Assigning Individual Roles and its Effect on the Cooperative Learning Setting

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Abstract
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Assigning Individual Roles and its Effect on the Cooperative Learning Setting

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Submitted in partial fulfillment of the requirements for the degree
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Supervised by

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Abstract

The research studied how assigning roles to individuals within groups during cooperative learning activities could improve the overall learning. It followed four classes of middle school science students during the learning of the topics density and pH through group learning activities. The research measured how assigning roles would affect the amount of time spent on task within groups, the amount of time when all students within the group were participating, and the group grades. The research concluded that assigning roles to students in groups reduced the amount of time students might get off task and increased the amount of participation within the groups. The result for group grades was not as definite and therefore might require further research in comparing the achievement in groups with and without roles.
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Assigning Individual Roles and its Effect on the Cooperative Learning Setting

Many teachers start their careers with a toolkit full of new and interesting teaching methods with the intention of testing and successfully applying each one. At some point though, these new teachers discover that their toolkit of methods, while in theory sound fantastic, frequently fall apart in practice. One such teaching method that seldom lives up to its theoretical potential is cooperative learning. It is a well-researched topic, extensively written about and has had proven success in the classroom setting. However, it is a tool many teachers struggle to implement successfully in their classroom.

Arranging students into groups, having them work well together and finally to submit a quality product may sound easy but in all actuality can be met with many obstacles. It is a method teachers try and when it is unsuccessful they give up rather quickly. It seems much easier for teachers to keep the students working individually and to be focused on the teacher than it is to handle them in groups working together. However, cooperative learning has so many benefits it really is a method deserving of a second chance. There are many ways cooperative learning can go wrong and so the problem is not always the method but the teachers not fully understanding how to implement it correctly. One of the most common mistakes is putting the students into assigned groups but not really giving each student a job. At this point the strong students might vie for the lead position in the group while the quieter students sit back and try to do the work independently, thus creating a very uncooperative group. Students need the extra structure assigning a role provides in order to work towards a common goal. This paper will look specifically at whether assigning roles in a cooperative learning group can benefit the overall atmosphere of the group setting and improve the chances for student success.
The purpose of this literature review was to look into the many different modes of thinking in regards to cooperative learning and to identify some of the most important ways to be successful when putting students into groups. It will focus on how roles fit in to the set up of a group and what the research has found about increasing student understanding of a topic through use of cooperative learning. The research will also look into trying to decrease the off-task behavior that plagues many group activities and look at ways to prevent free-riding students (students in the group that make no effort to participate) from benefiting from a group setting. Included in this literature review will also be some discussion on teacher misconceptions and beliefs in regards to cooperative learning. The hypothesis is that by assigning roles to students when putting them into groups there will be an increase in their participation and understanding while there will be a decrease in the unwanted group behaviors such as free-riding and off-task discussion. In doing so, the hope is to also resolve some of the preconceived notions many new teachers may develop upon applying the cooperative learning method.

Literature Review

Although cooperative learning is not a new idea, as it has been around in its present form since the 1960s, it is an idea that caught on, gained fame, and dropped out of the spotlight all within the 1990s. Johnson (2009) stated on his website that cooperative learning as an idea has been around since the 1800s but as a theory has only been around since the 1950s. Johnson and Johnson (1989) have been working with this 1950s model since the 1960s and their work forms the basis for much of the current research. That is not to say the Johnsons are the only researchers who have spent their careers on cooperative learning, but they hold an influential position in the field as some of the most
extensively referenced researchers. It is interesting to note that while there were many articles and books written in the late 1980s and early 1990s, during the 1990s and into this century, the number of books and articles about cooperative learning decreased. Pratt (2003) related this decrease in cooperative learning during the mid 1990s to the “push to rewrite curricula and activities based on the [national] standards” (p. 25).

Cooperative learning is defined as the instructional use of small groups where students work together to maximize their own and each other’s learning (Johnson, Johnson, & Holubec, 1994). Small groups of students ranging in size from 2-4 individuals are used in the classroom to increase the student-centered approach to teaching. In theory, this will increase the student understanding of a topic when compared to the traditional teacher-centered approach to education. In order for cooperative learning to take place, there are five key elements to incorporate. The first is positive interdependence, where students believe that they sink or swim together and must rely on each other to work towards a common goal. Second, cooperative learning needs face-to-face promotive interaction meaning the students interact to finish a task while promoting one another’s success. Third, there must be individual accountability. Each student still needs to take and complete their fair share of the work even when in a group setting. Fourth, social skills must be both discussed and positively reinforced to allow for groups to work well together. Finally, group processing is required to ensure students within the group are assessing the behavior and cohesiveness periodically in order to reevaluate what interactions may need to be changed or improved (Johnson & Johnson, 1993).

The following literature review will look into the specifics on how to effectively group students in preparation for cooperative learning and examples of roles to assign to
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students. It will also look at how to increase student participation and understanding. The research will discuss how to overcome some of the challenges of group learning such as free-riding students and off-task behavior. The literature review will look at the pros and cons of rewards and whether or not they should be group or individual based. Finally, teacher misconceptions and unfounded beliefs on cooperative learning, revealed in the research, will be discussed.

Grouping

Putting students into groups is by far the most essential part to the cooperative learning experience, but can also be the most difficult part. This first step can mean the end of cooperative learning for teachers who fail to understand the importance of carefully planned groups. Before getting students into groups or even starting cooperative learning in the classroom, a teacher should take some time to discuss what it means to work in a group with their students. One teacher tried cooperative learning for the first time and it ended up being a disaster. When he reflected, he found he had not discussed social skills with his students (Schultz, 1989). He found asking the students to reflect on what it means to be a good group worker actually improved the overall group atmosphere. Another teacher suggested having the students think about what they expect from their group and what they expect to contribute to the group and used these to come up with a group contract (Towns, 1998). This group contract is probably best for settings where the group will be together through the semester or year, which is most prevalent in higher education. Another key to this portion of the group work is to continually praise good cooperative behaviors and to revisit development of social skills periodically throughout the year. Some problems may arise during cooperative learning activities that
were unforeseen at the beginning; or certain social skills might need to be built upon over time. Setting up the ground rules ahead of group formation will benefit all five of the key elements to cooperative learning.

Once the ground rules have been set for proper cooperative and group behavior, it is time to place students into groups. There are many different ways to do this but the two rules that should be followed are, “never let the students pick their own groups” and “never allow students to change groups once formed” (Pratt, 2003, p. 26). Students will pick groups based on friendships and common interests, which will end up leading to off-task behavior. Also, students who are allowed to pick themselves usually end up picking students with similar learning levels and will end up with a product similar to others submitted in class prior to the group activity. One of the goals for cooperative learning is to actually increase student thinking and to challenge them. If the result is a product similar to what has already been demonstrated, there is really no increase in achievement. Another reason to not allow students to pick their own group is that it will inevitably lead to some students being left out. Also, problem students (either behavioral or ability based) will end up together and result in behavioral issues or no change in ability level. Most teachers will pre-arrange their students into heterogeneous groups based on ability or interest. Schulte (1999) recommended getting to know students’ personalities and abilities before putting them into groups and also to carefully observe group members upon first grouping individuals to make sure they are working cohesively. Mixed groups tend to “promote more elaborative thinking, more frequent giving and receiving of explanations, and greater perspective-taking during discussions about material” (Johnson et al., 1994, p. 26). This increase in interaction among students with different abilities
leads to greater understanding for all students involved, even the students who began the lesson with a higher ability than others.

Pratt (2003) recommended not allowing students to change groups when they are assigned. This goes into the discussion of problem solving and group reflection. Students will undoubtedly be placed with someone they do not want to be with, however, once one student is allowed to switch they will all want to switch. Pratt (2003) stressed to her students every job they will get in the future will require them to get along with their coworkers and they will most likely never get to pick their coworkers so they should get used to it now. Another key to the group success is for group members to know that they “sink or swim together, and if one fails, they all fail” (Johnson et al., 1994, p. 6). Knowing how much of their success depends on teamwork should prevent some of the problems. Students will not have to spend the entire year in a particular group and new groupings are certainly a way for students to get to know their fellow classmates better.

In some cases, it may be required for the teacher to conference with a troubled group, but the goal of cooperative learning is to get groups to a point where they can actively resolve problems from within; emphasizing problem-solving as a group during the social skills teaching segment, which precedes group formation, should help out in these situations. Part of the process of groups working together for extended periods of time is to allow time for students to reflect on their group. Two simple questions a teacher could ask were “name three things your group did well, and name one thing your group could do better next time” (Johnson, Carson, & Johnson, 1989, p. 30). This opens up a dialogue for students to constructively take action on group shortcomings. It also might let the teacher know about something he or she might not have seen when monitoring the groups.
In summary, there are a few key points to forming effective groupings. First, the groupings should be prearranged in heterogeneous groups by the teacher. Second, there are four things Johnson and Johnson suggested are the foundation for effective group work. Students must get to know and trust each other, communicate accurately and unambiguously, accept and support one another, and resolve conflicts constructively (Johnson et al., 1989). To ensure this, teachers should allow time to set-up cooperative social skills and to give time for students to reflect on their use of these skills.

