A Study Comparing Cooperative Learning Methods: Jigsaw & Group Investigation

Garonia L. Parchment
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A Study Comparing Cooperative Learning Methods: Jigsaw & Group Investigation

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Document Type
Thesis

Degree Name
MS in Mathematics, Science, and Technology Education

First Supervisor
Diane Barrett
A Study Comparing Cooperative Learning Methods:
Jigsaw & Group Investigation

By
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Submitted in partial fulfillment of the requirements for the degree
M.S. Mathematics, Science and Technology Education

Supervised by
Dr. Diane Barrett

School of Arts and Sciences
St. John Fisher College
April 2009
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A Study Comparing Cooperative Learning Methods, Jigsaw and Group Investigation

Kagan (1994) contended that one of the highest goals of education is to provide students with the experience that will allow them to structure their own future social and physical environments in positive ways, including their own continuing education. Over several decades the discussion and research on cooperative learning (CL) in the classroom and its effects on the pedagogical and cognitive development of students have been extensive. The research has shown a direct correlation between student achievement and the implementation of cooperative learning in classroom setting.

Research on the effects of cooperative learning in general, reveals CL methods surrender superior outcomes compared to those achieved by peers in classes with the traditional instructional methods (Cohen, 1994; Johnson & Johnson 2002; Shachar & Sharan, 1994; Sharan 1980, 1990; Sharan & Sharan, 1992; Slavin, 1983, 1990). The academic advancement of students in CL classroom has reported to be far better-quality to the traditional classroom (Foley & O’Donnell, 2002; Nichols & Miller, 1994; Sherman, 1994; Tamir & Yager, 1993). Incorporating cooperative learning methods in their instructional repertoire requires teachers to change their traditional roles as conveyer of information (Sharon & Sharon 1992).

The research addressed the many advantages, disadvantages and the multiple methods of cooperative learning. However, there are few studies reporting which method of cooperative learning is the most effective. Understanding what cooperative learning is and which method to use and when to use it is critical in order to maximize students’ potential and academic success. This study will examine the quantitative difference in academic achievement in respect to the two methods of cooperative learning, jigsaw and
group investigation (GI). The methodologies will be utilized in four separate biology classes, after which, each instructional styles will be switched, assessed, and results compared.
Cooperative Learning

Holubec, Johnson, and Johnson, (1994) defined cooperative learning as an instructional use of small groups through which students work together to capitalize on their own and each other’s learning. Cooperative learning exists when students’ goal attainments are positively unified. When one student obtains his or her objective, all other students with whom he or she is cooperatively associated obtain their objective (Deutsch, 1949).

Cooperative learning replaced the mass production, competitive, organizational structure of most classroom and schools with team-building, high performance organizational structure (Fischer & Shachar, 2003). CL helps to accomplish two important goals as an educator; increased the academic achievement of gifted and non-gifted students, and helped build positive student relationships and interactions that
fostered diversity. Society is dictated by the interaction between individuals and groups. Since, there are constant interactions among individuals in school setting, these interactions can be deemed useful in incorporating cooperative learning in classrooms ((Fischer & Shachar, 2003). Social interaction is crucial to the learning that occurs in groups (Bennett & Dunne, 1991).

Gillies understood the importance of the social component of learning. Gillies (2004) stated, “Cooperative learning capitalizes on adolescents’ desires to engage with their peers, exercise autonomy over their learning, and express their desires to achieve” (p.197). Students’ need for social interaction guarantees engagement in a lesson, verbally relaying opinions and ideas, while participating in CL. When students are engaged in learning and take ownership of their own learning, they make a conscience decision to educate themselves (Huber, 2003). Peer groups’ model and give mutual support, as well as, contain the dynamics of implementing and sanctioning behavioral norms (Rath, 1993). Even though, there has been an increased need for cooperative learning in the classroom, which promoted the cognitive development communal skills, an increase in motivation to learn, while reinforcing of basic skills; most educators were restricted to the mundane traditional educational rhetoric. Cocking and Sigel summarized their perspective on tradition instruction in the following passage,

The world is not fed up to us which we the passively ingest; rather, we ingest it through actively reaching out and taking it in….we build a conception of our reality through our experiences with it….. Participation and engagement in the event are the active bases from which a construction of the
particular is developed and from which meaning is extracted, a meaning shared in part with others. (Cocking & Sigel, 1977 p. 226)

As society evolves into an information technological era, the economy will depend more and more on diverse thinkers with advanced interactive proficiency. Educators must change common practices of dividing students, so each student works and thinks independently. The practice limits student learning by forcing them to rely only on their own perspectives. Students' goal achievements are independent; students perceive that the achievement of their learning goals is unrelated to peers goals (Deutsch, 1962, Johnson & Johnson, 1989). This individualistic practices focus only on self-interest and personal successes, rather finding relevance in the successes and failures of others. Working alone provide students with the inability to contend with the diverse linguistic, economic, and social aspects of school, the workplace, and society.

Along with traditional role of providing students with basic skills and information, increasingly schools must produce students capable of higher-level thinking skills, communication skills, and social skills (Kagan, 1994). CL cultivated opportunities for students to experience interaction among diverse members. Piaget (1973) stated, “Meaning is constructed, to no small extent, on the basis of people experience in the world, and including their experience with other people” (p 42).

