

INCREASE SUCCESS AND RETENTION IN YOUR CLASS WITH GROUP THEORY

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ABSTRACT

The coordinating of different points of view by cooperative learning groups leads to the construction of higher-level mathematical knowledge. Several concepts will be discussed, that can be applied to any class, using group theory to help students construct a better, thorough understanding of mathematical relationships. Students report that they found great value in the experience and felt that these learning groups had given them more confidence, encouragement, understanding, and hope.

"Many people valued 'life adjustment' a few decades ago, but the pendulum has now swung to the other-extreme of 'back to basics'." Constance Kazuko Kamil

BODY

A growing body of research along with research conducted both individually as well as earlier this year (April 2009) by Vanderbilt University indicates students learn more when they are taught math in such a way as to gain a better understanding. This ability to gain a higher level of understanding is the result of students being allowed to practice and compare various ways of solving mathematical problems. Two basic fundamental theories, one by Vygotsky and one by Piaget, provide an explanation of the basic underlying principles that enable the student to develop this higher level of understanding. Applying the implications of these theories to a proven learning-team model proposed by Gaston is one method which will allow teachers to help facilitate a higher-level of understanding, beyond that of the initial level of learning general procedures, in the majority of their students.

Vygotsky's social theory shows that there is a relationship between language development and social development. His theory is applicable to mathematics since many sources have referred to math as a foreign language, when considered in light of having its own specific terminology of words and symbols. Implications of his theory suggest that teachers need to encourage social interaction in the classroom, thereby fostering language development and understanding. Thus, basically Vygotsky's theory implied that learning precedes development of necessary skills and better understanding. Several of Vygotsky's experiments suggest that children can complete more complex tasks with assistance from others prior to completing the same task independently. These results indicate that teachers need to encourage social interaction among students by planning group activities that are at a level slightly above what students can master on their own (as long as it is still within the range of their knowledge and skills). The social

interactions enable some students to become a resource for other students by serving as peer tutors, and research on peer tutoring has shown that this type of tutoring produces many beneficial outcomes. Outcomes such as students have the ability to gain more specific individualized instruction from the teacher and other students, students learn responsibility and mutual respect for each other, and students gain self-control, pride, and power. Further, since peer tutoring is a form of self-learning, students become more effective learners and more proficient at the concepts in which they are teaching. Hence, peer tutoring serves as a model which enhances and reinforces the skills and behaviors being taught. Peer-tutoring also encourages open communication between students which is usually more effective for understanding since students are more likely to better understand each other. Additionally, peer tutoring fosters rational thinking as students must often “defend” and “justify” specific actions in the process of working towards successful completion of the problem.

Piaget’s theory of numbers has recently been recognized by an increasing number of educators as well as having substantial implications for the way teachers should attempt to educate mathematic students. Piaget’s theory related to the nature of logico-mathematical knowledge and how this knowledge is better constructed by each student through reflective abstraction. His theory shows that social interaction is also a key component in the construction of logico-mathematical knowledge. Piaget argued that this knowledge cannot be taught by the teacher, but must be developed and learned by the student. The theory’s construction is based on the belief that a number is a mental structure created by an individual resulting from that individual’s natural ability to think rather than learn from the environment. The theory explains why some students struggle to master mathematical concepts no matter how many times or how it is taught. Piaget’s theory implies that mathematics cannot be completely “taught” through social transmission (teacher instruction), but must be “constructed” by each student through reflection. His theory of numbers proved that mathematical understanding was mastered through the student’s ability to build relationships through mental activities that take place in the context of social exchange (general conversation). In summary, Piaget’s research implied that social interaction is an important and necessary part of an individual’s development of logic as it relates to mathematical understanding and mastery. Research conducted on Piaget’s theory by Perret-Clement studied the benefits of social interaction in the solving of logical tasks with students grouped into small learning groups. Perret-Clement’s results showed that more than 70% of those in these social groups mastered and understood the logical task. The observed “arguing” amongst the group members actually served as a key component for the “correcting” of illogical relationships. The confrontation of points of view was important in the development of logico-mathematical knowledge and serves to facilitate the development of higher levels of logical thinking which could be applied to more advanced related concepts. These conflicts were important in the fact that the student is in a social setting that encourages the student to consider other points of view, thereby forcing the student to re-evaluate previous pre-conceived concepts. This causes the student to be more mentally active in “understanding” the concept to be mastered. The social correction process was also found to be less likely to cause harm to the student’s initiative and self-confidence. The

social interaction actually encourages students to check each other's thinking, thus the students are getting immediate feedback from other group members with the overall result being that students learned that they can figure things out for themselves. Additionally, these results indicate that maximizing peer interaction will produce more understanding versus the traditional teaching models which are based mostly on individual isolation. Piaget once said, "Every student is capable of good mathematical reasoning if attention is directed to activities of his interest and if by this method the emotional inhibitions that too often give him a feeling of inferiority in lessons in this area are removed."

