Testing Jigsaw Learning In a Freshman Laboratory Course

Abstract:

In Jigsaw Learning,[1] a peer-to-peer teaching method developed by Elliot Aronson and his colleagues, every student in the class is placed in 2 sequential groups – an "expert" group to learn a section of a course topic (a jigsaw puzzle piece) and a jigsaw puzzle group where they join with different course topic "experts" to share and learn from each other,– thus completing the course topic as a whole in a group (the completed jigsaw puzzle). The class is then tested on the complete course topic. In prior research[2], which was part of a Students First grant to improve student retention, the author tested Jigsaw Learning against traditional individual student traditional instruction. The freshmen students were given new material to learn, individual grades were assigned and the Jigsaw Learning method was tested in the third week of the first semester. This class assignment was successful at building student relationships, which may improve student retention, but the study showed that use of Jigsaw Learning did not improve their knowledge of the given subject matter above the traditional lecture. The goal of this study was to test Jigsaw Learning in a freshman laboratory course according to the suggested areas of improvement from the author's previous research, which are as follows: utilize Jigsaw Learning to review course material instead of introducing new material, incorporate incentivizing group grades that are the average of individual grades, and implement Jigsaw Learning in the middle of the second semester of freshmen year instead of at the beginning of the first semester. The testing procedure employed was to divide a freshman Graphics II lecture/laboratory course into two equal randomly selected groups – a Jigsaw group of teams (3 students per team) and an individual review group – and benchmark all students. Both groups were then given the same material – a review course topic divided into 3 sections. Each member of each Jigsaw group was given 1 of the 3 course topic sections and instructed to form a new study "expert group" with classmates given the same topic. After a set time the expert groups were disbanded and the Jigsaw students returned to their original Jigsaw group where they teach/learn their topic/ review all topics through peer-to-peer instruction. After the same amount of time the Jigsaw and independent review groups were given the same test. The results of this study provide faculty with an understanding of the relative benefit of implementing Jigsaw Learning into their courses.

Introduction:

The dictionary's definition of a jigsaw puzzle is "a puzzle consisting of small irregularly cut pieces that are to be fitted together to form a picture."[3] The word jigsaw alone is defined as "a mystery that can only be resolved by assembling various pieces of information."[4] Jigsaw Learning is a cooperative, peer-to-peer teaching technique in which every student masters a piece of a course topic – the jigsaw puzzle piece – in one "expert" group and then shares their new knowledge in a group made up of "experts" from different pieces of the whole topic – the "Jigsaw" – group to complete the course topic – the jigsaw puzzle. Per Silberman, "Each student learns something which when combined with the material learned by others, forms a coherent body of knowledge or skill."[5] As Mazur found, "Nothing clarifies ideas better than explaining them to others."[6]

In a prior paper, the author assessed the use of Jigsaw Learning against a traditional lecture with first semester freshman Architecture and Construction Management students, who covered a new course topic using the Jigsaw technique, early in the semester. Both groups were benchmarked prior to the test. The results of this study showed that the Jigsaw students improved their interpersonal skills but did not improve their learning above the traditional lecture student.[7] It was concluded that the Jigsaw Learning method should modified similar to Slavin's Jigsaw II[8] method by changing the following: using review material instead of new course material, and the incentive of group grades instead of individual grades. It was also determined that this teaching method should be performed later in the semester to allow students time to settle into the course and college life in general. The goal of this paper is to test this hypothesis and provide faculty with quantitative and qualitative data on the results to aid them in implementing Jigsaw Learning successfully into their courses.

Background:

Both the Accreditation Board for Engineering and Technology (ABET)[9] and the American Society of Engineering Education (ASEE)[10] seek education standards which: encourage students to communicate, provide teamwork practice and encourage learning techniques for self-directed continuing professional development.

Long lecture classes can be tedious for the student and a balancing act for the professor. Freshmen students are especially vulnerable as they may not be used to the 3 hour or more class, and they may lack the concentration necessary to carry them through. They may sit in traditional lecture rooms with sociofugal rows where they wait for information to be disseminated for memorization and later regurgitation in exams, papers or projects. Faculty endeavor to explain and connect large amounts of course material while maintaining student interest and attention. Students who are actively engaged show increased learning. Per Umbach, P, and Wawrzynski "students report higher levels of engagement and learning at institutions where faculty members use active and collaborative learning techniques, engage students in experiences, emphasize higher-order cognitive activities in the classroom, interact with students, challenge students academically, and value enriching educational experiences."[11] To achieve this goal, lectures may be supplemented by professor-led activities such as discussion, relating professional antidotes, question and answer sessions, and problem solving group work. In group work, students sit together in class to perform a task but do not have defined roles. A common pitfall of group work is that one team member performs the whole group's task while the remainder of the group looks on. A further development of student participation is student-centered classroom activities such as cooperative learning where students work in small groups to collaborate on a task and "help one another master academic content"[12] One such cooperative learning method is Jigsaw Learning.