**Roles**

One way found to reduce conflict and off-task behavior in a group was to assign roles. By assigning roles, the teacher gave each group member a piece of responsibility, which allowed students to know what to do and what to expect from each other (Johnson et al., 1994). In the research there were many different examples of roles used in group settings. The roles varied depending on the activity being assigned. For example, if the students were working on a laboratory activity some roles could be the director, investigator, materials manager, and data recorder (Schulte, 1999). Other roles designed more for increasing social skills in the group were reflector, time-keeper, encourager, and checker (Lin, 2006). No matter what the groups were being asked to do, the important rule with assigning roles was to make sure each student knows what is expected of him or her. If a student is unsure of what is expected, he or she will most likely either not participate or fail to live up to what the other students believe is their job. Some of the roles could also help out with team dynamics and allow for groups to be monitoring themselves from within. For example, the team reflector might observe and take note of group dynamics and focus on better group functioning in the future. The encourager’s job
may be to make sure all students are actively participating (Lin, 2006). By assigning roles the teacher gives some of his or her job to the students. The teacher in a cooperative classroom would find it very hard to be with every group for the entire period, by giving some of the monitoring roles to the group itself, the teacher is free to observe groups periodically and to focus on resolving conflict or confusion. Another important aspect of role assignment was to make sure roles are rotated (Johnson et al., 1989). If one student has the leader role for too long, other group members may find it unfair and also, in the case of reflective type roles, it allows all members to be able to have input towards group dynamics or improvement. Giving students their individual roles allowed for them to be held accountable for their share of the work (Vermette, 1995), as well as helped them to see how they were linked to one another within the learning group (Johnson, Johnson, & Smith, 1998b). Giving students complementary roles such as reader, checker, elaborator, and encourager allows for the students to realize they are all connected and in order to succeed, need to work together.

In conclusion, it is important to assign roles to not only give the students a job, but to also make sure the group can monitor their own behavior and work. In a cooperative setting, the teacher is meant to be a facilitator of the learning and needs to be able to float from group to group. If groups are given capacity to help themselves, the teacher will not have to spend his or her time helping or monitoring one group but can spread his or her time among the entire class.

Student Understanding

One of the aspects of cooperative learning that has been studied the most is whether or not it actually improves students’ understanding or achievement on a specific
topic. Slavin (1991a) found when looking through 67 different studies on the effects of cooperative learning that “41 (61 percent) found significantly greater achievement” in cooperative learning classrooms (p. 76). Slavin (1991a) discussed in order to enhance student achievement there needs to be group goals and individual accountability. Johnson, Johnson, and Smith (1998a) looked at more than 168 studies done on cooperative learning since 1924 and found that when comparing cooperative learning to competitive learning (students working against each other) and individual learning (students working alone), cooperative learning showed an increase in individual achievement over competitive and individual learning. One of the key elements in cooperative learning was face-to-face promotive interaction. When students helped each other towards success and interacting positively with each other, students reach higher levels of achievement (Johnson & Johnson, 1993). Lord (2001) found when students were in teams they performed better than when students studied alone. Students in teams “spoke more often, asked more questions, and were more engaged” during class (Lord, 2001, p. 31). He found when students were trying to explain a topic to another person or when students were trying to understand something being told to them by a colleague, they actually made better connections to the material and also were more likely to speak-up and correct misconceptions.

In conclusion, placing students into groups with their peers for cooperative learning purposes allows them to compare their knowledge with one another. Students are much more likely to ask a peer for clarification or even to listen to a peer than they are to seek information from a teacher.
Off-task Behavior

Off-task behavior is described by many teachers as when a student is in the classroom, but is talking about or participating in something completely unrelated to the subject of the class. For example, students coming into science class and talking about what just happened in the hall or the relationships of their friends. While it is good the students are conversing and sharing information, off-topic conversations are a waste of valuable subject area time. Students need to realize how important their class time is to their education. One way off-task behavior can be dealt with in cooperative learning is to use it as a discussion point with students prior to getting them into groups. However, this will only work up to a certain point. Eventually, students will forget the many discussion topics used before the group formation and will gradually go back into old habits.

Another way to decrease off-task behavior is to prearrange who is put into each group. Students who are a constant distraction to each other will not benefit from being put into the same group. One of the group roles found specifically for keeping students on task was the time-keeper. Their job was to keep the group on-task and within the time limits of the activity (Lin, 2006). This student’s role in the group was to make sure they can stay focused on the activity and hand in a product on time. Another role beneficial for on-task behavior is the reflector whose sole purpose was to observe group dynamics (Lin, 2006). If the reflector notices off-task behavior that could be a point of improvement the group needs to work on. Johnson, Carson, and Johnson (1989) recommended using bonus points to make sure groups show desired behaviors. For example, the group who is noticed as staying on-task the most for the day could get five bonus points. These bonus points could go towards earning a prize at the end of the marking period for the group.
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who has the highest amount of points. Another way roles can reduce off-task behavior is if they increase positive interdependence, which is needed in cooperative learning. Strongly stressing to students the idea that they will either sink or swim may be enough to get them to realize how much they all need to be working towards the common team goal the entire time (Johnson & Johnson, 1993).

One task teachers must do to target off-task behavior is to constantly be monitoring the groups. Cooperative learning is not meant to be an activity for allowing teachers to sit at their desk while the students do work. Carefully and consistently monitoring groups shows the students the teacher is aware of what is going on in each group at all times (Schulte, 1999). Monitoring was also found to be essential not only for keeping students on-task but to make sure students used appropriate social interactions such as no put-downs or negative talk amongst the group (Shultz, 1989). One article also said “success [of cooperative learning] depends on a teacher continually circulating the room in order to listen, to keep students on task” (Pratt, 2003, p. 29).

The methods to reduce off-task behavior in group settings include discussing the behavior with the class prior to group formation, arranging groups carefully, creating a reward system to maintain desired group behavior, assigning roles to students to monitor off-task behavior, and from the teacher’s perspective, constantly monitoring groups throughout the class period and resolving off-task behavior when noticed.

*Free-riding Students*

Free-riding, hitchhiking, or social loafing is an act some students may use in group settings where they do not contribute and essentially allow the rest of the group to work for them. It is a problem when initially putting students into groups. When a student
finds themselves put into a group with a student who seldom does work, he or she immediately thinks about how much more work they will have to do to compensate. This leads to the working student requesting to be changed out of the group or to become completely disinterested in the activity because they do not want to take on the non-working student’s share. As a result, the group dynamics get off to a poor start. One research paper noted “a student’s ability to hide in a group and not contribute is the worst thing that can happen to a cooperative learning process” (Vermette, 1998, p. 279). Assigning roles, stressing individual accountability and positive interdependence, and giving assessments and evaluations are all tools to discourage free-riders.

According to Vermette (1998), “every student can be held accountable if the teacher assigns roles” (p. 279). Assigning roles to monitor group interactions – whether it be the leader (makes sure all members fulfill their roles), encourager (ensures all members are participating), or reflector (observes group dynamics) – should reduce free-riding due to the fact that students cannot sit idly and do nothing without other students taking notice and either asking them to participate or reporting the inactivity to the teacher (Lin, 2006). Also, as mentioned with off-task behavior, monitoring by the teacher is beneficial in cooperative learning. It is best when the group can handle the problem of a team member not sharing the workload, but it is still essential that the teacher be available to properly “organize, encourage, and mediate” (Lindblad, 1994, p. 293).