One of the great philosophers of education John Dewey, viewed schooling and education as a democratic social process that included a social interactive and cooperative
approach to the acquisition of knowledge, or what later became known as constructivist approach to cognition (Barnes, 1976; Cocking & Sigel, 1977; Wells, 1998). Figure 1 illustrates the difference between the roles of teacher in cooperative learning and a traditional classroom and also reflects of John Dewey’s constructivist approach to education.

Through the maintenance of cooperative relationships, students can benefit from each other learning. Ashman and Gillies (1996) argued that when children work cooperatively together they develop a perceptive of each other’s needs and will often provide help when necessary.

As students work cooperatively together, they learned to engage in processes of shared thinking which helped them to not only gain a better understanding of the perspectives of others but also to build on their contributions to develop new understanding and knowledge (Brown & Campione, 1994; Rogoff, 1994).

Benefits of Cooperative Learning

The benefits of CL included academic gains across different curriculum domains and produced positive interpersonal attitudes, behaviors, values, and skills (Battistich, Solomon, & Watson, 2002). Over the years, cooperative learning methods have produced and distinguished a large repertoire of exercises and activities that enable students to acquire and practice effective interactions (Graves & Graves, 1990; Kagan, 1992). Ross (1995) found that when children find success in providing help and assistance to their peers, they become more self-confident and more willing to offer help others. Numerous researchers have suggested that CL increases student involvement and interest in learning (Gillies 2004: Johnson & Johnson 2000; Kagan; Sharan & Sharan 1976; Slavin 1978;).
Figure 1. The roles of teachers in cooperative learning and traditional class.

<table>
<thead>
<tr>
<th>Cooperative Learning</th>
<th>Traditional Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select and divide the lesson for group work</td>
<td>Follow the course profile</td>
</tr>
<tr>
<td>Train students cooperative skills</td>
<td>Ignore teamwork skills</td>
</tr>
<tr>
<td>Arrange the classroom and assign roles</td>
<td>Try to keep students in their seats</td>
</tr>
<tr>
<td>Observe and intervene</td>
<td>Ignores functioning groups</td>
</tr>
<tr>
<td>Play more sophisticated instructional role like asking high-order questions, extending the group’s thinking on its activities</td>
<td>Provide detailed instruction</td>
</tr>
<tr>
<td>Being a facilitator of learning</td>
<td>Provide detailed instruction</td>
</tr>
<tr>
<td>Assess student’s contribution</td>
<td>None</td>
</tr>
<tr>
<td>Provide feedback to groups and analyze group effectiveness</td>
<td>None</td>
</tr>
</tbody>
</table>

(Holubec, Johnson, & Johnson, 1991, p. 59)
Intrinsic Motivation

One of the major concerns of educators is the lack of motivation of students to engage in the process of learning. The motivating features of cooperative learning have been given a great deal of interest in the current literature on cooperative learning (Johnson & Johnson, 1985, Sharan & Shaulov, 1990; Slavin, 1987). Although, there is controversy in determining the best way to educate students, the various methods of CL has been shown to demonstrate the basic principles of motivation, one being arousing students’ interests.

‘Intrinsically motivated behaviors will be of two general kinds. When there is no stimulation people will seek it. A person who gets no stimulation will not feel competent and self-determining; he will probably fell ‘blah.’ So he seeks the opportunity to behave in ways which allow him to feel competent and self-determining. He will seek out challenge. The other general kind of intrinsically motivated behavior involves conquering challenges.” (Deci, 1975 p.61)

Academic Achievement

Research conducted by Johnson and Johnson (2000), claimed that the outcomes of CL can be divided into three categories; efforts to achieve, positive relationships, and psychological help. The outcomes are further demonstrated in Figure 2. The first category is effort to achieve, which includes a higher achievement and greater productivity by all students (high, medium, and low achievers), long-term retention, intrinsic motivation, achievement motivation, time on task, higher level reasoning, and critical thinking. The second category deals with building positive relationships among students.
Outcomes of Cooperation

Figure 2: The Five Essential Components of Cooperative Learning.

(Holubec, Johnson, and Johnson, 1994, p. 12)
This segment comprises of increase cooperation, caring and committed relationships, personal and academic support, valuing diversity, and cohesion. The final category of CL outcomes encompasses greater psychological health. This component takes account of psychological adjustment, ego strength, social development, social competencies, self-esteem, self-identity, and ability to cope with adversity and stress.

**Rewards & Effects of Cooperative Learning**

Slavin (1983) listed the many rewards and effects of cooperative learning. Specific group rewards, based on individual learning enhanced the effects on academic achievement during CL. Task specialization has a positive effect on learning of basic skills, but only if there are incentives for students to learn from each other and only in subjects that can be broken down into subtopics.

CL is not limited to grade school, but college students also benefit from participating in cooperative learning. Cooperative learning experiences tend to lower attrition rates in college. In a study conducted by Stager and Wales (1978), found students working in small groups were likely to display lower rates of attrition rates and higher rates of academic achievement than those not involved in cooperative group learning. Over half of the student who dropped out of college their first semester of freshman year was due to the lack of social interaction to become academically successful. Conversely, it has been shown that CL maximizes social interaction to engage students in learning.

**Cognitive Development**

Dansereau (1985) found that individuals in cooperative groups used explanations and metacognitive strategies more frequently than individuals working competitively and,
therefore, performed at a higher academic level. Piaget’s (1973) cognitive development theory point out that higher-level reasoning is promoted by cooperative experiences. Research has shown individuals working cooperatively used a focusing strategy in figuring out a concept underlying a set of numbers or words more frequently than individuals working competitively or individualistically and, therefore, solved the problems faster. Cooperatively learning increased the students’ ability to decipher underlying conceptual ideas. Social, cognitive and autonomy development can be enhanced when CL is implemented correctly, using various methods, basic elements of CL, and groups.