Jigsaw Learning was developed by Elliot Aronson and his colleagues in 1971 to help to stifle racial tension in Austin's elementary classrooms during desegregation.[13] It was designed to improve the performance of minority students and allow students to integrate and become more accustomed to each other by dividing learning tasks among groups of students.[14] Jigsaw Learning is now widely practiced in classrooms of all age ranges and abilities. Aronson et al

found that when compared to students in traditional classrooms, Jigsaw students were: less prejudiced toward others, more self-confident, enjoyed school more, were absent less often from school and showed greater academic improvement.[15] In the Jigsaw method tested prior a course topic and the class were divided up into equal number of sections. Each section team member was given a different segment of the course topic to study. Students from different teams who had studied the same course topic now form a new group to discuss their shared topic and presentation ideas – this is the "expert group." After a set period of time, the students return to their original group and take turns teaching and discussing their individual topics thus completing the whole course topic – the "jigsaw puzzle." Students had to listen carefully to each other to learn different topic sections and they had to explain their own topic to their team members. This mutual support and co-dependence was a motivating factor to encourage interest in one another's work.[16] Students were then tested and individual scores were given. Per Amato et al, "the Jigsaw strategy not only alters the peer group structure of the classroom, it also changes the role of both student and teacher. Student becomes teacher, and teacher becomes facilitator and content expert."[17] However, the data on the outcome of Jigsaw Learning in comparison to the traditional lecture on content retention is mixed. The finding of the previous Jigsaw test is similar to that of Thompson et al in 1998 and Slavin[18] in 1995. The Thompson et al paper titled "Cooperative Learning Versus Traditional Lecture Format: A Preliminary Study" states: "The results failed to document any significant differences in the scores of students taught by the lecture method versus students taught by Jigsaw."[19] Slavin found that students have limited exposure to the topic material that their team members are responsible for, so "learning gains on their own topics may be offset by losses on their group mates' topics." A separate study by the Johnsons found that the reward of group grades (based on the average of all group member individual scores) increased the achievement of Jigsaw Learning.[20] In another study, teambuilding activities alone had no effect on the achievement outcomes of Jigsaw Learning.[21]

Jigsaw II is a modification of the Jigsaw Learning method and was developed by Robert Slavin.[22] In Jigsaw II all students read a common text prior to receiving a topic section on which to become an "expert". Similar to the original Jigsaw method, students with the same topics are divided up into expert groups where they discuss and develop their presentation strategy before returning to their Jigsaw group to teach and learn with their teammates. The students still take individual tests but their final scores are an average of all of the students' grades in their Jigsaw group rather than only their own result, as in the original Jigsaw Learning method.[23] This acts as a formal group incentive, stresses individual accountability and has proven to be more effective at increasing learning over the original method.[24] Research in the use of Jigsaw II has shown statistically significant results in favor of this teaching method, both in the improvement of student learning and in student classroom inter-relationships.[25] [26]

Methodology:

In the spring of 2012, 18 Architecture and Construction Management students in one 3 hour long Graphics II lecture/laboratory class were randomly divided into 2 equal groups – a Jigsaw group comprising of 3 teams of 3 students per team and a review group comprising of 9 students who worked independently. Both groups were given a pre-test on AutoCAD Architecture topics covered during the first half of the semester. The pre-test results showed that both groups had an

approximately equal understanding of the topics given in the test. Both groups were then given the same material – a review course topic divided into 3 sections. Both groups were also informed that they would be tested on the review topics at the end of that class. The control group was instructed to review the course material independently without interaction with other students. Each member of each Jigsaw group was given 1 of the 3 course topic sections and instructed to form a new study "expert group" with classmates given the same topic. After a set time, the expert groups were disbanded and the Jigsaw students returned to their original Jigsaw group where they shared their knowledge and learned from their team members through peer-to-peer instruction. After the same amount of time, the Jigsaw and independent review groups were given the same test to complete in the same time.

Results:

The following are the quantitative and qualitative results for the modified Jigsaw II test.

Quantitative Results:

Jigsaw (n=9)	
Student	Score out of 5
DU	4
SP	4
MV	4
MA	4.5
GM	4.5
KR	4.5
PC	5
KR	5
NT	5
	4.5

Independent (n=9)	
Student	Score out of 5
AG	4
GP	4
RD	3
LN	3
BS	3.5
MD	4
MS	3.5
RH	4
MG	1
	3.333333

Difference of Means t-Test (P=0.05)		
	Traditional	*Jigsaw*
Observations	9	9
Mean	3.333	4.5
Variance	0.9375	0.1875
df	11	
t Stat	**3.2998**	
P(T<=t) one-tail	0.0035	
t Critical one-tail	1.7959	

Qualitative Results:

The following is the list of questions given to the Jigsaw II students and their average responses based on a Likert Scale of 1(Strongly Disagree) to 5(Strongly Agree).

1. I remember more when I explain what I have learned to someone else. 3.89 (Agree)
2. Working in groups in class is similar to what I expect to be doing in my future professional career. 3.89 (Agree)
3. Working in groups helps the classroom learning environment. 3.89 (Agree)

4. Working in a group gives me an opportunity to meet my classmates. 4.89 (Strongly Agree)

Discussion:

Although the sample size is small, the results indicate that the modified Jigsaw II method significantly improved student learning. This finding is in agreement with other studies such as that by the Johnsons which found that the reward of group grades (based on the average of all group member individual scores) increased the achievement seen in Jigsaw Learning.[27]

Conclusion:

The quantitative and qualitative results indicate that there is a relative benefit to implementing Jigsaw II into lecture/laboratory courses to improve student learning and student interaction. Further research on this topic with a larger sample size is warranted.

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