Stressing individual accountability is probably the biggest factor in reducing the incidence of free-riders. Johnson and Johnson (1993) said “students are held individually accountable to do their share of the work” (p. 63). Students need to be individually assessed on their group behavior as well as their individual portion of the product. Also,
group members need to know they cannot hitchhike on others hard work (Johnson & Johnson, 1993). One way found to ensure individual accountability was to give a short quiz at the end of each class (Lord, 1998). These quizzes ensure the student was actively participating in gaining the knowledge within the group and would accurately reflect which students paid attention and participated. Knowing the grade would be factored into the class grade might prevent some free-riding (Lindblad, 1994,). These quizzes could also be used towards a group grade. Knowing that all of the individual grades need to be good for the group to get a good grade, will motivate the free-rider to participate in order to not be seen as a burden by his or her peers. One teacher increased individual accountability by collecting each group member’s paper but letting it be known that she will only grade one for the group’s grade (Pratt, 2003). When the students did not know which paper would be graded, all students contributed to the product. For some this may seem unfair, but when the students know the rules before hand and are given ample time to complete the task with a group, there really is no reason why each member should not have a decent product to hand in. Strongly developing a group’s positive interdependence, such as in the sink or swim aspect, can also decrease the free-riding. This can increase group members’ motivation by making them feel responsible for their fair share of the work. When students start to feel their efforts might affect the outcomes of their peers, they start to make more of an effort because “failing oneself is bad, but failing others as well as oneself is worse” (Johnson & Johnson, 2009, p. 368). Most students do not want to be seen as the weak link of the group and this is motivation enough to get them to work.
Assigning individual roles

Assessments can be used as tools to increase student participation. Quizzes or tests can be used to increase individual accountability. However, it is up to the teacher to decide whether or not the assessment will count towards individual grades or as a group grade. Teachers need to know how the assessment will be used before hand and to make it known to the groups before the cooperative learning activity even starts. One study looked at how giving peer evaluations affected the free-riding problem. The researchers found that using peer evaluations at an early stage in the group project and then at multiple points throughout, resulted in a reduction in the free-rider problems and it lead to students viewing group settings in a more positive light (Brooks & Ammons, 2003). Students also thought free-riding problems were reduced when “evaluations provided specific feedback,” to the group and the individual (Brooks & Ammons, 2003, p. 271). This feedback was taken from the peer evaluations, given back to the group, and identified aspects of poor performance amongst the group members in addition to providing ways to improve future performance. When free-riders actually saw how the other group members rated them and what they thought about their behavior, the free-riders were more likely to change their behavior so as not to be perceived in a bad light by their peers. Johnson and Johnson (1993) found that groups need to decide what group behaviors are helpful and unhelpful to ensure group members “receive feedback on participation” and to remind students to practice collaborative skills consistently (p. 64). If students know the group finds free-riding or lazy behavior harmful, they may be less likely to exhibit it. Reducing free-rider behavior basically comes down to making the behavior and effect known to students and to have groups provide feedback to the group members to show the free-riders their behavior is unwanted. If a student finds his or her
behavior to be un-cool with their peers they are much less likely to participate in the behavior.

Rewards

In order to motivate students to participate actively in a group setting, there needs to be some incentive for them to work. It was found students were “unlikely to exert the sustained, systematic effort needed to truly master a subject without some kind of reward, such as praise, grades, or recognition” (Slavin, 1991b, p. 90). These rewards can be and should be both individual and group based.

Individual rewards are needed to increase individual accountability within the group setting. Students could earn points towards their grade through “contribution to the team… and through assessing their understanding as individuals” (Lord, 1998, p. 588). Students could be assigned individual parts, which are to comprise the total group product. These individual parts would be assessed and the grade would be given to the individual. “This type of exercise provides the instructor with a measure of each person’s contribution to the group effort (and, therefore, how accountable each member was for their information)” (Lord, 1998, p. 588). Also, each group member can be given an individual quiz or test on the material the group was expected to learn to assess how well individuals were obtaining the knowledge. If the group was working successfully, then the assessment results should be similar among the group members. Teachers need to make sure students are “assessed and the results given back to the group and the individual” (Johnson & Johnson, 1993, p. 63). If feedback is not provided in a timely manner, then the individual will not know how to improve and the group will not know who in the group may require help in mastering the topic.
Group rewards are needed to ensure the group is working cohesively. They are intended more to keep the group working well together as opposed to assessing the group product as a whole. Slavin (1991b) found almost “every study of cooperative learning in which the cooperative classes achieved more than traditional control groups [the cooperative classes] used some sort of group reward” (p. 89). These group rewards enhance individual’s intrinsic motivation to help the group succeed. Most group rewards were given based on group interaction. Schulte (1999) gave “rewards based on group behavior and participation” (p. 46). Many teachers used the group reward system as a way to “teach students the interpersonal and small-group skills they need” (Johnson et al., 1989, p. 31). Teachers discuss with students the group behaviors that students should be using within the groups. When the behavior is seen, the group can earn points. The points can be shown on some sort of visual display for the whole class to see and at the end of the week or end of the marking period, the group with the highest amount of bonus points can receive the reward or recognition. Some of the recommended behaviors to be rewarded include following directions, all group members completing assigned tasks, all group members actively participating, and all group members being on task.

In the research there was some debate on whether or not to use individual rewards over group rewards or vice versa. Pratt (2003) believed individuals need to be held accountable and therefore need to be assessed individually. Many educators believe grading the group and giving a group grade is unfair to students who may have put in more effort than others. This can lead to some students believing “group work punishes some students who happen to work with less-motivated peers” (Lin, 2006, p. 38). Again, this raises the problem of students not wanting to work with others because of the belief
their grade will suffer due to another students’ incapability of working well with others. Other researchers stressed group grades as essential for the group to work well together. The overwhelming consensus for most of the research is there needs to be a mixture of both. The best system is one in which quizzes, tests, and parts of the group project (i.e. anything counting towards the student grade) are assessed individually and count individually. Group rewards need to be given based on the group working well together and need to be non-grade based, such as recognition or praise. These group rewards ensure the group is working well together. Lord (1998) recommended that if a teacher did want to take a group grade it should be weighted differently than individual grades, thus, showing to the students it is just as important for them to be working together towards the group project as it is for them to be completing their individual parts since both would end up affecting their class grade. Whether or not the group grade is weighted more or less is strictly be up to each teacher, but the decision should be made known to students prior to the actual group activity.

Teacher misconceptions

As mentioned earlier, one of the main problems with teachers implementing cooperative learning is the lack of knowledge and misconceptions. One research study looked specifically at teachers’ thoughts and understanding of cooperative learning. Koutselini (2008) found most teachers are unwilling to use cooperative learning because they are unsure of how to put the students into well-working groups. She also found many teachers are unaware of just how beneficial cooperative learning groups can be and are also very unsure of how to gauge individual student accountability. Many of the teachers were unable to “differentiate group work from cooperative learning” (Koutselini,
Koutselini found many teachers are taught in their education training of all the benefits of cooperative learning groups but the main thing deterring them from using the method are their own negative beliefs on groups derived from their personal experience in education. It was also discovered many teachers are so worried about covering content; they do not take the chance to use or try alternative learning approaches. After this study was conducted, Koutselini found she was able to change teachers’ misconceptions by providing time to discuss experiences and reflect without the teachers feeling overwhelmed with educational theories. Allowing teachers the time to build knowledge from one another as opposed to telling them what to do from books seemed to be the best way to improve upon their previous understanding and encourage them to try new teaching methods in the classroom.

Koutselini brought up the most significant reason why many teachers stick to the traditional method of teaching: they are too “interested in ‘covering the content’” (Koutselini, 2008, p. 40). Too many topics to cover and a general lack of knowledge on a specific teaching method can lead to teachers struggling to implement the method and possibly reaching greater success. When a teacher is unsuccessful, they believe all the time they put in to learning a new method was wasted and instead of persistently trying, they decide to go back to the method that has always worked for them in the past, which was usually the method they were most exposed to during their own education. Not only is this bad for students but it also leads to many teachers getting stuck in a rut. Sometimes they get so set in their habits that when a good idea comes along, they are among the first to say they will not try it. However, it is beneficial to students when teachers try new
methods because these methods may work better for more students than traditional methods.

Summary

Since cooperative learning has been shown over and over to increase student understanding of a subject, it is essential for teachers to continue to try the method and build upon it. This literature review was specifically developed to look at many different aspects of cooperative learning and to examine how assigning individual roles within a group would increase student understanding while decreasing unwanted behaviors such as off-task discussion and free-riding. While none of the research explicitly studied groups with roles versus groups without, it was mentioned several times of how important role assignments are when putting students into groups. Not only does it increase individual accountability, but it also assigns students with a specific role to carry out, thus, increasing the chances of the group working well together.

Throughout the research, a central theme regarding cooperative learning was to make sure groups are set-up correctly. Formulating mixed groups of students while taking the time to discuss expectations and behavior was essential to ensuring a well-rounded group. Discussing behaviors and allowing for group feedback will reduce the amount of off-task and free-riding behaviors; when students actively monitor themselves and others within the group there is a better chance for success. Giving both individual and group rewards will also create a difference in the group setting due to students being more motivated to work towards the group goal. Not only will students be held individually accountable for their fair share of the group product, but they will also be held accountable for their behavior towards others within the group. The group reward
Assigning individual roles is probably one of the aspects of cooperative learning many teachers overlook. Along with the abovementioned aspects of cooperative learning, it was found that many teachers struggle in their understanding and implementation of cooperative learning. If schools want to increase the number of teachers using this method, then it is important for them to allow time for teachers to discuss their failures and successes and to allow for reflection.

In general, it was found cooperative learning, when done correctly, should increase student achievement. Allowing students to problem solve together as opposed to against each other is the best way for them to retain the knowledge for a longer period of time compared with memorizing the knowledge for a short amount of time. Providing roles for the students to complete while in a group is just one of the many ways to keep them motivated and on-task throughout the group interactions.

