

*Cooperative Learning &*  
**Mathematics**  
*High School Activities*

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# Chart of Structures



Structures	Activities		Blacklines		Activities		Blacklines		Activities		Blacklines		Activities		Blacklines	
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# Foreword

Are you a high school mathematics teacher looking for ways to add ZING to your classroom? Are you looking for alternatives to the traditional lecture approach? Have you tried putting students into work groups and wondered why it failed miserably? Have you had the good intention of trying cooperative strategies but thought that it seemed too complicated and labour intensive? If you answered “yes” to any of these questions, then this book is for you!

The purpose of this book is to provide high school mathematics teachers with cooperative learning lessons they can *easily* and *effectively* implement into their teaching repertoire. The lessons and activities in this booklet are based on techniques developed by Spencer Kagan. These strategies will be explained and developed where appropriate throughout the book. One of the great aspects of the Kagan model is that you do not need to overhaul everything you are already doing in order

to implement cooperative strategies. The lessons in this book can be used within the context of what most teachers are already doing, but they can significantly increase student involvement, achievement and accountability.

There is a vast difference between “group work” and “cooperative learning”. Many teachers (myself included) have put students into groups, given them a task to complete, and told them to work together on that task. Ideally, one would hope that the stronger students would help the weaker students to learn the concepts necessary to complete the task. One would also hope that everyone would be actively engaged in the learning activity, and that each student would pull his or her weight in the completion of the task at hand. Unfortunately, these ideals are not usually achieved. Instead, one often sees some students doing all the work while others “sit out”, due to either lack of motivation or lack of ability. There is often no incentive for the weaker students to learn the concepts at hand because the stronger students can simply give them the answers. There is no incentive for the unmotivated students to get involved because the more concerned group members will take care of their share of the work load. In either situation, the “group work” situation has become a breeding ground for resentment, between the students themselves, and between students and teachers. To top it off, no real learning is likely to take place, even though the worksheet is filled in or the maths problem gets solved.

Kagan’s model of cooperative learning is called the “structural approach”, and it is designed to help teachers overcome the obstacles described above. A structure is simply the way you organise an activity. The structure you use indicates the way in which students will interact in regards to the content. There are over 100 different structures in the

Kagan model, each designed to help teachers achieve different objectives. Each structure incorporates four key principles, commonly referred to as PIES. They are:

- 1. Positive Interdependence:** A gain for one is a gain for another. Students need each other to complete the given task.
- 2. Individual Accountability:** Individual public performance is required of all students. There is no hiding in the shadows. Structures insure that everyone is required to do something.
- 3. Equal Participation:** Structures in this book help insure that no one dominates the group, and that no one is able to sit back and let others carry the load.
- 4. Simultaneous Interaction:** Each activity attempts to get as many students overtly active at once. The activities aim to get *at least 25%* of the students in the class doing mathematics at any given time.

As stated earlier, there are over 100 structures in the Kagan model. The structure you choose depends on your objectives. Structures can be used for team-building, class-building, teaching thinking skills, teaching communication skills, sharing information, checking for understanding, mastering content, and much more. In this book, I have chosen to focus on six structures which I believe are most useful for the teaching of mathematics. These structures will help students master content and develop higher level thinking skills. Each chapter is devoted to a single “structure” and includes a detailed description of how to most effectively implement that structure. Following the description is a list of topics for which that structure would be an effective teaching tool. The list is divided into activities for Pre-Algebra, Algebra 1, Geometry, Algebra 2 and Trigonometry,

and PreCalculus. Examples of activities for each of the aforementioned courses are included at the end of each chapter. The activities are designed so that teachers can simply reproduce the pages in this book and get down to the business of teaching.

The last chapter in the book contains a summary of eight other structures which lend themselves to the teaching of mathematics

The activities included in this book can only be successful if students have the will and motivation to participate. Using grades as a motivator is strongly discouraged. When grades are used, students become more focused on the grade than on learning, or helping others learn. Students may worry about how their performance might affect other people's grades, or how their grade might be adversely affected by others. A much better way to motivate students and encourage their will to participate is by doing Classbuilding and/or Teambuilding exercises.

A Classbuilding exercise is any activity during which students learn more about the other people in the class and/or develop an identity as a class. A Teambuilding exercise allows students to focus on getting to know the people in their cooperative team. These exercises help students to get to know each other better, and help create a positive climate. Through Teambuilding and Classbuilding, students learn to value individual differences and appreciate each other's talents. A mutual

support system can then evolve as students participate in the learning activities. Many of the structures featured in this book can be easily modified and used for Classbuilding or Teambuilding. These exercises don't have to take a lot of class time! Often, one or two minutes is enough for students to do, for example, a Round Table on who their favorite movie actor is. If such exercises are done a few times per week, the improved classroom climate will be well worth the time spent on them.

The activities in this book are only a small sampling of how cooperative techniques can be implemented into the high school mathematics classroom. My hope is that the ideas presented here will act as a springboard for teachers, who can then develop their own activities and adjust them to fit their particular content. With a little practice and some willingness to experiment, using cooperative techniques will add new life to your classroom! Whenever I try a new cooperative activity, students invariably tell me how much more they enjoy learning mathematics. May you find the activities and strategies presented in this book to be useful, effective, and fun! Good luck!

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# Introduction

## Why Use Cooperative Learning?

Why is it important to use cooperative learning? You are, after all, a busy maths teacher. You barely have enough planning time to make your worksheets and tests, let alone develop a whole mess of new “cooperative learning activities”. And you have a curriculum to get through, for crying out loud! There’s no time for silly “feel good” games and activities! Besides, doesn’t “cooperative learning” mean that a few kids do all the work while others just leech off of their efforts and hard work? Won’t the high achievers be held back by the slower students? What are we really gaining by using these strategies anyway?

