questions and do the jobs. The interactions within the group are found to be very negative (based on the recorded discussion on the screenshots). At the end the group members are no longer willing to participate for Task #4.

Figure 2 shows the SNA diagrams of a Multi-Center mode Group V doing the collaborative learning tasks. Starting from Task #2, student  $v_1$  (who is the group leader) and  $v_2$  are actively interacting with each other frequently. While working on the Task #3, student  $v_7$  is also jumping in become another center besides the leader  $v_1$ .

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<sup>2</sup> <https://rpubs.com/crconline/igraphreview>

4

In order to solve Task #4, it is necessary to find the answer on the group's own. Among eight group members five of them choose to not participate. At the end  $v_2$  actively played in the group to complete Task #4.

Figure 3 shows the SNA diagrams of a Centerless-Flat mode Group A doing the collaborative learning tasks. In Group A, student  $a_1$  is the group leader. In this group there is no outstanding one but the interactions and discussion among the group members are positive and active. Even when one member drops out under the pressure of the difficult task while working on Task #4, the interaction mode is still maintained and the rest of group members are still working on the task actively. Nevertheless, all the groups do suffer from the individuals' reduced engagement in the difficult task, Task #4. This result verifies the Hypothesis H2.

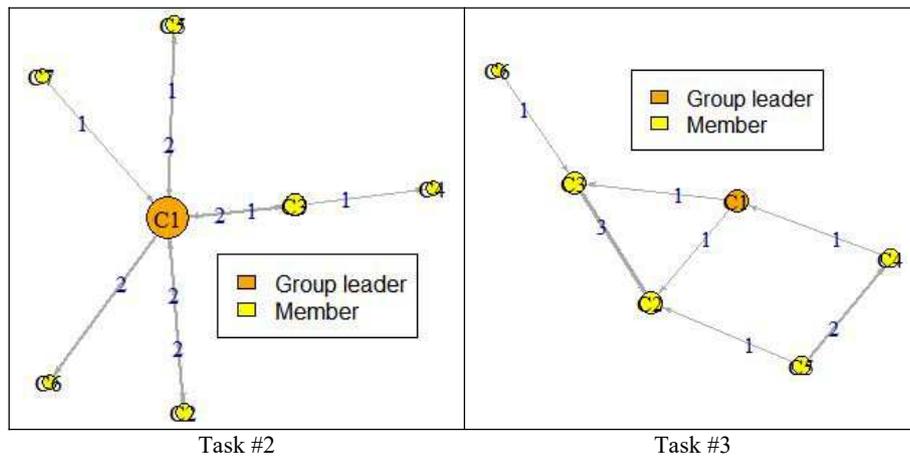


Fig. 1. Group C (Unipolar mode) works for Tasks #2 and #3.

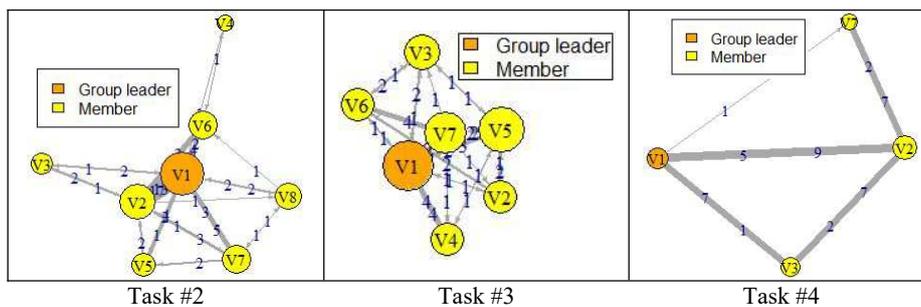
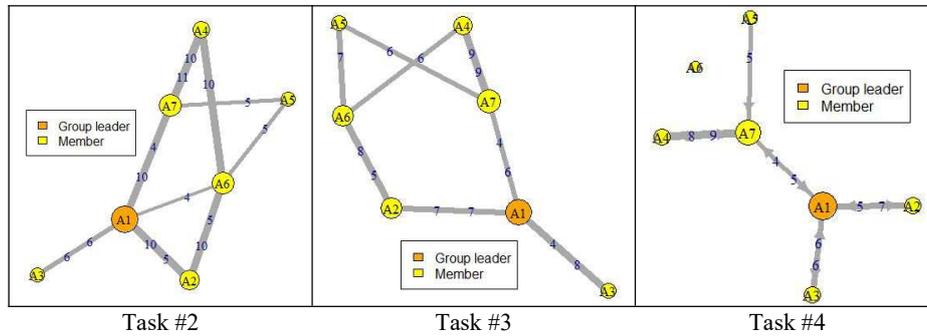
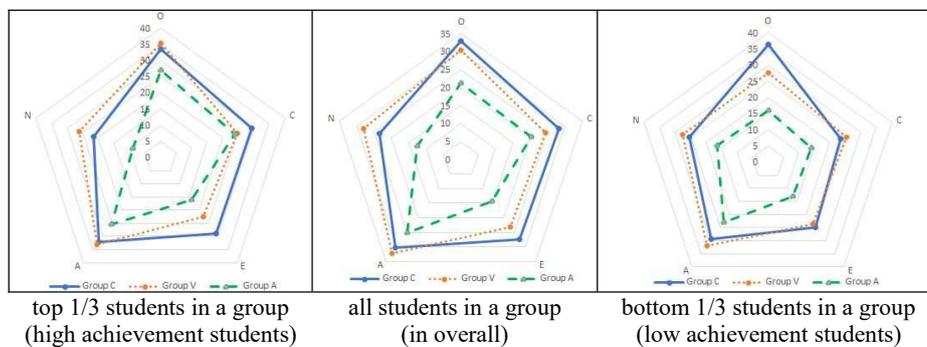