Methodology

Cooperative learning is a difficult teaching technique to truly master and obtain good results. Much of this is due to lack of planning on the teacher’s part. Good group structure is the main element of successful group products. Many middle school teachers will tell anyone about how much their students want to talk with each other; to many students seem unfocused on the class and more interested in their social life. If teachers could harness that need to talk and focus it into meaningful group work, many students would look forward to their education. This could also be a way to motivate more students to take an active role in their learning.

The research that follows looks at cooperative learning groups. More specifically, since the literature revealed a gap in role assignments, this research will look at how
assigning roles in a cooperative learning setting can increase student achievement, decrease off-task behavior, decrease free-riding students, and increase participation.

**Participants**

The participants for this study included 56 middle school science students ranging in age from 13-14 years old. The students were split into four class sections as described in table 1. Throughout the research, the class sections will be referred to by the number specified in table 1.

Table 1.

<table>
<thead>
<tr>
<th>Class Name</th>
<th>Total Students</th>
<th>Number of Males</th>
<th>Number of Females</th>
<th>Class Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class One</td>
<td>13</td>
<td>4</td>
<td>9</td>
<td>8th Grade Physical Science</td>
</tr>
<tr>
<td>Class Two</td>
<td>12</td>
<td>5</td>
<td>7</td>
<td>8th Grade Physical Science Honors</td>
</tr>
<tr>
<td>Class Three</td>
<td>16</td>
<td>2</td>
<td>14</td>
<td>8th Grade Physical Science Honors</td>
</tr>
<tr>
<td>Class Four</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>8th Grade Physical Science Honors</td>
</tr>
</tbody>
</table>

Throughout the research all students were observed for their behavior in regards to being on-task and actively participating with their groups. The grades received by the groups for their work together will also be used to compare groups with roles to groups with out. The purpose of this research was to see how assigning roles to cooperative learning groups would affect overall learning, on-task behavior, and participation.

**Instruments and Materials**

At the end of each day, using the cooperative learning activities, groups were given a short two question survey about that class day’s success (see appendix A).
Students were also given an individual survey to be completed to assess how they felt they behaved and acted individually within the group (see appendix B). Classroom materials used were sixteen large clasp envelopes and student worksheets (see appendix C). After the five days used for research a final survey was given to get an overall view on how the students felt about the group learning activities (see appendix D). Table 2 shows the laboratory materials needed for the various activities done within the groups on each day of the research.

Table 2.

<table>
<thead>
<tr>
<th>Day of Research</th>
<th>Laboratory Materials Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day One</td>
<td>4 graduated cylinders- each filled with corn syrup, vegetable oil, red dyed water, and green dyed rubbing alcohol, aluminum nail, cork</td>
</tr>
<tr>
<td>Day Two</td>
<td>4 triple beam balances, 4 graduated cylinders, 4 measuring cups with water, 4 rulers, 4 sets of objects to be measured for density (paperclip, rubber stopper, nail, marble, rock, clothespin)</td>
</tr>
<tr>
<td>Day Three</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Day Four</td>
<td>2 lemon slices, vinegar, bleach red and blue litmus paper strips pH paper</td>
</tr>
</tbody>
</table>

Data Collection

Student understanding of the topic was measured using student test grades and group completion grades. For each topic a short exit slip quiz was given at the end to see
how well students were able to obtain the needed information. At the end of the research time a test on the topics used for the research was given. These test scores were compared to previous test scores where cooperative learning was not the main source of student learning. Test scores within groups were also observed to see how assigning roles might affect test scores. Group and student responses to the cooperative group activities were used to see how having roles assigned might affect how well each question was completed.

Data for student off-task behavior, free-riding, and participation were a little harder to obtain. A daily group reflection survey and a daily individual group survey were given at the end of each class during the cooperative learning activities. The group survey was intended to see how the group felt their overall behavior and participation was during the class. Groups were asked to complete this survey together as a way for the group to reflect on ways to possibly improve their performance for the next group activity. The individual survey asked for each student to rate how well he or she remained on task during the class time and how well he or she participated with the group. The information from this survey was subject to students not being entirely honest about their own efforts, however, it was made known that the survey had no effect on the student grade so to be as honest as possible. Throughout the cooperative learning activities, observations were made by the teacher to see how well groups were working. Each time a group was heard to be talking about something other than the task at hand or whenever it was noticed a student was not actually participating with the group, a tally was put down along with a brief description of what was going on within the group at that time. These tallies were put next to the group letter so it could be seen how groups with roles compare
to the groups without roles. These tallies were used to give each group a daily on task and participation score out of five points.

A final survey was given the day after the test as a way to finalize the students’ thoughts on the group activities. This survey asked for input on what they thought of the activities themselves, how their group stayed on task, how group mates participated, and how their group cooperated with each other. It also had a section for any other comments the students might want to put down about the group learning.

Procedures

The activities and group work used in this research took place over the course of five days. Prior to the five days, students were prearranged into groups based on previous grades in class. Groups were made up of a student who was constantly getting high grades and who understood topics quickly, with students who were a little lower in their ability. Each class was divided into four groups of three to four students. These groups were assigned a letter (A, B, C, D) that would be their letter to put on any group assignments or activities.

On day one of the research, the teacher discussed with the class, prior to separating into groups, the behavioral expectations of the group activities. Students were also asked to give their input in regards to how quality group work should look and sound. The group rewards were also discussed with the class. At the end of every class day the group who worked the best together and showed the greatest team work would receive three bonus points. During the research and at the end there were short individual quizzes. The group with the highest average score for these assessments would also get three bonus points. These points were kept on a poster to show how groups were
Assigning individual roles

progressing through the activities. The group with the highest points after the five days would receive a prize, in this case candy was a big motivator so getting a big candy prize was the reward. After these ground rules were discussed students were put into their groups and told these groups would be the same for the next five days of activities. Table 3 below shows what groups were assigned roles on different days and a brief description of the day’s activity. The roles used for this research were the group leader whose main job was to keep the group on task throughout the class period, materials manager whose job was to obtain any needed equipment for the group, recorder whose job was to keep record of all answers and to fill out any group worksheets, and the time keeper whose job was to make sure the activity was done within the time limits of class, this job was absorbed by the materials manager in groups of three students. The detailed description of each day can be found in Appendix C along with any student worksheets.

Table 3.

Description of group assignments and activities.

<table>
<thead>
<tr>
<th>Day of Research</th>
<th>Brief Description of Activity</th>
<th>Group A and B</th>
<th>Group C and D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day One</td>
<td>Group learning of density</td>
<td>Assigned roles</td>
<td>Not assigned roles</td>
</tr>
<tr>
<td>Day Two</td>
<td>Group activity- measuring density</td>
<td>Not assigned roles</td>
<td>Assigned roles</td>
</tr>
<tr>
<td>Day Three</td>
<td>Group learning of pH</td>
<td>Not assigned roles</td>
<td>Assigned roles</td>
</tr>
<tr>
<td>Day Four</td>
<td>Demonstration/group learning pH</td>
<td>Assigned roles</td>
<td>Not assigned roles</td>
</tr>
<tr>
<td>Day Five</td>
<td>Individual density and pH assessment</td>
<td>Not applicable No group work</td>
<td>Not applicable No group work</td>
</tr>
</tbody>
</table>
On the group learning days, groups were given different tasks to complete. Each task came in a separate envelope and needed to be completed before the next envelope would be given. Groups that were assigned roles were given the role assignments and descriptions in the first envelope and in subsequent envelopes the group roles were used to give directions to the students. In the groups where roles were not assigned, directions were given in a generic statement that someone should take on the responsibility of doing a certain part. Envelope one came with a demonstration set-up without any other information. Groups were asked questions on what was thought to be causing the phenomenon they were observing. The second envelope contained the main lesson portion of the learning. The group, using the textbook or other sources, was asked questions specifically geared towards the most important parts of the topic. This information would essentially be the student’s notes on the topic of either density or pH. It was up to the groups to ensure each student within the group obtained the information. The last envelope of the class contained the group survey to be filled out as a group. After this was complete the group was asked to go back to their seats and fill out the individual survey. The teacher acted as a facilitator; constantly monitoring groups and answering questions when needed.

On the group activity day, groups were participating in a laboratory activity to determine density. Again the groups were given envelopes containing the assignments for different sections of the activity. On these days the first envelope contained some pre-laboratory questions along with some safety review. If the group was assigned roles, this envelope would have the assignments along with the role descriptions and all directions were given with specific roles assigned to do specific parts. If the group was not assigned
roles, the directions were given essentially to the group as a whole and they would need to decide which member would actually complete it. The second envelope contained the directions to the actual laboratory activity. After the laboratory activity was complete, groups received envelope three which contained the group survey. After the survey was complete, students were asked to go back to their seats to complete a five question exit slip assessment and the individual survey. The teacher acted as a facilitator; constantly monitoring groups and answering questions when needed.