Groups

The benefits in students working in CL groups are classroom and instructional management. Having students work in the CL groups solves two common classroom problems; keeping students involved with their work and managing instruction for students with a ride range of academic skills (Cohen, 1994). Cooperative learning was more than placing students in close vicinity of each other and expecting a miraculous academic improvement. Cooperative learning was very structured and particular and most effective in small groups. When devising a group, a clear understanding of the meaning of a group and its dynamics is essential in CL. Although there is no unitary definition of what constitutes a group, there are characteristics that can give a clear understanding of a group and the numerous benefits working in groups when incorporating cooperative learning methods in the classroom.

A group is more than a collection of people. A group can exemplify several specific characteristics relevant to creating an effective cooperative learning environment.
However, these characteristics do not manifest, simply from placing students in groups. Jaques (1991) provided a comprehensive picture of the range of dynamic qualities within a group with distinguishing features.

The first feature dealt with collective perception. Collective perception included members who are collectively conscious of their existence as a group. The second feature focused on the needs of the individual. Jaques also noticed that members tended to join groups because they believed it would satisfy some need or give them some reward. The third characteristic of a group is shared aims. Members, who had common aims or ideals, were brought together. Presumably the achievement of aims became one of rewards. Interdependent, socially organized, and interactive groups can represent a social unit with roles, statuses, power, and relationships. Members influenced and responded to each other in the process of communicating, whether they were face to face or otherwise deployed. The sense of group existed even when members were not collected in close vicinity. These features fostered cohesiveness or a sense of membership. Members wanted to remain in the group, to contribute to its well being and aims, and to join in its activities. None of these qualities can define a group on its own, but each characteristic designate an important feature of a group. Consequently, these dynamics can not be represented in every group.

*Group Size*

Although, there is no ideal size for cooperative learning, the right size of a group depends on each lesson’s objectives, student’s ages, experiences working in teams, and the available curriculum materials and equipment (Holubec, Johnson, & Johnson, 1994). One should also consider the number of participants preferred and the ways in which this
population can be divided to achieve various objectives (Cooper, 1979). The size of the total group was shown to be important in implementing corporative learning accurately. The group size should also correlate with the time allotted for objectives. The shorter the time the smaller the group (Johnson et al., 1991), this approach forced students to remain on task, need little organizations and limits any frustration that may derive from CL groups. As size of a group increases, the dynamics and climate of a group also changes, as demonstrated in Figure 3.

Rice (1971) considered six as the critical number for groups in all situations. The larger the group the more reluctant the students were to share their views, opinions, and ideas. The comfort level and trust was hard to achieve as the size of the group enlarges. Smaller groups demonstrate more intimacy and therefore personal relationships were formed quickly and honestly.

Assigning Heterogeneous or Homogeneous Groups

Assigning students to groups can be a difficult task; there are numerous factors to consider when assigning groups. These factors include; scholastic skill, gender, and ethnicity. Low achieving students clearly benefited from heterogeneous groups and classrooms where there were more academic resources available to them (Dar & Resh 1986; Kerckhoff, 1986). A group’s productivity was determined by its members and teamwork skills (Holubec, Johnson, & Johnson, 1994). However, the research indicated that, before students were assigned to a group it needed to be determined if the groups will be heterogeneous or homogenous.

Homogeneous CL groups are appropriate when teaching specific objectives, even though heterogeneous groups are preferred.
Figure 3: Changes in Characteristics in Group Dynamics.

<table>
<thead>
<tr>
<th>Number of members</th>
<th>Changing characteristics</th>
</tr>
</thead>
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<tr>
<td>2-6</td>
<td>Little structure or organization required; leadership fluid</td>
</tr>
<tr>
<td>7-12</td>
<td>Structure and differentiation of roles begins. Face-to-face interaction is less frequent.</td>
</tr>
<tr>
<td>12-25</td>
<td>Structure and role differentiation vital. Sub-groups emerge. Face-to-face interaction is difficult</td>
</tr>
<tr>
<td>25-?</td>
<td>Positive leadership is vital to success, sub-groups form; greater anonymity. Stereotyping, projections and flight/fight occur.</td>
</tr>
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</table>

(Jacques 1991 p. 14)
Groups composed of students with various background and abilities created a dynamic unit with multiple perspectives and problem-solving methods, which generated more cognitive disequilibrium (Johnson, Johnson, & Holubec, 1994). Heterogeneity lead to greater confrontation but can also provided the group with a wider range of resources. Homogeneity, lead to greater intimacy, but promoted less variety. This effect can restrict the number of learning possibilities available to the group (Cooper, 1979).

The least recommended procedure for grouping was student self-selection groups. This method of assigning groups tended to be homogeneous in nature. The clustering of high achievers, minority groups, and same sex groups usually was the result of student self-selection (Johnson et al., 1994).

Cooperative Learning Groups

Research showed cooperative learning to be most effective as an instructional tool when used in small groups. Although small groups are ideal, not all small groups represent cooperative learning groups. Simply dividing students into groups (i.e. lab groups or project groups) could easily fall under traditional classroom learning. However, CL groups are detectable, when groups and members of the groups become self-reliant. The purpose of these types of groups was to make each member a stronger individual. Student accountability for each individual was shown to be a key component in making certain that all group members were indeed strengthen by learning cooperatively. CL relies on three types of formal, informal, and cooperative base groups.