Fig. 2. Group V (Multi-Center mode) works for 3 tasks.



**Fig. 3.** Group A (Centerless-Flat mode) works for 3 tasks

The research team is also interested in understanding the differences of personality trait distributions that different group modes may have. The investigation results could not only enlighten the way of forming better groups for all students learn more efficiently, but also become the basis of implementing an intelligent tutoring system that can make recommendation for teachers on how to group their students to maximize the learning achievement. The research team compares personality trait distributions among the three group modes based on the average personality traits distributions that (a) top one-third students who have higher performance on the quizzes (i.e., high achievement students), (b) bottom one-third students (i.e., low achievement students), and (c) all students in a group. Figure 4 uses the radar charts to present the differences of students' average personality traits in the three group modes.



**Fig. 4.** Group personality traits distributions

From the radar charts shown in Figure 4 we can tell that the three groups do have different personality traits distributions – Unipolar mode Group C with solid line in blue, Multi-Center mode Group V with dot line in orange, and Centerless-Flat mode Group A with dash line in green. Comparing the three groups' average personality traits values by taking all students in a group into consideration as well as the high and low achievement students.

6

The research has found that Centerless-Flat mode Group A not only has lowest average personality traits than the other two groups but also has positive skewness on Agreeableness personality trait than the other four traits. From the group-based average academic performance on the final exam and the quizzes (see Table 2), the group's average quiz performance is lowest. Furthermore, doesn't like other two modes the standard deviations of Centerless-Flat mode group members' final exam marks and average quiz marks are at similar level, although the group's average final exam mark is not the lowest.

**Table 2.** Descriptive Analysis of academic performance

Group	Mode	Final Exam (mean)	Final Exam SD (high/low)	Quiz Avg (mean)	Quiz Avg SD (high/low)
Group C	Unipolar	43.50	24.71 (84/19)	60.85	12.29 (74.86/43.58)
Group V	Multi-Center	53.88	18.86 (83/29)	60.14	12.19 (77.82/42.00)
Group A	Centerless-Flat	47.33	14.81 (70/30)	54.29	13.35 (72.12/39.36)

On the other hand, the Unipolar mode Group C and the Multi-Center mode Group V do share similar personality traits distributions according to Figure 4. However, the group personality traits distributions show the Unipolar mode Group C has (1) higher Openness trait value, especially for the low achievement students; (2) lower Neuroticism trait value, especially for the high achievement students; and (3) higher Conscientiousness and Extraversion personality traits, especially for high achievement students. Last but not the least, while the two groups' students have similar average quiz performance in terms of the mean value and the standard deviation, they do have different performance on the final exam according to Table 2. Therefore, Hypothesis H1 is supported.

## 4 Conclusion

This research investigates the interactions of doing collaborative learning activities within groups in which each group has 6 to 8 members involved. The research identifies three major group modes: Unipolar, Multi-Center, and Centerless-Flat mode. Multi-Center mode has been proved to have overall better academic achievements in terms of average quiz mark and the group structure and member connections are more stable and tighter even under the pressure of doing the difficult collaborative learning task online together. Personality traits do have influences on the communication types; for instances, a group has very high Openness personality trait value distribution may make the group become a Unipolar mode group in which most of students may not engage in the discussions; and a Centerless-Flat mode group may be formed when the group's personality trait value distribution shows that the group's Agreeableness personality trait outstanding to other traits.

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