The removal of inferiority is what served as the basic idea behind William Glasser's choice theory. Glasser theorized that by removing the feelings of inferiority, students will gain empowerment which would then give even the poorest students the ability to feel in power and would be need satisfying. This satisfaction would in turn motivate the students to gain more power and satisfaction. Glasser's research indicates that "learning-teams" are need-satisfying, and seen enthusiastically by the majority of all students. Classes which utilize learning-teams create "both more access to power and more friendly student-to-student support within their structure." (1988) Students are motivated to learn, and also gain valuable mental connections between knowledge (education) and power (wealth). Glasser's model utilizes small learning-teams which foster motivation by students gaining a sense of belonging by working together. This sense of belonging provides the initial motivation to achieve success, and success provides power which encourages harder work to gain more power, thus increasing future motivation. Since learning-teams are also need fulfilling, strong students find satisfaction when helping weaker students because of the need for power, and weaker students find satisfaction because their help contributes to the knowledge base of the team, whereas alone, they find a little effort gets them little or nowhere. The students learn to become less dependent on the teacher which gives the student more power and freedom. This results in students learning to structure mental thoughts to achieve a higher level of individual knowledge.

Together, results of these three theories and their research imply that to become more effective, teachers should give serious thought to incorporating some variation of the learning team model as a way to encourage social interaction within the mathematics classroom. The learning team model has a proven record, reinforced by years of extensive research. Learning teams allow the teacher to act as a facilitator, coach, and resource; focusing more individualized attention to some students, while other students are seeking attention from peers within their group structure allowing students to have some power and helping them to accept more responsibility for their own education resulting in a more satisfying experience for all.

Learning teams or cooperative learning is generally separated into two basic models, genuine learning teams and artificial learning teams. The difference between these two models is how students are expected to perform within each group and how outcomes of each team are to be evaluated. In the genuine learning team models, the teams are

assigned a specific task or project where each team member is given a specific duty within that team. The team is then evaluated as a whole unit and given a team grade which is then assumed by each group member, and counted as an individual grade for the given task or project. In the artificial teams, team members all work together on one common task of a project or assignment, critiquing each other's views and progress, as the team works towards the common goals. Grading (if applicable) for the team assignment is only used as a supplement to, replacement of, or bonus to each team member's individual grades (but cannot have a negative impact on an individual within each team). The artificial learning team model seems to be the favored method preferred by most students and is the easiest model to enact in the classroom since each team member shares the identical same task with only a positive grade outcome. Procedures and guidelines for the organization of either cooperative learning team models have been created by the Cooperative Learning Center of the University of Minnesota and published in a short book entitled "Circles of Learning" by David and Roger Johnson. These models have proven to be a method that highly motivates all students involved. While other different learning team models are available, they all exhibit the same basic structure: Students completing their assignments while working in cooperative learning teams.

The artificial learning team model has been tested on two separate education levels, high school and college, using the basic underlying principles of Vygotsky, Piaget, and Glasser. The initial model and data was gathered from approximately 120 freshman and sophomore high school students in either Algebra 1 or Geometry. The classroom was organized to utilize small groups of four students in a complete cooperative learning environment. Students were assigned to desks which had been organized into "pods" of four. All work for the group was contained in the group's folder along with any assignments to be returned to the group or the group's members. Students received a brief lecture over the material, and then were given the corresponding assignment. The students would work together on the one group assignment sheet, and as time permitted, begin the individual homework assignment due the next day. Testing was completed first individually and then repeated by the group immediately with a single identical group test. Over ninety percent of these students passed their state required math exam and the course.

The second model consisted of approximately 60 freshman and sophomore college students in Intermediate (non-college/remediation level) or College Algebra. Students were taught using a traditional lecture method with time given for group work on the specific concepts to be mastered. The group work included homework, quizzes, test preparation, and test corrections. Students were also tested individually, and then together as a group. Both models utilized the group test as extra credit/bonus points. Over seventy-five percent of these students successfully completed their course. Both models supported the implications of these theories. At both education levels, the learning team model students generally out-performed the average traditional taught student, and were able to explain logico-mathematical concepts at a higher level of understanding. Additionally, most students commented that the course had become one

of their favorites due to the learning teams. Students also reported that they found great value in the experience as well as they felt that the learning teams had given them more confidence, encouragement, and hope. Several students from these classes have reported that they have continued to meet in groups to study and complete homework in subsequent semesters. The experience has also increased the likelihood of these students becoming active participants of the student government and other organizations within the university by removing the reluctance to enter into conversation with other students.