Formal CL groups consisted of students working together for a class period to a few weeks to achieve shared learning goals, and to complete specific tasks and assignments. These assignments included decision making, problem solving, completing
a curriculum unit, writing a report, conducting a survey, or experiment, reading a chapter or a reference book, learning vocabulary, or answering questions at the end of the chapter (Holubec, Johnson, & Johnson, 1991). Utilizing of formal cooperative learning groups provided the basis for educators to gain expertise in using the CL strategies and foundation for the other two.

Informal CL groups consisted of having students work together to achieve a joint learning goal in temporary groups that last from a few minutes to one class period (Holubec Johnson, & Johnson, 1990; Johnson, Johnson, & Smith, 1991). These assignments focus students’ attention on specific topics and the lesson to be learned. It could be used to reinforce key concepts during discussions or lectures. Cooperative base groups are long-termed, heterogeneous CL groups, with stable memberships (Holubec, Johnson, & Johnson, 1991; Johnson, Johnson, & Smith, 1991). The base group purpose was to advocate, promote, encourage, and provide academic assistance. Base groups acted as a family-social network in and outside of the classroom. This group met daily and was an academic and personal support system that lasted up to a year.

The research described the typical outcome of cooperative groups was that students worked together to complete a single group product, shared ideas and helped each other with the answer to questions. Additionally, they made sure all group members were involved and understood group answers. Students asked each other for help before asking the instructor, and the instructor gave praised and rewarded the group based on performance (Johnson & Johnson, 1979, Johnson, Johnson, & Johnson et al. 1983; Skon 1979).
In order to actively encourage and integrate CL in the classroom there were elements of cooperation that needed mastery by educators within the three types of learning groups. The implementation of specific CL fundamentals was critical for the pedagogical development of students. There are five essential components of CL (Johnson et al., 1989). The first component was positive interdependence, which included identifying and understanding of the task, and making sure all group members and class members understood the task. Second component was individual accountability and personal responsibility. This occurred when the group and individual accepted responsibilities for achieving goals and the consequences for not completing assigned tasks. The third aspect included face-to-face promotive interaction. Positive feedback from group members fostered trust and confidence in abilities. Interpersonal and small group skills allowed group members the ability to resolve conflict, make decisions, and communicate, while demonstrating mutual respect for others opinions and ideas. The final feature was group processing. Group processing consisted of self-evaluating and re-evaluating the groups’ workability and achievements.

The essential components are not just procedure of CL, but meticulous disciplines that are needed to ensure CL occurring. According to Holubec, Johnson, and Johnson (1994), these components act as guidelines to produce outcomes that ensure students academics success. The outcomes of cooperative learning is further illustrated Figure 4.

Types of Cooperative Learning Methods

Slavin (1990) research on cooperative learning methods dictated that team rewards and team and individual accountability are essential elements for cooperation on basic skills achievement. There are numerous CL strategies/methods that yield an
increase in student academic achievement. The most widespread CL methods used were the group investigation (GI) and the jigsaw method.

*Group investigation*

Group investigation (GI) was a flexible set of guidelines that organized the process of study. The GI method developed by Sharan and Sharan (1992), promoted self-reliance among students. The primary goal of GI was to create conditions that allow students, in collaboration with their classmates, to participate in the steps of scientific method. The basic features of GI are investigation, interaction, interpretation, and intrinsic motivation (Sharon & Sharon, 1992). GI method emphasized social interaction among group members. Sharan and colleagues (1984) stated social interaction in CL groups provided a great deal of gratification to students. Capitalizing on students' urge to interact, a group of task-oriented interactions are developed, and students are motivated to learn. Collaborative skills are taught directly and reinforced throughout GI.

Implementation of the GI method usually followed these general guidelines. During the initial stages of GI, the class determined subtopics after the teacher’s presentation of the main topic. The classes are then organized into research groups. The class was divided into groups, based on teacher’s discretion, and each individual group plans how they intended to proceed with their work. The groups carried out their investigations, planned how to present their findings to the class, and later made group presentations. After which the teacher and students evaluated the presentations (Sharan & Sharan, 1992). These guidelines contrast a traditional method of instruction (i.e. lecture). Cooperative learning with GI was appropriate for the study of topics in science when the subject matter required group discussion and analysis, and when students were
able to collectively suggest ideas and examined them empirically in the laboratory or elsewhere (Lemke, 1990; Sherman, 1994). CL method also yielded superior academic achieve outcomes among students of mathematics and biology (Davidson, 1990; Gardner, Mason, & Matyas, 1989; Lazarowitz & Karsenty, 1990), as well as in group problem solving efforts with scientific problems (Towns, 1998).

Although the GI method promoted academic achievement through social interaction, there were some drawbacks in the implementation. GI could only be utilized on certain kinds of instructional content. The content had to have the capability to be deconstructed into subtopics. When mastery of certain skills sets, concepts or facts was the primary goal, it was difficult to deconstruct the material into subtopics for students to teach each other. Traditional instruction was indeed more effective in retrospect. Students can also became frustrated with peers who were not able to comprehend the topic. This frustration can result into conflict and disengagement from the GI method.

