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Group Formation - Finding-Your-Matching-Card in a Collaborative Learning Classroom

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Abstract

This paper presents a non-traditional strategy of group formation that engages students in utilizing prior learned knowledge to solve problems at a collaborative learning classroom. Through the grouping process students communicate mathematical thinking with their peers and physically moving around to find their matching cards and group partners. The grouping process warms up students to launch an active learning mode. Although the grouping method was implemented in the mathematics content course for preservice elementary teachers and the capstone course for preservice secondary mathematics teachers, it could perfectly fit different types of classrooms including grades K-12 or college level.

Keywords: *Group formation; finding-your-matching-card; collaborative learning.*

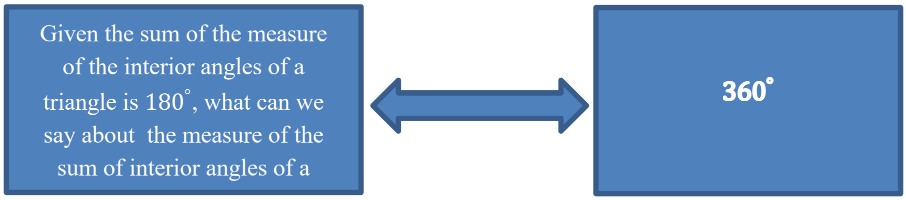
1. Introduction

Collaborative learning is an effective teaching/learning approach. Collaborative activities have positive impact on student learning with respect to effectively communicating ideas, developing critical reasoning, and cooperating with others (Schlichter, 1997; Barros & Verdejo, 1998; Dillenbourg, 1999; Alfonseca *et al*, 2006, Kaddoura, 2013). Students are provided opportunities to actively engage in learning through working together in groups at a collaborative learning classroom. Existing Research have documented how collaborative learning benefited students' learning outcomes and helped equip students with the skills needed in the 21-century workplace by a joint intellectual effort of students and teacher (e.g., Johnson & Johnson, 1989; Artzt & Newman, 1990; Andrini, 1991; Johnson, Johnson, & Holubec, 2008; Johnson, Johnson & Smith, 2014; Gillies, 2016). It has been becoming a common educational practice that students are divided into small groups to engage in deep discussions or solving problems collaboratively. Naturally a question is raised: How to divide groups can ultimately promote collaborative learning? There have been different strategies being proposed to form student groups. For example, student groups could be formed heterogeneously, randomly, or could pair-up with neighbors (think-pair-share) due to different considerations (Kaddoura, 2013; Zhang *et al*, 2016). In this paper, I would like to propose a non-traditional way of group formation that provides an opportunity for students to revisit the previously learned content knowledge and get prepared for class discussions while grouping activity is taking place. In this sense, grouping itself is an integral part of the collaborative learning process.

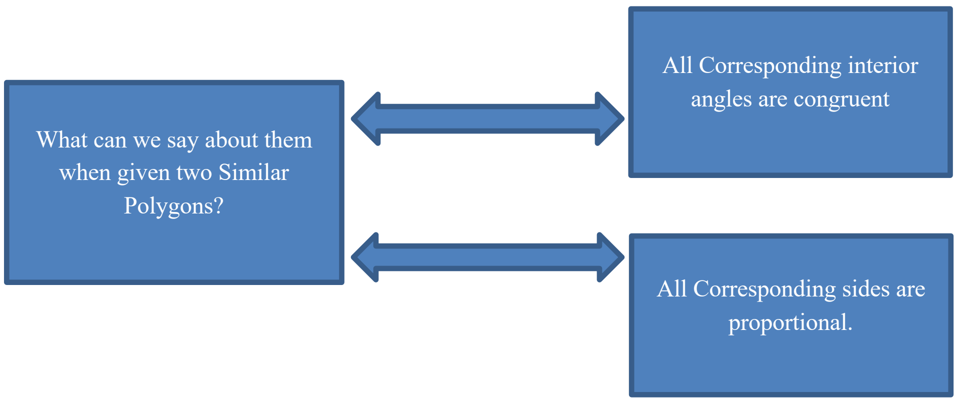
2. The Innovative Group Formation Method