On day 5 of the research, a test assessment was given to each student as a way to individually gauge how students obtained the information about the topics of density and pH during the group activities. The test was a mix of multiple choice and short answer. The test included some density calculations. Classes were allowed the use of calculators to work out density problems.

Results

In this study, assigning roles in group learning is examined for its effect on student participation, on task behavior and achievement.

On Task

During each day of the research, each group from each class was given an on task score out of five points. These groups were kept the same for all four days of in class research with the exception that roles were assigned to different groups depending on the day. The activity and everything else for the days of research was kept the same. The on task score was based on teacher observations of the groups and was scored according to the amount of time in which individuals or the group appeared to be truly engaged and discussing the topic at hand. The hypothesis for on task behavior is as follows:
H₀: On task scores for groups with assigned roles will be equal to on task scores for groups without assigned roles.

H₁: On task scores for groups with assigned roles will be greater than on task scores for groups without assigned roles.

A Wilcoxon-signed rank test was performed to compare the on task scores of groups with roles to on task scores of groups without roles. The Wilcoxon score received was 19, which is lower than the critical value of 20 for 16 group observations. The sixteen group observations were a total of four groups in each of the four classes. The mean of the on task scores for groups with roles was 8.125 and 7.75 for groups not assigned roles. The null hypothesis can be rejected at the 0.005 level showing there is a significant difference in the data; moreover the data demonstrates that on-task behavior is significantly greater when roles are assigned in group work than when they are not.

*Student Participation*

During the days of research, each group in each class was also given a participation score out of five points. The groups were kept the same with the same students and activities while the only change was whether or not roles were assigned for the group activity that day. The participation score was given based on observations by the teacher and was directly related to how many students within the group were working. The hypothesis for participation is as follows:

H₀: Participation scores for groups with assigned roles will be equal to participation scores for groups without assigned roles.

H₁: Participation scores for groups with assigned roles will be greater than participation scores for groups without assigned roles.
A Wilcoxon-signed rank test was performed to compare the participation scores for groups with roles to groups without roles. The Wilcoxon score received was 24, which is equal to the critical value of 24 for the 16 observations used in this comparison. The mean of the participation scores for groups with roles was 8.938 and 8.438 for groups not assigned roles. The null hypothesis can be rejected at the 0.01 level showing there is a significant difference in the data. The data demonstrates the participation is significantly greater when roles are assigned in group work than when they are not. It was also observed during the days of research that groups with three students had better participation than groups with four students.

Group Grades

During the research, groups were given opportunities to earn points on projects they worked on together. Group grades given on day 2 and day 4 of the research were used to compare how assigning roles might affect the achievement of the group. These grades were given on specific questions and worksheets the group completed together. The grades for the eight groups with roles on day 2 were compared to those given to the groups without roles on day 2 as were the grades for day 4. The hypothesis for the group grades is as follows:

$H_0$: Grades for groups with assigned roles will be equal to grades for groups without assigned roles.

$H_a$: Grades for groups with assigned roles will be greater than grades for groups without assigned roles.

A Wilcoxon-signed rank test was performed to compare the grades of groups with roles to the grades of groups without roles. The Wilcoxon score received was 1, which is
lower than the critical value of 20 for the 16 observations used in the comparison. The mean of the group grades for groups assigned roles was 73.75 and 73.91 for groups not assigned roles. The null hypothesis can be rejected at the 0.005 level showing there is a significant difference in the data.

Discussion

This research observed how assigning roles to groups of students affected the overall group learning of pH and density in four science classes. The areas specifically observed were how on task students were within the group, how group members participated during the activities, and how the group grades reflected the group learning. From an observational standpoint, it was interesting to see how groups interacted differently when assigned roles versus when they were not assigned roles. For the most part students cooperated nicely with each other and worked hard to complete the assignment.

*On Task*

The null hypothesis that the on task score for groups with roles assigned would be equal to the on task score for groups without roles can be rejected. The mean score for groups with roles was greater than the mean score for groups without roles. There is some chance for error in the on task scores since it was purely subjective on the teacher’s observations and it is very possible that not every instance of off task behavior was observed to be counted against the group.

Based on teacher observations, groups with roles seemed to be on task a greater proportion of time than the groups without roles. When students were not assigned jobs there seemed to be a greater desire to have conversations unrelated to the subject matter.
It also seemed easier for students to get distracted if they did not have someone within the group whose job was to keep them focused. This agrees with the literature which stated that by assigning roles, each group member is given a piece of responsibility and this responsibility did keep the students on task a greater proportion of time (Johnson, Johnson, & Holubec, 1994). It was noticed that a strong group leader, whose primary job was to keep everyone working, worked better when roles were assigned. If the student constantly was reminding the group of the job at hand, the group succeeded at getting more done which would in turn lead to an increase in group grade since grades were largely dependent on amount of work completed. However, if a group leader was not as strong, he or she was less willing to speak up to keep the group on task. This role is one that needs much consideration before assigning. The group roles were also rotated in order to give students a chance to try various jobs in accordance to the literature (Johnson, Carson, & Johnson, 1989). This worked in some cases and in others did not. Students who were given a role they liked wanted to keep it and when they were asked to switch to something different, typically did not like the new role. This could have been due to the research being done in a matter of days. Switching roles may be more beneficial when using groups for longer periods of time. In this case, students may grow weary of the same role every time and look forward to the change a new role would bring. Probably the biggest deterrent of the off-task behavior was the constant monitoring of the groups as recommended from the literature (Schulte, 1999, Pratt, 2003). Many times a group was sensed to be off topic by the teacher and when approached quickly changed gears. Only a few reminders were needed to get a group back to where they needed to be with the activity. While some teachers may look at cooperative learning as a
way to give themselves a break, it really is the opposite. Careful planning to make sure the activities are engaging plus consistently monitoring each group definitely makes the difference in whether or not the groups are doing what they are supposed to be doing and whether or not they are benefiting.

**Student Participation**

The null hypothesis that the participation score for groups with roles would be equal to the participation score for groups without roles can be rejected. The mean participation score for groups with roles was greater than the participation score for groups without roles. Again as with the on task score, there is a chance of error with the participation score since it was due to teacher observations. Each time a student was seen to not be participating with the group a point was taken off of the five point total the group could receive. It is unreasonable to think that every time a student was not working the teacher would have been around to observe it.

That all students participating in a group was much more evident when the students were given a role to complete. Students seemed to take pride in their job and when someone else tried to take part of it, they would make it known that it was their role. Some students were less likely to participate if they were assigned a role they did not particularly want but for the most part they still worked anyway. This agrees with the literature in two ways. First being students would take responsibility for their part of the group through the role they were assigned and others would hold them accountable to that job (Johnson et al., 1994). Second, even when students were not particularly happy with the role given they did it anyway because they realized the “sink or swim” aspect of
group learning where if one piece of the puzzle is not there they might all fail (Johnson et al., 1994).

One unexpected outcome was the difference in participation when comparing groups of three to groups of four students. When there were four students in a group whether or not they were assigned roles, there always seemed to be one student who was not helping the group at all. In fact, one student (in a group of four) mentioned in the end survey that one person did not really have a job and another stated that two people were always working while two people were not participating. It seems it is easier to get distracted when there are more people in the group and when not everyone has a constant task to fulfill. When there were three students, all students needed to be working in some capacity for the activity to be completed.

When roles were assigned to groups, there seemed to be less free-rider problems if the roles were assigned well. For example, if a student who was typically known to be a free-rider received a role that did not require constant work, he or she would most likely fall back into the habit of sitting there while others did the work. If the student was assigned a much more in depth role such as recorder or group leader, he or she typically did much better than usual with the group activity by actually working and helping the group. However, there were some cases where the student would not participate no matter what the activity or whether or not roles were assigned which hints to the fact there may need to be more research done to find better ways of preventing this problem with student participation. The literature did suggest to do frequent surveys of group members to find out specifics on member participation as a way to lessen the free-rider problem (Brooks & Ammons, 2003). During the research, it was intended to give
individual surveys to ask about participation by group members but there never seemed to be enough time for students to give thorough answers to the survey, if there was time to do it all. Also there was little time for the group to then reflect and let other group members know their feelings on the free-rider's lack of work. In the survey given at the end of the research, which again asked about member participation, students were much more open to calling out specific students who did not do their fair share. This could have been because they knew the groups were over for the time being or could have been because they had more time to really think about their answers. Whatever the case may be, when group learning is used again, it will be taken into consideration to give more time for group reflection especially at the beginning when groups are newly formed in order to try and iron out these little bumps that seem to plague any group activity.