There are many misconceptions about a) what cooperative learning is and b) how to effectively use cooperative strategies in the classroom. There are teachers who agree that cooperative learning is beneficial in theory, but that it takes a tremendous

amount of extra planning and materials to put it into practice. I would like to briefly address some of these misconceptions and share with you some of the benefits of cooperative learning.

Let's first address why cooperative learning is important. We are certainly in the midst of the "information age", an era in which analysing and communicating information plays a vital role in the economy and the world at large. Unfortunately, you cannot communicate information alone. Interaction is required. In many workplaces today, employees work in teams to generate data, solve problems, and develop strategies for success. Our students need to be prepared for this type of environment if they are to compete in the job market. Not only do they need to learn the social and communication skills necessary to work with others, they also need to develop higher level thinking skills. It can no longer be presumed that social and communication skills are taught at home. Today, many of our young people face the challenges of single parent homes or homes where both parents work full time. Many families relocate, often more than once, tearing students away from the familiar stabilising influences they once too relied on. With less contact and guidance from concerned adults, students are spending more time than ever in front of the television. Their values and self images are being shaped by poor role models and the advertising spin doctors. They are continually exposed to violent, racist, or overtly sexual content. Schools need to do something to teach students how to get along together, tolerate differences, feel good about themselves, and help one another. Cooperative learning is one solution to our socialisation problem. Numerous studies show that students involved in cooperative learning develop a wider variety of social skills, are better able to

work with others in solving problems, and are more willing to help and praise others.

No other educational innovation has been more intensely researched than cooperative learning. In addition to improved social skills, cooperative learning strategies produce many other positive outcomes. Studies show that students involved in cooperative learning activities enjoy improved relations between races and ethnic groups. These students had a greater tendency to choose friends from an ethnic group other than their own. Students in cooperative classrooms also demonstrate greater self-esteem and tend to like class more. Cooperative activities also tend to lower students' anxiety level, since students have more peer support and opportunities to receive praise.

"But what about scholastic achievement?" you ask. Research proves that cooperative learning produces higher academic achievement than individualistic or traditional teacher-centred methods. This is true at all levels and across all subject areas. Minority groups and low achievers tend to experience the greatest gains, but this has no negative impact on the higher achieving students. In fact, high achievers perform just as well, if not better, in a cooperative environment than in a traditional one. Cooperative learning activities produce greater achievement results because they create more opportunities for peer tutoring than do traditional classroom methods. A well-structured cooperative lesson also forces students to spend more time on task and to have more interaction in regards to the academic content. In a cooperative classroom, the teacher actually spends less time lecturing and is therefore able to give more individual attention to the neediest students.

Most of the teachers I have talked to say that their worst discipline problem is students



**S** **T** **R** **U** **C** **T** **U** **R** **E** **S**

**M** **FOR**

**Mathematics**

**Mix-N-Match 1**

**Line-Ups 2**

**Inside-Outside Circle 3**

**RallyCoach 4**

**RoundTable 5**

**Mix Pair RallyCoach 6**

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# STRUCTURE 1

## Mix-N-Match

### Steps at a Glance

1. With a card in their hand, each student mixes around the room. Each finds a partner, and quizzes him or her by asking a question relating to their card.
  2. Partner answers. Praise or coaching is given.
  3. Switch roles: The other partner asks then praises or coaches.
  4. Partners trade cards.
  5. Partners split up and repeat Steps 1 through 4 a number of times. Teacher calls "Freeze!"
  6. Students freeze, hide their cards, and think of their match.
  7. Students move to the centre of the room, find their match, and quickly move away from the centre of the room with their new partner.
- Optional: Teacher may post a class graph to record the time it takes for students to find their matching partners. Students try to beat their class record.

In this structure, each student is given a card with some type of problem or information on it. Each student should be certain as to the correct answer to his or her problem before beginning the "Mix-N-Match". You may want to give students some time in their teams to ascertain the solutions to their problems or teachers can hand out the cards in matched pairs, so students are already sitting with a "match". Once this is done, students are to "mix" (that is, mingle about the room) and find the person with a card that "matches" theirs. For example, if each card has an equation on it, students would have to find the person whose solution is the same as theirs. As students pair up, they should move to the outside perimeter of the classroom and stand together as a pair. Once everyone has found their match, students can confer with another nearby pair to double check that they do indeed make a match. When everyone is satisfactorily paired up, the teacher can then collect the cards and redistribute them

# MIX-N-MATCH

for another round (if desired). The possibilities for this structure in the maths classroom are endless!

One possible pitfall to this structure is that an unmotivated or struggling student may simply stand around and wait for his match to find him, thus managing to get through the activity without really doing any work. (Remember the “E” in “PIES”: Equal participation is the goal!) One way to avoid this is to have the students do several “quiz and swaps” before finding their match. Students would mingle and form random pairs and quiz each other regarding the content on their cards. If both partners get the correct answers, they swap cards, and then find another random partner. If anyone gets an incorrect answer, their partner should re-teach him before swapping cards. After several swaps, the teacher

would yell, “Freeze! Find your match!” At this point students would purposely seek out the person whose card is equivalent to theirs.

On the next several pages, you will find a list of ideas for incorporating the Mix-N-Match structure into your teaching repertoire.

Following this list are several sets of Mix-N-Match cards that are ready to use. Simply reproduce one set of cards for the class, pass them out, and let students search for their matches. If you have an odd number of students, have two students walk around with one card, or the teacher can participate in the activity. Each set in this book contains 30 cards (15 matching pairs). You may have to remove a matching pair or two to account for smaller class sizes. Just make sure that whatever cards you remove are indeed a “match”.

## Mix-N-Match Contents

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