Educational research has reached a consensus that actively engaging in doing mathematics has more effective impacts on student learning than passively listening to a lecture. Documented positive impacts of active learning include deeper understanding, communicating mathematical ideas effectively both orally or in writing, persistence, and sense of belonging (Kogan & Laursen, 2014; Freeman *et al*, 2016; Braun *et al*, 2017). I implemented active learning approach in both the mathematics content course for preservice elementary teachers and the capstone course for preservice secondary mathematics teachers. Students were doing mathematics in groups during each class period. Students' engagement in group discussions is a vital part of the learning process in the structured course of active learning. Usually in the beginning of semester, I randomly divided students into groups for discussions, and then after several weeks when I became familiar with students, I grouped students heterogeneously based on their level of achievement. However, I observed that each class took some time to form groups only. I wanted to change the way of group formation in order to make a grouping activity itself an integral part of learning. Starting spring semester 2020, I implemented a new way to group the students in class. Students started solving mathematics problems in the beginning of each class while finding their group partners. Before each class, I created the question cards and the corresponding answer cards accordingly. In the beginning of a class, the created cards were randomly issued to students, then they had to find his or her group member(s) by matching the question card and the corresponding answer card at their hands. Each question-card had one question and could be matched by another card with the answer for the question. Since I had odd number of enrollments for both of the classes, I must have one group formed with three students. In this case, I created two answer-cards which match the same question-card. On the one hand, the questions on question-cards were selected to engage students in recalling some previously learned content knowledge in order to find their matching cards and group partners; on the other hand, the questions on question-cards were designed to provide the scaffolding knowledge for the current class discussion and warm up students to make connections between the prior learned knowledge and the new knowledge. There are two examples given below.

The one-on-one card matching for a group of two members:



The one-on-two card matching for a group of three members:



Similarly, if one group of four students are preferred, then one question/description on one card can be designed to correspond to the content on three other cards. In next section, designing appropriate groping cards will be discussed.

3. Designing the questions on the question-cards

Relating new knowledge to prior knowledge helps meaning-making and connecting mathematical ideas/concepts in a complete picture for a better understanding. Constructivism recognizes that learning takes place when a learner integrates new knowledge and understanding with prior learned knowledge and experience (Piaget, 1972). Activating a relevant prior knowledge is crucial to an effective instruction (Sidney & Alibali, 2015). Guided by learning theory of constructivism, when designing a question on a groping card, an instructor should consider what content will be studied and discussed in class. Answering the question on a groping card should help students recall a previous knowledge that connects to the new knowledge being learned. In this sense we can consider the groping activity as a warm-up activity for students to make learning connections. For example, when learning the similar polygons, students need to know congruent angles and proportional lines in order to understand that there are the congruent corresponding interior angles and the proportional corresponding sides in the similar polygons. Samples of question-cards are provided in the following:

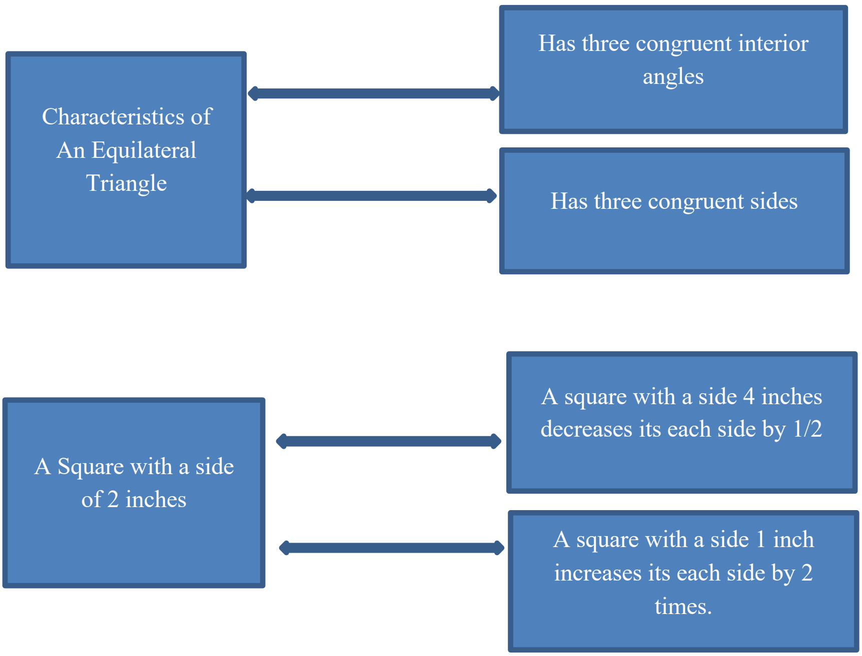


Figure 1. Samples of question-cards.

This way of group formation forces students to interact to each other, communicate mathematical ideas, and helps create active learning atmosphere. In the process of group formation, students recall what they have already learned and process their understanding again for “old” knowledge application. In order to serve the purpose of this way of group formation, when creating questions on grouping cards, I would like to recommend the rules of thumb as follows:

- The questions on cards should be closely related to previous learned knowledge.
- The questions on cards should help scaffold students’ thinking for the new mathematical content being discussed in class.
- The questions should be concept/main idea oriented.
- The question should not be too complicated to solve.