*Group Grades*

The null hypothesis that stated groups with roles would receive grades equal to groups without roles can be rejected but only very slightly. The Wilcoxon score received would indicate that there is a significant difference in the data however, if the mean scores for group grades are taken into consideration, the groups without roles actually had a higher mean score. This margin is very small and that is why out of all the data this portion would need to be repeated in order to give a more thorough answer to the hypothesis.

It was noticed that individual grades seemed to be better than normal for some students when working with groups. This is a good outcome but at this point could be contributed to the subject matter being a little less complicated than previous subject matter and not necessarily the group work. It was also noticed that some students when
first put into the groups might not have taken the work seriously. Many of the students noticed to be slightly lacking in participation had absolutely horrible results on the first exit slip and when they realized it really affected their grades seemed to step up in their work with the group and many had much better grades on the second exit slip. Overall, individual grades on the pH and density test were very well; mainly A’s and B’s. Again it is unknown as to the exact cause of this being related to the use of group activities or the subject matter itself. If it is due to the group work then it would be in agreement with the literature that found classes with cooperative learning did have higher achievement than classes with a more individualistic atmosphere (Slavin, 1991a).

*Group Rewards*

In accordance with the literature and following the methodology, a group reward system was set up for groups to earn points through their behavior and through the individual assessments (Johnson, et al., 1989, Lord, 1998, Schulte, 1999, Slavin, 1991b). This by far was probably one of the most promising aspects of the research to take away and use again with the cooperative learning groups. At first when it was explained to the students, they seemed interested and after the first round of points were assigned really started to take more notice. Many of the groups awarded with points were really proud and it could be seen as they would work even harder to keep earning more points. Some individual students really did not seem to care too much for this mini-competition and due to this lost their group’s chance of winning since they were constantly not showing the good group behaviors. The reward ended up being candy prizes for each member of the winning group for each class. When the final prize was awarded to the group in each class with the highest point number, the group members
themselves were very happy with the candy they received. One student, whose group did not win, asked when the class would have another competition like this to earn candy. This did show how beneficial having a competitive atmosphere within the class did work for some students. Since this was the first of its kind though, many students did not realize the benefits of hard work until it was too late for their group to actually win. It was also interesting to look at the scoreboard and see that in some classes it seemed to be the same group over and over winning the points. This motivated some groups to try harder but again for others they did not seem to care. This would be another aspect where further research could improve the quality of a semi-competitive classroom atmosphere where prizes and rewards are involved.

**Student Comments**

The end survey ended up providing better feedback than the group survey and individual survey that were meant to be given at the end of each day of research. When asked to rate the group activities many students said they were good, they were fun because they got to work together and it was good to do something different. Some students mentioned the need to have more time and some recommended the groups would be best for when there was a very small lesson that needed to be taught. Students were very truthful when asked about the overall on task behavior of their group. Many stated that although there group was on task most of the time there were cases when they got off task. Some mentioned that they were really good at being on task at the beginning but as time went on they got a little worse. This could be an interesting aspect of research to see if the longer students are in the same group if they become more comfortable and potentially not as hard working. When asked to rate the participation of all group
members, students were really honest. Some specifically listed the names of group members who did not participate well. One student recommended that the recorder had more work than the other group members and that maybe that role should be shared. Some students mentioned the difficulties the group sometimes faced with arguments and discussions. Overall, observations from the teacher were very similar to what the students had noticed and recommended. The students, for the most part, were very active and worked well. There were groups who were constantly sharing the work and taking turns when asked to read. It was nice to see students working so well together towards the common goal of getting the activity done and receiving a good grade.

Conclusion

Throughout all the days of research, it was noticed that many students did enjoy the different setting in the classroom. Most did not take advantage of being in groups as a way to converse more with friends. Some students who typically did not show an interest prior to the research were actually beginning to show some interest and cooperation with others. This research did show that assigning roles did have an impact on the group learning activities. Students were on task a greater percentage of the class time and more students participated in the activities. It was hard to tell exactly how well the group learning and the assigning of roles impacted the grades of the students but in general grades from this research were better for a lot of students than previous grades. The instances of free-riders within the groups was rare, however, it was still there and a point of contention within some groups. Overall, it was a beneficial experiment both for the students and the teacher.
One reflection taken from the research is when using this type of group learning it is probably best on an occasional basis. During the research it was used for four days in a row. Students grew weary of their group members and there was not as much teacher student discussion as a whole group which is very beneficial as a way of reflection and learning. One student mentioned in the survey that she did not know if she knew the content very well because she felt she was teaching herself. This group learning will most likely be used along with teacher based instruction in the future. It is hoped that over time more and more group activities will be incorporated as more experience is gained.

One bit of information that came out of this study was to make sure to try groups from the beginning of the year. It was hard for some students to become acclimatized to a new way of learning. This could have also influenced some of the resulting behavior and grades. Many students need to have some sort of structure when they come to school and by using groups from the beginning and really stressing the desired behavior and work-ethic, one could have much better results with group learning in the classroom.

Further possible research might be done to look into the number of students in a group and how that affects the overall group learning. As discussed previously, it did seem to work better when there were three students per group as opposed to four. It would be interesting to see if there actually was a noticeable improvement in performance and grades. Another possible research idea might also be looking into the aspect of friendly competition in the classroom. As students were earning more points over others, they seemed to actually work harder to try and get even more points. In group discussions, students were actually using that as motivation with other group
members. They wanted to earn the points so all the members needed to be working harder.

Cooperative learning, as a whole, is a very in depth and widely studied strategy for the classroom. It has many aspects that make it challenging but over time, with practice could become easier to implement. If a teacher should decide to use this technique it is recommended to start with careful planning and arranging of the groups and to only use it a few times during the course of a topic until students become used to the structure of the activities and the requirements of the teacher. From the research done in this paper, it is recommended to assign roles to the groups as a way to get better work and products from the students. The actual roles used may depend on the type of activity and the students in the groups should be carefully considered when deciding who will receive each role. Rotating the roles should be done but not every time the group gets together; maybe once or twice during a quarter. Also, taking time to really discuss the desired behaviors for groups as well as rewarding students for displaying them is beneficial in preventing or at least lessening the undesired behaviors of off task work and free-riders. Using the strategy of group learning can improve achievement as well as increase student motivation within the classroom.
References


Appendix A

Daily Group Reflection

Group Letter ______

Within your group have your recorder write your answers to the following questions on how your group worked together today.

1. Name 3 things your group did well today.
   1. ________________________________________________________________
   2. ________________________________________________________________
   3. ________________________________________________________________

2. Name 1 thing your group could do better next time.
   1. ________________________________________________________________
Appendix B

Daily Individual Student Reflection

Group Letter ________

** Please do not put your name on this survey. Please only include your group letter. **

Circle the number that corresponds to how effectively you used class time today.

<table>
<thead>
<tr>
<th>None of the time</th>
<th>Some of the time</th>
<th>Half of class time</th>
<th>Most of class time</th>
<th>All of class time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

1. I was on task:

Explain why you chose this number:

________________________________________________________________________

2. I was actively participating with my group:

Explain why you chose this number:

________________________________________________________________________

3. Everyone within my group was contributing to the group product:

Explain why you chose this number:

________________________________________________________________________
Appendix C

Description of lesson plans

**Please note groups who were not assigned roles would have directions that would not include role names.**

Day 1- Density group learning activity

Envelope 1:
- Students names with roles will be given to groups A and B along with role description
  - Group leader- keep group on task and direct group in tasks
  - Materials manager- obtain needed equipment for the group
  - Recorder- record answers on group questions and worksheets
  - Time keeper- make sure your group gets the tasks done within the class period (this should be assigned to the materials manager if a group of 3)
- Each group is given a graduated cylinder with four levels of liquid (corn syrup, vegetable oil, red dyed water, and green dyed rubbing alcohol)

Questions for group recorder to record:
1. Make 5 observations of the graduated cylinder (you may not mix/stir/agitate/smell the liquids within the graduated cylinder).
2. Make a prediction of what substance each layer could be.
3. Make a prediction as to how or why the liquids are staying in this specific arrangement.
- When finished with questions, have group leader raise their hand, have questions checked, receive second envelope.

Envelope 2:
- Materials manager obtain 2 textbooks for your group and 1 calculator
- Open to page 44.
- Group leader read aloud starting from the bottom of page 44 through to “using density to identify substances” section.
- Group- complete the Mathbreak (3 questions) Recorder record group answers
Assigning individual roles

- Group leader raise hand when group is finished, have answers checked (need to have all correct to receive next envelope)

**Envelope 3:**

- Group leader continue to read to the end of the section on page 46.
- Group- answer the “apply” question on the bottom of page 46. Group recorder-record group answer

**Questions for group recorder to record:**

1. What is the equation for density?
2. Now explain what phenomenon you observed within the graduated cylinder using what you now know about density.
3. A block of pine wood has a mass of 120g and a density of 0.4g/cm³. What is the volume of the wood?
4. Would this block float in a pool of water? Explain why or why not.