*Jigsaw*

Johnson and Johnson (1990) contended that the jigsaw classroom or structure belonged to a set of innovative cooperative forms of learning. It differed from random unstructured traditional group work. The jigsaw cooperative learning strategy avoided many of the problems of other forms of learning in groups (Berger & Hanze 2007). This method of cooperative learning manifested several characteristics among group members. It cultivated positive interdependence shown when each member has contributed to group task. It helped promote individual accountability. Accountability allowed all group members to make their own contribution to the group. This led students actively promoting each others learning, which was the premise of CL. Interdependence among
Cooperative Learning Methods

students is promoted by giving each student in a learning group access to information comprising only one part of a lesson (Sharon, 1990). The experts were then accountable to their group for teaching the part of the lesson to the rest of the jigsaw group members. Cooperative skills are demonstrated and taught directly throughout the jigsaw process. However, there was no group reward, but rather individual grades were the incentives behind this method of cooperative learning.

Aronson (2002) found that students learned the material more rapidly and performed considerably better on exams than students learning the same materials in classes conducted with traditional instruction. Additionally, Aronson emphasized the jigsaw structure encouraged listening, engagement, and empathy by giving each member of the group an essential part to play in academic activity (Berger & Hanze, 2007). This method of CL employed group members to work together as a team to achieve a common goal. Teachers and students combined emotional involvement, the mental stimulation, and the personal significance of the investigation project to make it an authentic learning experience (Sharon & Sharon, 1993)

Baird, Lazarowitz, and Hertz-Lazarowitz, (1994) showed that students in the jigsaw classroom scored significantly higher in academic outcomes, self-esteem measures, and involvement in the classroom. However, research conducted by Malvin, Moskowitz, Schaeffer, and Schaps (1985), found that participation in the jigsaw classes did not have any positive effect on students. The jigsaw was unsuccessful in changing student perceptions of classroom or school climate, attitudes toward peers, attendance, and math and reading achievements (Berger & Hanze 2007).
Summary

Evidently different theoretical perspectives, ranging from social interdependence, accountability, cognitive-development, and behavioral learning, provide a clear understanding as to why cooperative efforts are essential for maximizing learning and ensuring a improved cognitive and social development as well as many other important instructional outcomes. The research presented an assurance that if cooperative learning is implemented effectively, the likelihood of positive results is reasonably high. The mixture of research, theory, and practicality makes cooperative learning one of the most eminent of all instructional practices. However, it is difficult to advise the exact cooperative learning methods to use in every classroom, since there have been only a few studies conducted comparing achievement of the various CL methods.

This study will examine and compare students academic achievement based on two widely used cooperative learning methods, jigsaw and group investigation. Students academic achievement will be measured by data collected through assessments. Each instructional strategy will be compared to determine which cooperative learning method is most effective.
Methodology

The research has shown that cooperative learning methods can increase academic achievement of students, by capitalizing on students desire to interact, fostering positive interdependence and confidence. However, the research did not indicate which cooperative learning method yield the best academic success. The current study will examine and compare assessment scores of the two of the most prominent CL methods; jigsaw and group investigation, and that of traditional instruction.

The following criteria were used to select topics for the jigsaw and group investigation cooperative learning methods. The topics satisfied New York State’s educational requirements, had the ability to divide of materials into segments, and had relevance to current ecology unit. The class interpreted and discovered data through research or group discussion in respect to assigned method. Topics included the examination of various relationships and interactions among species and the effects of human influences on the environment.

Participants & Experimental Design

Four 9th grade living environment classes, with a total of 46 students participated in the 2008-2009 school year. The four classes consisted of 25 female and 21 male students from ages 13 to 17. Each class was labeled (A) through (D). The students were divided into heterogeneous groups, based on academic strengths and weaknesses. Each instructional strategy included two to four members per group. All classes were given the same task and allotted time. The instructional strategies were switched simultaneously with the learning unit. Previous assessments derived from traditional instruction were used as a control.
Conducted research allowed a comparison of the effects of two cooperative learning methods on academic achievement. According to Kagan and Johnson, (1990; 1980), the objectives of the jigsaw methods included: content mastery, concept development, creating positive relationships among peers, interdependence, and the academic achievement (See Appendix A). Slavin (1995), six-stage model depicts the instructional framework for the GI method (see Appendix B).

_Procedures_

During the implementation of the jigsaw method, students were divided into five home groups (Groups A, B, C, D and E). Each of these home groups consisted of five students depending upon class size. The jigsaw activity allowed students to examine symbiotic relationships among species at various stations. These relationships included commensalism, mutualism, predation, parasitism, and competition, which represented the five stations. Each station had a standard definition of one of the symbiotic relationships and corresponding picture of the species interaction. The text book was also provided to act as a resource. A member from each home group was assigned a station group. Each station group collectively re-wrote two definitions in their own words and developed two additional examples of each relationship. Each station group returned to their home groups as experts of at least two symbiotic relationships. An illustration of the rotation process is shown in Appendix C. Each expert rotated and discussed two out of the four revised definitions and examples with their home groups. Appendix D illustrates an example of the symbiotic relationship provided at each station.

During the GI activity, students were introduced to a broad topic of current environmental issues. To summarize the conditions of the GI instruction: students were
grouped in pairs and asked to brainstorm the various ideas and which subtopic they would like to investigate. After a brainstorming discussion, groups chose an environmental issue and had to follow the guidelines to discover the distinguishing details of their chosen topics. The groups, delegated responsibilities and determined resources needed to present individual group topic to the class. Rubrics and a guide were given to outline the substance of the assignment (see Appendix E and F). At the end of the experimental period, students were given assessments. The assessments (Appendix G and H) reflected the assignments and were later compared. The qualitative data of students’ perceptions toward the group investigation and jigsaw method were discovered through group discussion.