You may add more to this list when you gain new insight after implementation in your active learning classroom.

4. The innovative way of group formation applies the learning theory into teaching practice

In the past decades, constructivism has guided teaching/learning research and practice in the field of mathematics education. Research have indicated that human beings learn by active engaging and knowledge cannot be delivered or transferred from an expert to students by simply telling and listening (e.g., Vygotsky, 1978; Lorsbach & Tobin,1992; Freeman *et al*, 2014). Constructivists believe that instructors should help students develop the bridge connecting previously learned knowledge and new knowledge. Knowing what students have already known and then teaching accordingly is the most important factor influencing learning (Ausubel, 1968). Starting a class by having students recall prior knowledge and figure out the matching cards, each student is provided an opportunity to communicate with other students and verify their understanding of certain concept/idea. Many times, students have the opportunity to help or to be helped addressing some misconception. For example, four students get four different cards respectively as follows:

$(x+3)(x-3)$	x^2-6x+9	x^2-9	$(x-3)^2$
Card 1	Card 2	Card 3	Card 4

Figure 2. Samples of question-cards.

Based on our teaching experience, we know that there is often a common mistake made by some students, they may think that $(x-3)^2 = x^2 - 9$, but some student would realize that $(x+3)(x-3) \neq x^2 - 6x + 9$. The four students would have to work together to figure out the appropriate match. If the four students are not able to match successfully, they can ask other students to help them and explain which pair are a correct match. In this case, students are forced to learn from their peers when needed during the process of grouping.

Finding-your-matching-card group formation works as a bridge connecting prior learned knowledge to new knowledge. It offers good opportunities for students to collaborate and engage in correcting misconception when necessary. Through working together to find the match of a question and an answer on their cards, students experience applying what they have learned to solve problems; it is one important stage in learning hierarchy (Anderson *et al*, 2001; Stanny, 2016). In addition, after practicing the application of the prior knowledge, students will bring their understanding into the process of acquisition of new knowledge.

5. Observed Effects of the innovative method of group formation

Once the finding-your-matching-card (FYMC) grouping becomes a routine practice and is implemented in the beginning of each class, the students would regard finding the group member(s) as a regular class activity. In my classes, students were pushed to recall knowledge they had learned before; and they were helped by peers in case they didn't sustain the prior knowledge. Words often heard were: "what is on your card?", "No, the answer on my card doesn't match the answer on yours.", "Yeah, my card question seems to match yours", "I think she has the card answering your card question"…… I observed some quiet students had to step out and talked to other students in order to find their matching partners. Some interesting conversations took place, for example, "our cards are not matched because not all rectangles are similar, remember the example we discussed last class……"; "is an isosceles triangle a regular polygon?"; "no, $(a+b)^2$ is not equivalent to a^2+b^2"……. Based on what observed during the process of group formation and reflecting on the implementation, I recognized that the FYMC grouping has the positive impact on learning and teaching. On the one hand, from the perspective of student learning, the grouping activity

- stimulates students' learning interest;
- engages every student in revisiting previous learned knowledge;
- promotes collaborative learning environment;
- increases interactions among students;
- pushes students to make connection between mathematical ideas/concepts;
- provides scaffolding knowledge for students to learn new knowledge;
- help students sustain knowledge they learned previously.

On the other hand, from the perspective of instructor teaching, the grouping activity

- informs an instructor of students' learning status;
- provides evidence for an instructor to make a wise decision during the process of classroom teaching (e.g., when students have trouble to match their cards due to

mistakes or lack of understanding, the instructor could decide to spend some time to address any problems right targeting on the involved concept/idea);

- helps an instructor systematically design in-class tasks coherently related to students' previous learning.

The FYMC grouping method is a promising teaching strategy for an active learning classroom. Its benefits on learning will be revealed as more practices are carried on over times.

6. Concluding Remarks

The FYMC group-formation method engages students in thinking about prior learned knowledge, communicating with their peers, and physically moving around to find the matching card in the beginning of a class. The grouping process itself bridges "old" knowledge with new knowledge and becomes an integral part of learning; it warms up students to engage in learning new content in an active and interesting way as well as takes students to launch an active learning mode . This paper brings up an innovative group formation strategy that provides a promising impact on active learning. More experimental study report on this grouping method will be beneficial on mathematical teaching and learning in the future. Mathematics educators can create more effective grouping cards applicable for different mathematics content ready to use in active learning classrooms. Although the group formation method was implemented in the mathematics content course for preservice elementary teachers and the capstone course for preservice secondary mathematics teachers, it could perfectly fit different types of classrooms including Grades K-12 or college level.

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