- Group leader- staple all question sheets together. Make sure group letter is on the front.
- Materials manager- put books and calculator back. If not already done put graduated cylinder back as well.
- Recorder- Obtain Envelope 4 from teacher when questions are handed in and materials are put away

**Envelope 4:**

Group survey to be completed together by the group. Recorder please record answers.

Everyone should go back to their seats to fill out the individual survey. Remember to only put your group letter on the survey and it DOES NOT count towards your grade.

Group that worked the best today will receive 3 bonus points.

Homework/ end of class worksheet (if groups finish early)- A matter of density worksheet
Matter of Density worksheet (Childers, 2001)

Complete this worksheet after you finish reading Chapter 2, Section 2.

Imagine that you work at a chemical plant. This morning, four different liquid chemicals accidentally spilled into the same tank. Luckily, none of the liquids reacted with each other! Also, you know the liquids do not dissolve in one another, so they must have settled in the tank in four separate layers. The sides of the tank are made of steel, so you can only see the surface of what’s inside. But you need to remove the red chemical to use in a reaction later this afternoon. How will you find and remove the red chemical? By finding the chemicals’ different densities, of course!

The following liquids were spilled into the tank:
- a green liquid that has a volume of 48 L and a mass of 36 kg
- a blue liquid that has a volume of 144 L and a mass of 129.6 kg
- a red liquid that has a volume of 96 L and a mass of 115.2 kg
- a black liquid that has a volume of 120 L and a mass of 96 kg

1. Calculate the density of each liquid.
   - Green liquid:
   - Blue liquid:
   - Red liquid:
   - Black liquid:

2. Determine the order in which the liquids have settled in the tank.
   - First (bottom):
   - Second:
   - Third:
   - Fourth (top):

3. Use colored pencils to sketch the liquid layers in the container in the diagram on the next page.

4. What kind of property did you use to distinguish between these four chemicals?
   - a. a chemical property
   - b. a physical property
   - c. a liquid property
   - d. None of the above
A Matter of Density, continued

5. Now that you know where the red chemical is inside the tank, how can you remove it?

   
   
   

4  HOLT SCIENCE AND TECHNOLOGY
Day 2- Density group laboratory activity- measuring density

Envelope 1:
- Students names with roles will be given to groups C and D along with role description
  - Group leader- keep group on task and direct group in tasks
  - Materials manager- obtain needed equipment for the group
  - Recorder- record answers on group questions and worksheets
  - Time keeper- make sure your group gets the tasks done within the class period (this should be assigned to the materials manager if a group of 3)
- Materials manager- obtain calculator for the group

Pre-lab Questions for group recorder to record:
1. A jar contains 30mL of glycerin (mass= 37.8g) and 60mL of corn syrup (mass= 82.8g). Which liquid is on top? Show your work and explain your answer.
2. A student measures the mass of an 8cm$^3$ block of brown sugar to be 12.9g. What is the density of the brown sugar?
3. A teacher performing a demonstration finds that a piece of cork displaces 23.5mL of water. The mass of the cork was 5.7g. What is the density of the cork?
4. Gold is one of the densest substances on Earth. A gold bar 20 cm by 5 cm by 5 cm has a mass of 9700g. What is the density of gold?
5. From the questions 1-4, which substances would be able to float if put into a pool of water? Which substances would sink? Explain your answer.
- Group leader- when finished, raise hand, have questions checked (must have all correct to receive next envelope)

Envelope 2:
- Materials manager obtain lab materials (triple beam balance, graduated cylinder, water in measuring cup, ruler, objects to be measured) located on counter- all materials located in box for the group
- Group leader- read aloud directions to the measuring density task

**predictions must be made before group starts determining density**
- Group recorder- record group’s answers in the chart
- When finished with laboratory activity:
  o Group leader- staple all question sheets together. Make sure group letter is on the front.
  o Materials manager- put laboratory supplies back on the counter
  o Recorder- Obtain Envelope 3 from teacher when questions are handed in and materials are put away

Calculating Density Lab Activity
Created by Bonnie Coggeshall January 2009

Calculating Density Lab

Name: ____________________________

Procedure:

Finding Density of an Object

1. Use the balance to find the mass of the object. Record this value on the "Density Data Chart."

2. Use the following steps to find the volume of the object:
   • Pour water into a graduated cylinder up to an easily-read value, such as 20 milliliters and record the number.
   • Drop the object into the cylinder and record the new value in millimeters.
   • Find the difference between the two numbers is the object’s volume. Record the volume on the data chart.

3. Compute the density of the object by dividing the mass value by the volume value. Record the density on the data chart.

<table>
<thead>
<tr>
<th>Object</th>
<th>Mass (g)</th>
<th>1st Volume before adding Object</th>
<th>2nd Volume after adding Object</th>
<th>Volume (mL)</th>
<th>Density (g/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
Envelope 3:

Group survey to be completed together by the group. Recorder please record answers.

Everyone should go back to their seats to complete the 5 question exit slip and fill out the individual survey. Remember to only put your group letter on the survey and it DOES NOT count towards your grade.

Group that worked the best today will receive 3 bonus points.
Group with the highest combined average on exit slip will receive 3 bonus points.

Exit slip questions:

1. An ice cube has a volume of 12 cm$^3$, and a mass of 11 g. What is the density of the ice?
2. A machine shop worker records the mass of an aluminum cube as 176 g. If one side of the cube measures 4 cm, what is the density of the aluminum?
3. If a block of gold were cut in half, would the density of the gold change? Why or why not?
4. Liquid A has a density of .90 g/cm$^3$, liquid B has a density of 1.15 g/cm$^3$, and liquid C has a density of .65 g/cm$^3$. They are poured into a graduated cylinder and allowed to sit overnight. Assuming that the liquids do not mix into one another, which liquid will be on the bottom, in the middle, and at the top in the graduated cylinder? Explain why they will be in this arrangement.
5. What is the density of water? If water were added to the graduated cylinder in question 4, where would it sit in the arrangement? Explain why.

Day 3- pH group learning activity

Envelope 1:

- Students names with roles will be given to groups C and D along with role description
  - Group leader- keep group on task and direct group in tasks
- Materials manager- obtain needed equipment for the group
- Recorder- record answers on group questions and worksheets
- Time keeper- make sure your group gets the tasks done within the class period (this should be assigned to the materials manager if a group of 3)

Task:
- You will be given back worksheets from Day 1 and Day 2 as well as the exit slip from Day 2.
- With your group mates, you need to go over the questions and make sure everyone understands what they missed and why they missed it.
- EVERYONE needs to make sure they can calculate density correctly for the test next week.
- Give your group about 8 minutes to properly reflect and correct any mistakes for density.

Envelope 2:
- Materials manager obtain 2 textbooks for your group
- Open to page 377, chapter 15 section 2.
- Group leader read aloud starting from the beginning of section 2 through to the section title “bases”
  - Everyone will fill out the acids section of the “acids and bases notes” sheet
- Group leader read aloud from Bases section to “acids and bases neutralize one another section”
  - Everyone will fill out the bases section of the “acids and bases notes” sheet
- Group leader raise hand when group is finished, have notes checked, receive next envelope
ACIDS and BASES notes

Definition of an Acid
• Acid =

Characteristics of an Acid
• ___________ taste
• Can ___________ of certain compounds
  ➜ Shows ___________ (acids can react with other compounds to create new substances)

• ___________ ➜ can break down something
  ➜ Acids can cause holes in clothing or can corrode metal

• ___________ ➜ Depending on level of acidity

• Can react with some metals
  ➜ Causes a ___________

Examples of an Acid
• 1.
• 2.
• 3.
• 4.
• 5.

Definition of a Base
• Base =
Characteristics of a Base

- ____________ taste
  
  - Have you ever gotten soap in your mouth?

- ____________
  
  - Some strong bases can break down materials

- Can ______________ of some compounds
  
  - Shows ____________ (bases can react with other compounds to create new substances)

Examples of Bases

1. 
2. 
3. 
4. 
5. 

Acids and bases together

- Acids and bases can ______________ each other

- What does “neutralize” mean?

- If a substance has a pH of 3 and we want to neutralize it, what should we add?

- Group leader- staple all question sheets together. Make sure group letter is on the front.
- Materials manager- put books away
- Recorder- Obtain Envelope 3 from teacher when questions are handed in and materials are put away
Envelope 3:

Group survey to be completed together by the group. Recorder please record answers.

Everyone should go back to their seats to fill out the individual survey. Remember to only put your group letter on the survey and it DOES NOT count towards your grade. Group that worked the best today will receive 3 bonus points.

Day 4- pH group laboratory activity- measuring pH

Teacher demonstration prior to group activities:
Teacher will use a lemon slice, vinegar, and bleach to demonstrate the use of litmus and pH paper.