*Academic Performance*

All classes completed an assessment following each cooperative learning activity. The two assessments in a form of quizzes varied and were constructed according to the instructional methods. The assessments indicated the specific knowledge acquired during the learning unit. Each quiz was designed to reveal the different skills of organization, content mastery, transferability, and problem-solving. The assessments scores were later compared to each other and previous scores from traditional lectured-based instruction.
Results

A study was conducted to determine if there were significant differences in the academic achievement of students after utilizing two cooperative learning methods; jigsaw and group investigation. There were several comparisons conducted to examine the qualitative data. First, a comparison of overall academic achievement based on the post assessment scores from each method of instruction. The second comparison involved individual class achievement based on all three instructional strategies. The last comparison implicated the percentages of assessment scores 65 or higher in jigsaw, group investigation, and traditional method.

Table 1 illustrates the means and standard deviations of assessment scores for all classes in the three instructional strategies. This comparison showed the GI method rendering a slightly higher assessment average and lower standard deviation value ($M = 79$, $SD = 12$, $N=45$) than the jigsaw assessments ($M = 78$, $SD = 24$ & $N=46$). Although there were no significant difference (1 point) in the comparison of the CL methods assessments, there was a considerable difference when compared to traditional instruction assessment scores. The traditional assessment scores were six and seven points lower than its counterparts ($M =72$, $SD = 22$, & $N=42$).

Table 2 demonstrates the assessment averages of individual classes in respect to each the instructional method. This comparison showed Class A performing higher (93.3) in the jigsaw activity, while Classes B and C scored higher with the group investigation method (81.7 & 88.6). Class D possessed a slight increase in achievement with traditional instruction (72.4). Lastly, an examination of individual class achievement based the methods of instruction was also compared.
Table 1

*The Mean and Standard Deviation of Jigsaw, Group Investigation, and Traditional Instruction*

<table>
<thead>
<tr>
<th>Methods</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jigsaw</td>
<td>78</td>
<td>24</td>
<td>46</td>
</tr>
<tr>
<td>GI</td>
<td>79</td>
<td>12</td>
<td>45</td>
</tr>
<tr>
<td>Traditional</td>
<td>72</td>
<td>22</td>
<td>42</td>
</tr>
</tbody>
</table>

*GI- Group investigation
*N- Number of Participants
*SD- Standard deviation
Table 2

The Assessment Averages of Jigsaw, Group Investigation, and Traditional Instructional Methods

<table>
<thead>
<tr>
<th>Classes</th>
<th>Jigsaw</th>
<th>GI</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A</td>
<td>93.3</td>
<td>81.7</td>
<td>76.4</td>
</tr>
<tr>
<td>Class B</td>
<td>74.1</td>
<td>88.6</td>
<td>55.1</td>
</tr>
<tr>
<td>Class C</td>
<td>70.7</td>
<td>73.3</td>
<td>72.2</td>
</tr>
<tr>
<td>Class D</td>
<td>70.6</td>
<td>70.8</td>
<td>72.4</td>
</tr>
</tbody>
</table>

*GI- Group investigation
The percentages of students scoring 65 or higher on the assessments in all instructional strategies are shown on Table 3. In this comparison GI rendered a higher percentage of students passing two out of the four classes. Both class A and B had 100% passing rate. However, when the overall percentages of students scoring 65 or higher was compared, group investigation had a highest percentage (90), as shown in Table 4.
Table 3

The Percentages of Assessment Scores 65 or Higher in Jigsaw, Group Investigation, and Traditional Instruction Methods

<table>
<thead>
<tr>
<th>Classes</th>
<th>Jigsaw</th>
<th>GI</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A</td>
<td>93</td>
<td>100</td>
<td>75</td>
</tr>
<tr>
<td>Class B</td>
<td>71</td>
<td>100</td>
<td>40</td>
</tr>
<tr>
<td>Class C</td>
<td>80</td>
<td>89</td>
<td>89</td>
</tr>
<tr>
<td>Class D</td>
<td>73</td>
<td>69</td>
<td>67</td>
</tr>
</tbody>
</table>

*GI- Group investigation
Table 4

*Overall Percentages of Assessment Scores 65 or Higher in Jigsaw, Group Investigation, and Traditional Instruction Methods*

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jigsaw</td>
<td>79</td>
</tr>
<tr>
<td>GI</td>
<td>90</td>
</tr>
<tr>
<td>Traditional</td>
<td>68</td>
</tr>
</tbody>
</table>

*GI- Group investigation*
Discussion

The present study sought to investigate which cooperative learning methods; jigsaw or GI will reveal higher academic success in the classroom and also compare the assessments scores from the two CL methods and traditional delivered instruction (lecture, complete assignments, and assessment). The study was conducted over a four week period and required implementation of traditional instruction, jigsaw, and group investigation. Assessment scores were recorded and averaged for each method of instruction and compared. After comparing the overall percentages of students scoring 65% or higher, GI seemed to be the most effective on student academic performance. The traditional delivery of instruction rendered lower assessment scores throughout the investigation. This study clearly supports the research that showed a relationship between CL and student achievement, which identifies cooperative learning as a means to increase students’ academic performance.