The third model consisted of a comparison between the 37 freshman and sophomore students in Fall 2008 College Algebra (College Algebra students only from second model), and an additional 36 freshman and sophomore students in Fall 2009 College Algebra. Retention data was also considered in both semesters as well. Students were taught using the same traditional lecture method as in the second model during the Fall 2009 semester and given the same examinations during the semester including the departmental comprehensive final exam. The data from each model remains the class average used to assign the semester grade. The third model students from the Fall 2009 semester were given additional group work which consisted of in-class group practice tests the class before the actual test, and additional group worksheets throughout the semester. These additional group activities were completed within the classroom during the last 30-minutes of class, and were not counted in the computation of the course grade (students were aware these activities resulted in no additional credit with the exception of possibly a better understanding and mastery of the material, and the activity could not affect their course grade in any way). The Fall 2008 College Algebra consisted of an initial 43 College Algebra students enrolled in the course on the 12 class day (official day of record) of which 36 completed the course. Seventy-five percent of the students who completed the course had a course average of 70% or better, 11% completed the course with an average between 60-69%, and 14% having an average below 60%. The Fall 2009 College Algebra consisted of 35 initial College Algebra students of which 32 completed the course. Eighty-one percent of these students, who completed the course, had a course average of 70% or better course average, 6% completed the course with an average between 60-69%, and 13% having an average below 60%.

This third model shows that there was an average of an 8% increase in overall success during the Fall 2009 semester. The complete grade distribution for these classes including those students who withdrew during the semester, is shown in Table 1 indicate that the greatest increase occurred with students who had a course average between 90-100%, an increase in course averages between 80-89%, while there was a slight decrease in those students who had course averages between 70-79%, a decrease in students with averages between 60-69%, and a slight decrease with those with averages below 50%. However, there was a significant decrease in the number of students who withdrew during the semester as approximately 16.3% withdrew from the course during the Fall 2008 semester, and only 8.6% in the Fall 2009 semester. Thus, the retention rate experienced a 47.3% increase in the number of students who withdrew from the course between the Fall 2008 and Fall 2009 semesters which resulted in an overall increase of

9.2% of students who completed the course, in which 8% of these students successfully completed the course with a 70% or better course average.

TABLE 1 – GRADE DISTRIBUTION

SEMESTER	100-90%	89-80%	79-70%	69-60%	BELOW 60%	WITHDREW
Fall2008(43)*	0.1628	0.2326	0.2326	0.0930	0.1163	0.1628
Fall2009(35)*	0.2286	0.2857	0.2286	0.0571	0.1143	0.0857

* Total Percentage Distribution Based on Initial Course Enrollment Total

Therefore, this data indicates that retention rates increased as group interaction is increased. This shows that the additional group activities encouraged students to socially interact and remain in contact with other students both inside and outside of the classroom resulting in more students remaining active in the class. The increase in the number of students completing the course along with the increase in the number of students successfully completing the course indicates that although more students remained active, they did have a significant impact on the overall success rate (approximately 1% of those who remained in class were not successful).

In summary, cooperative learning, when applied to small group settings, has benefits for both the student and the teacher. The research conducted exhibited the same basic outcomes as all three theories implied: (1) Students needs are satisfied with all students having a positive experience and attitude about the course material and the class experience, (2) Students tended to stay on task longer, (3) Homework and drill assignments were completed more efficiently with more students mastering the material, (4) Teachers have the freedom to go from team to team to assist, manage, and encourage more students than when assistance was offered on an individual basis, and (5) Team scores are well received due to their use as supplements, replacers, or bonuses to individual grades. The theories also indicate that the teacher's authoritarian power should be kept to a minimum in order to increase the sharing and exchanging of points of view, general academic tips and ideas. The teacher's role assumes that of coordinating and encouraging the communication within the groups to foster a higher-understanding and mastery of mathematical concepts. Further, the scientific evidence resulting from years of research empirically demonstrates that the coordinating of different points of view as demonstrated by cooperative learning groups leads to the construction of higher-level, logico-mathematical knowledge. Since logico-mathematical knowledge consists of relationships made by the student, by encouraging students to think on their own, the teacher will be instilling the confidence and responsibility the student needs as a solid foundation for future learning. The impact of the grouping experience on these students show that the relationships established by the students are likely to continue in future classes and have positive, beneficial impacts on the way the students perceive their educational goals and objectives.

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