Envelope 1:

- Students names with roles will be given to groups A and B along with role description
  - Group leader- keep group on task and direct group in tasks
  - Materials manager- obtain needed equipment for the group
  - Recorder- record answers on group questions and worksheets
  - Time keeper- make sure your group gets the tasks done within the class period (this should be assigned to the materials manager if a group of 3)

- Students take homework sheet to groups with them

Questions for group recorder to record: Brainpop Video Acids and Bases

1. Class will be shown the acids and bases brainpop video. As a group complete the worksheet. Video will be shown twice.

- Group leader- raise hand, receive next envelope

Envelope 2:

-Materials manager- obtain 2 books for your group

Open up to page 378. You will find the answers for the following questions somewhere between pg 378-381.
Questions for recorder to record:

1. Draw a pH scale and label the ranges for a base, an acid, and neutral.
2. What is a pH indicator?
3. How are red and blue litmus paper used to test pH? Describe how pH paper works.
4. What is a pH meter?
5. Which pH indicator is probably the most accurate?
6. Why is it important for the pH of lakes and soil to stay at a regular level? Why is it important for blood to stay at a specific pH level?
7. On the pH scale drawn above put one example of a base, an acid, and neutral on its proper spot on the scale.

Envelope 3:

Group survey to be completed together by the group. Recorder please record answers.

Everyone should go back to their seats to complete the 5 question exit slip and fill out the individual survey. Remember to only put your group letter on the survey and it DOES NOT count towards your grade.

Group that worked the best today will receive 3 bonus points.
Group with the highest combined average on exit slip will receive 3 bonus points.

Exit slip questions:

1. List 3 properties of acids.
2. Describe how antacids can be used to help with heartburn.
3. Why is acid rain harmful?
4. Illustrate the pH scale. Put lemon juice, blood, and soap at the proper pH levels on the scale.
5. Describe how you go about testing the pH of an unknown substance in a beaker (include at least 3 steps).

Homework: Remind students they will have a density/pH test and they should study.
Day 5- individual student assessment
Each student will take the density/pH test. The group with the highest combined average will earn 3 bonus points.
Test score will be compared to previous test scores to determine if using cooperative learning groups helped increase student understanding.
At this point the group with the highest bonus point score will earn the candy prize.

Density and pH Test
Created by Bonnie Coggeshall January 2010
DO NOT WRITE IN TEST BOOKLET!!! PUT ALL ANSWERS ON STUDENT ANSWER SHEET!!

**Density/ Acids/ Bases Test**

Complete the following multiple choice questions. For each question there is only 1 best fit answer.

1. What are two ways scientists can measure pH?
   a. Triple beam balance and pH paper
   b. Litmus paper and a graduated cylinder
   c. pH meter and litmus paper
   d. pH meter and iodine strips

2. RED litmus paper is used to test for the presence of ________.
   a. Acid
   b. Base
   c. Sugar
   d. Density

3. When BLUE litmus paper comes into contact with an acid it turns ________ in color.
   a. Red
   b. Blue
   c. Orange
   d. Green

4. What is the range on the pH scale for a base?
   a. 7-14
   b. 6-10
   c. 0-6
   d. 8-14

5. What could be a possible pH for a bucket of acid rain?
   a. 14
   b. 7
   c. 3
   d. 10

6. What is the equation for density?
   a. Density = mass / volume
   b. Density = volume / mass
   c. Density = mass / volume
   d. Density = grams / volume

7. If water has a density of 1 g/mL, which one of the following would sink if placed in water?
   a. Helium = 0.0001663 g/mL
   b. Oxygen = 0.001331 g/mL
   c. Ice = 0.92 g/mL
   d. Copper = 8.96 g/mL

8. A characteristic of an acid is ________ and an example is ____________.
   a. Tastes bitter/ orange juice
   b. Feels slippery/ detergent
   c. Tastes sour/ soap
   d. Tastes sour/ soft drinks
9. What is the definition of mass?
   a. The amount of space an object takes up
   b. The stuff that everything is made up of
   c. The amount of matter in an object
   d. The amount of density in an object

10. What will give the most accurate pH reading?
    a. pH paper
    b. pH meter
    c. litmus paper
    d. stapler

11. If a substance has a pH of 13 and we want to neutralize it, what should we add?
    a. A base
    b. An acid
    c. A cup of water
    d. A drop of oil

12. The diagram below shows a tall beaker with four different liquids and their densities.

    ![Beaker diagram]

    If a ball that has a density of 1.73g/cm³ is placed in the beaker, where will the ball come to rest?
    a. on top of liquid A
    b. between liquids B and C
    c. between liquids C and D
    d. on the bottom of the beaker

13. An example of a base and a characteristic of a base are
    a. soap/ tastes sour
    b. lemon juice/ tastes sour
    c. lemon juice/ tastes bitter
    d. soap/ tastes bitter
The data table below shows the masses and volumes of three objects (A, B, and C).

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass</td>
<td>4 g</td>
<td>6 g</td>
<td>8 g</td>
</tr>
<tr>
<td>Volume</td>
<td>2 cm³</td>
<td>6 cm³</td>
<td>4 cm³</td>
</tr>
</tbody>
</table>

14. Which statement about the densities of these three objects is correct?
   a. B is more dense than A
   b. A is more dense than C
   c. B and C have equal densities
   d. A and C have equal densities

Calculate density for the following problems. Be sure to show work and record answers on STUDENT ANSWER SHEET! 3 points each (1 point for equation, 1 point for showing work, 1 point for answer with units)

15. A piece of lead has a volume of 30 mL and a mass of 133 grams.

16. What is the density of an object that has a mass of 89g and a volume of 34mL?

17. What is the density of a piece of wood that has a mass of 70 grams and a volume of 46 cm³?

18. If you have a piece of an unknown object that is 4 cm by 8 cm by 9 cm with a mass of 35 grams, what is the density?

19. Looking at your answer for question 18. Would this object sink or float when placed in a cup of water? EXPLAIN why or why not. (2 pts)
DO NOT WRITE IN TEST BOOKLET!! PUT ALL ANSWERS ON STUDENT ANSWER SHEET!!

Base your answers to questions 20 through 22 on the passage below and on your knowledge of science. Be sure to record your answers on the STUDENT ANSWER SHEET!

**Acid Rain**

Sulfur dioxide and nitrogen dioxide are pollutants released into the atmosphere from the burning of fossil fuels. These pollutants combine with moisture in the air to form acid rain. A main source of these pollutants can be traced to power plants located in the Midwestern United States. Due to weather patterns, the effects of acid rain have been most severe in the northeastern United States, including New York State.

The acid rain destroys the natural balance in lakes and streams and kills many species of fish. Acidic conditions affect not only lakes and forests, but also buildings and statues composed of limestone and marble. Other materials, such as metals, ceramics, glass, paints, and leather, are affected by acid rain.

20. Which two pollutants combine with water vapor in the air to produce acid rain?

21. Describe how the acid rain plays a role in the ecosystems of the Northeastern United States.
   (2pts)

22. Identify one action that could be taken to reduce the amount of acid rain.
23. The beaker shown below contains four liquids of different densities. The blocks shown in the beaker represent four different solid materials. The table below shows the densities of the four solid materials.

<table>
<thead>
<tr>
<th>Solid Material</th>
<th>Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>copper</td>
<td>8.90</td>
</tr>
<tr>
<td>plastic</td>
<td>1.17</td>
</tr>
<tr>
<td>rubber</td>
<td>1.34</td>
</tr>
<tr>
<td>wood</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Indicate where each of the four solid materials would be located by writing the name of each solid material in the space provided. (2 pts)
## Appendix D

### End Survey for Group Activities

<table>
<thead>
<tr>
<th>Group Letter</th>
<th>Period:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1. Overall, how would you rate these group activities?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>Okay</td>
<td>Average</td>
<td>Good</td>
<td>Great</td>
<td></td>
</tr>
</tbody>
</table>

Explain your reasoning to the above question:

<table>
<thead>
<tr>
<th>2. How would you rate your groups “on-task”ness during these activities? <strong>(amount of time everyone was thinking about science)</strong></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>Okay</td>
<td>Average</td>
<td>Good</td>
<td>Great</td>
<td></td>
</tr>
</tbody>
</table>

Explain your reasoning to the above question:

<table>
<thead>
<tr>
<th>3. How often do you think ALL group members were equally sharing in the work?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>A little</td>
<td>Sometimes</td>
<td>Most of the time</td>
<td>Always</td>
<td></td>
</tr>
</tbody>
</table>

Explain your reasoning to the above question:

<table>
<thead>
<tr>
<th>4. How would you rate your group’s cooperation with one another?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>Okay</td>
<td>Average</td>
<td>Good</td>
<td>Great</td>
<td></td>
</tr>
</tbody>
</table>

Explain your reasoning to the above question:

<table>
<thead>
<tr>
<th>5. Any other suggestions or comments:</th>
</tr>
</thead>
</table>