Although the study determined group investigation as the most effective instructional strategy, topic familiarity and group dynamics could have influenced the results. In actuality, topic familiarity may have had the most influenced on the results. The jigsaw activity focused on the symbiotic relationships between species, in which students had no prior knowledge, while the group investigation activity explored topics students had some familiarity with. Since, the investigated environmental issues are so prevalent in current media; students knew the causations before researching. This could account for the high number of students scoring 65% or higher in the group investigation method.
Since, some classes ratio of males to females were 3-1, this could have had a significant influence on academic performance. The groups dominated by one a particular sex, may have intimidated their counterparts, therefore limiting contributions and discussion. During cooperative learning students must feel confident in expressing ideas and opinions, if compromised than cooperative learning can not exist. Even though the CL methods did not exceed the critical number of six in a group (Rice, 1971), classes varied in group sizes. Some groups were smaller than others. Classes B and C had groups of 2 to 3 members, while classes A and D had 4 to 5 members. The smaller groups had fewer members to share opinions and ideas, therefore limiting contributions to the activity.

The study has shown group investigation as the most effective cooperative learning method. Undoubtedly, class dynamics and task familiarity may have an influenced students’ academic performance on the assessments. The comparisons also revealed that the CL methods do impact student performance and traditional instruction yield unfavorable results, by limiting peer social interaction.
Conclusion

This study demonstrated that when cooperative learning is implemented there is an increase student achievements and direct student-center learning. Although there was a clear advantage of using the GI method, when compared with traditional facilitated learning there were extraordinary differences. CL methods allowed students to rely on their peers for information and less teacher-dependent. Students demonstrated critical thinking and problem solving skills. This instructional strategy fostered positive interdependence, individual accountability, and self-confidence. The cooperative learning methods enhanced achievement by making each student take ownership of their learning. The study provided insights into the difference in academic achievement in regards to the various CL methods as well as traditional methods of delivering instruction.

In order for students to become critical thinkers and obtain a true understanding of the topic, activities must be student-centered rather teacher-centered. An enthusiasm and motivation for learning can be derived from peer social interaction, which is the foundation of cooperative learning, in addition to demonstrating concepts and procedures, and increasing learning through inquiry. The objectives of incorporating cooperative learning strategies are for students to become independent thinkers and problem solvers, while working cooperatively with others in performing a task. Clearly, both CL methods demonstrated these objectives. However, a study comparing assessment scores from multiple jigsaw and GI activities may have rendered a more decisive conclusion of which CL methods is most effective. A comparison of the academic improvement or
achievement of gender-based groups, low performing students, and various group sizes may need further investigation.
References


groupwork at key stage 3: solving an attitudinal crisis among adolescents.


Appendix A

Jigsaw Information and Procedure

When you have information you need to communicate to students, an alternative to lecturing is a procedure for structuring cooperative learning groups called **Jigsaw** (Aronson 1978).

**Task:** Think of a reading assignment you will give in the near future. Divide the assignment into three parts. Plan how you will use the jigsaw procedure. Script out exactly what you will say to your class in using each part of the jigsaw procedure.

**Procedure:** One way to structure positive interdependence among group members is to use the jigsaw method of creating resource interdependence. The steps for structuring a jigsaw lesson are:

1. **Cooperative Groups:** Distribute a set of materials to each group. The set needs to be divisible by the number of members of the group. Give each member one part of the set of materials.

2. **Preparation Pairs:** Assign students the cooperative task of meeting with a classmate in another learning group who has the same section of the material to complete two tasks:
   - a. Learning and becoming an expert on their material.
   - b. Planning how to teach the material to the other members of their groups.

3. **Practice Pairs:** Assign students the cooperative task of meeting with a classmate in another group who has learned the same material to share ideas about how the material might best be taught. The best ideas from each pair member are incorporated into each member's presentation.

4. **Cooperative Groups:** Assign students the cooperative tasks of:
   - a. Teaching their area of expertise to the other group members.
   - b. Learning the material being taught by the other members.

5. **Evaluation:** Assess students' degree of mastery of all the material. Reward the groups whose members all reach the preset criterion of excellence.
Appendix B

Six-Stage Model of Group Investigation

FIGURE 1

Six-Stage Model of Group Investigation

I. Identify topics and form groups
   - Scan sources, propose topics, & categorize suggestions
   - Form heterogeneous groups based on topic interest
   - Instructor facilitates organization

II. Plan the learning task
   - What do we study?
   - How do we study?
   - Who does what?
   - What are our purposes and goals?

III. Carry out the investigation
   - Gather information
   - Contribute individually
   - Exchange, discuss, clarify, & synthesize ideas
   - Reach conclusions
   - Analyze data

IV. Prepare the group presentation
   - Determine essential message
   - Plan what to report
   - Plan how to report
   - Coordinate plans

V. Present the group project
   - Variety of forms
   - Peer feedback
   - Audience involvement

VI. Evaluate achievement
   - Higher-order thinking
   - Investigation of certain aspects
   - Application of knowledge
   - Inferences
   - How conclusions were reached

Based on Slavin (1995)
Appendix C

The Jigsaw Rotation Model

1. Home Groups

   - ABC DE
   - ABC DE
   - ABC DE
   - ABC DE
   - ABC DE

2. Stations and Expert Groups (rotated 2-3 times)

   - AA BB
   - AA BB
   - CC DD EE
   - CC DD EE
   - CC DD EE

3. Discussion Groups (Home Groups)

   - ABC DE
   - ABC DE
   - ABC DE
   - ABC DE
   - ABC DE
Appendix D

Example of station’s definition and example

**Station A**

**MUTUALISM**

—symbiotic association in which both partners benefit.

a) Example: Crocodile and Crocodile Bird

- The Crocodile bird sits in the mouth of the crocodile feeding of the leftover food particles between the crocodile’s teeth, while the crocodile gets his teeth cleaned.

![Image of a crocodile and a bird](image_url)
Appendix E

Group Investigation Activity Rubric

<table>
<thead>
<tr>
<th>Human Impact Poster</th>
<th>Rubric: Human Impact Poster</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description and Analysis</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Beginning</strong></td>
<td>Description of the issue included less than 3 points.</td>
</tr>
<tr>
<td><strong>Developing</strong></td>
<td>The cause of the problem was not given.</td>
</tr>
<tr>
<td><strong>Accomplished</strong></td>
<td>Description of the issue included at least 4 points.</td>
</tr>
<tr>
<td><strong>Expert</strong></td>
<td>The cause of the problem was given but not clear.</td>
</tr>
</tbody>
</table>

| **Map** | |
| **Beginning** | No map was provided to help your audience understand the issue better. |
| **Developing** | The Map was provided but did not enlighten your audience with a better understanding of the issue. |
| **Accomplished** | The Map provided was enlightening but repeated other information on the poster. |
| **Expert** | The Map provided was enlightening and gave your audience a new understanding of where in the world the issue is happening. |

| **Controversy & Solutions** | |
| **Beginning** | No controversy was mentioned. |
| **Developing** | At least one controversy was mentioned but with no detail. |
| **Accomplished** | The stakes were listed but the positions were not clearly explained. |
| **Expert** | At least one controversy was explained in detail so that the audience could understand what the “big deal” was. |

| **Expert Questions** | |
| **Beginning** | Less than 5 questions were provided. |
| **Developing** | 5 questions were provided that helped the audience learn but not in depth. |
| **Accomplished** | 5 questions were provided that helped the audience learn something useful about the issue. |
| **Expert** | 5 challenging questions were provided for the audience that helped them understand the issue and become an expert themselves. |

| **Group Cooperation & Use of Time** | |
| **Beginning** | We did most of the work by ourselves, we talked a little among our group members. |
| **Developing** | We worked together most of the time, sharing information regularly. |
| **Accomplished** | Everyone had a job to do but some jobs were incomplete. |
| **Expert** | Everyone worked together using his or her abilities and knowledge to make the project come together. |

| **My Accountability** | |
| **Beginning** | Rarely focused on the task and what needed to be done. |
| **Developing** | Focused on the task and what needed to be done some of the time. |
| **Accomplished** | Work performed was incomplete and contributions were less than expected. |
| **Expert** | Consistently stayed focused on the task and what needed to be done. Work performed was very useful and contributed significantly to the final project. |

Comments:
Appendix F

Group Investigation Guideline

Be An Expert! Human impact on the Environment

Now that you have received a brief introduction to some environmental issues affecting neighborhoods today, you are challenged to study one environmental issue in depth. This assignment is designed to give you a fuller understanding of one issue, its players, and its controversies. You will also have the opportunity to assess the knowledge of your classmates on your “expert” issue.

Research a topic of your choosing (one group per topic) using your textbook, internet, study guide and regents review book for two class periods. All the parts that you must include on your poster are listed below.

A: Description and Analysis of Issue:
1. What is the environmental issue? Include at least 5 points of description.
2. What are the major causes of the environmental problem?

B. Map:
Map out the hot spots (globally) where your environmental issue has its greatest effects a blank map printout will be provided.

C. Controversy and Solutions:
1. Explain the various controversies associated with this issue.
2. Who are the interest groups or stakeholders involved? What is the position of each group?

D. Expert questions
Develop a set of 5 questions to be to be completed by the rest of the students in the class. Your questions should be written on your poster. The answers to the questions should all be clearly found on your poster. Your group is to turn in an answer key at the end of the second class period.

E. Gallery Walkthrough
On the third class, we will have a gallery walkthrough. Members of each group should be prepared to answer relevant questions about your topic. This class will also be the opportunity for other students to learn more about your issue. Answers to each poster’s questions will be this week’s quiz grade.

F. Group Cooperation, Accountability, and Use of Class Time
1. Develop a division of tasks for your group.
2. Each group member is to initial the parts of the poster in which s/he made a contribution.

Topics to chose from:
- Renewable and nonrenewable resources (forest, land and ocean)
- Renewable and nonrenewable resources (air and water)
- Acid Rain and pollution
- Global Warming
- Ozone Depletion
- Biodiversity (introduced species and pollution)
- Biodiversity (Habitat loss and conservation)
Appendix G

Jigsaw Assessment

Name: ________________________________  QUIZ

- Parasitism     - Predation
- Competition    - Commensalism
- Mutualism

Directions: Explain two of the terms in your own words and also give an example of 2 species interactions in which you learned from other group members.

1. ______________________________________
   Ex 1: _________________________________
   Ex 2: _________________________________

2. ______________________________________
   Ex 1: _________________________________
   Ex 2: _________________________________
Appendix H

Group Investigation Assessment

Name: ___________________________  QUIZ

Directions: Answer the following 10 questions after listening and reviewing all presentations. Hope you took GOOD notes!!!

1. Name one cause of GLOBAL WARMING?

2. What can be done about GLOBAL WARMING?

3. Name one chemical that causes OZONE DEPLETION?

4. Why is the OZONE LAYER good for us?

5. What effect does ACID RAIN have on forests?


7. Name one RENEWABLE resources

8. When BIODIVERSITY is low, how stable is an ecosystem?

9. Why are INTRODUCED SPECIES a problem in ecosystem where they did not come from?

10. How does HABITAT LOSS affect endangered species?