SERD

The impact of Jigsaw and STAD on social studies pre-service teachers' academic achievement*

Aşkın Baydar[1], Ufuk Şimşek[2]

Abstract

The aim of this study is to compare two cooperative learning methods, jigsaw and student teams achievement divisions (STAD), in terms of their effects on social studies pre-service teachers' academic achievement. The study group of the research consisted of 40 students who attended teaching principles and methods course at Artvin Çoruh University College of Education Department of Social Science Education. Data was collected during 12 weeks implementation and with Academic Success Test (AST) which was developed by the researcher and was analyzed with independent samples t-test and one way analysis of variance (ANOVA). The findings of the research show that STAD is more effective than jigsaw on social studies pre-service teachers' academic achievement. Research also includes the recommendations for future applications.

Keywords: Cooperative learning, jigsaw, STAD, academic achievement, teacher education

Introduction

Today's education should make students overcome the difficulties that they would face in work environment and everyday life. For this reason, "students not only need knowledge but also communication skills, problem solving skills, creative and critical thinking skills in the years ahead" (Zakaria & Iksan, 2007, p. 36). Therefore, it seem that teacher centered, traditional methods which are criticized for not attaching

[1] ORCID: 0000-0002-5795-8282, Assist. Prof. Dr., Artvin Coruh University, Department of Basic Education, askinbay@gmail.com

[2] ORCID: 0000-0002-4699-0674, Assoc. Prof. Dr., Ataturk University, Department of Turkish and Social Studies Education, ufuk@atauni.edu.tr

* This study is a part of doctoral dissertation entitled as "The Impact of Jigsaw and Student Teams Achievement Divisions on Social Studies Pre-service Teachers' Epistemological Beliefs and Academic Achievement, under supervision of Assoc. Prof. Dr. Ufuk Şimşek."

enough importance to problem solving and critical thinking skills (Hannafin & Land, 1997), give their place to the learning methods which consider different thinking techniques and participation. Cooperative learning is one of these methods that is student centered and aimed to improve social skills. In teacher centered classes "students become passive recipients of knowledge and resort to rote learning. The majority of work involved teacher-talk using either a lecture technique or a simple question and answer that demand basic recall of knowledge from the learners" (Zakaria & Iksan, 2007, p. 35). In cooperative learning groups on the other hand, "students are employing their social skills to help all group members to achieve and to maintain effective working relationships within the group" (Johnson, Johnson, Holubee, & Roy, 1984, p. 8).

In traditional learning groups students usually study individually and the system is competitive (Slavin, 1977). In individualistic and competitive models students are evaluated independently and generally with comparing with each other. This system is being criticized for many years. On the other hand new research shows that cooperative teaching techniques provides much more academic achievement and social development than traditional methods (Slavin, 1978). "An individualistic goal structure is one in which students are given individual goals, and by using a criterion-referenced evaluation system students are assigned individual rewards. Whereas student interdependence is required in the cooperative structure, students behave quite independent of each other in an individualistic structure. Individualistic structures usually use a criterion-referenced evaluation system" (Sherman, 1991, p. 5); however in cooperative learning "by sharing their knowledge with each other in small groups working toward a common goal, students can benefit from distributed cognition, where the strengths of one student complement the needs of another, and each increases her knowledge base" (Coke, 2005, p. 385).

In "cooperative learning, that has been widely researched and used in classrooms around the world since the 1970s" (Vaughan, 2002, p. 359). Cooperative "teams are evaluated and/or rewarded on the basis of how much each member improves; because each student's achievement increases the success of the total team members work toward a common goal (Ascher, 1986, p. 2). An effective communication occurs

among the members work together and students force their minds with thinking and discussing (Bayrakçeken, Doymuş, & Doğan, 2013). "Cooperative learning groups are based on positive interdependence among group members, where goals are structured so that students need to be concerned about performance of all group members as well as their own" (Johnson et al., 1984, p. 9).

Jigsaw and STAD are among the most well-known (Kagan, 1989) and most widely used (Leming, 1985) structures of cooperative learning. Also according to Slavin and Karweit (1979), these two methods are among the most extensively researched and according to Zetty (1992), well-researched and highly touted cooperative learning methods.

In accordance with the findings above, the research problem is stated as "what are the effects of jigsaw and student teams achievement divisions (STAD) on social studies pre-service teachers' academic achievement.

Method

The independent variables of the study are two of the cooperative methods, jigsaw and STAD; and the dependent variable of the study is social studies pre-service teachers' academic achievement level. To measure the effects of these two cooperative methods on dependent variable pretest-posttest, no control group design was chosen. In this type of design, pretest is given to group or groups before the experimental process start. After finishing the experimental process the same test is given as the posttest (Sönmez & Alacapınar, 2011, p. 56).

Research Design

In the study a quasi-experimental design was used. It is common situation that educators do not prefer true experimental design in their researches. Because, randomly selection of classes and students that are necessary for the research, is almost impossible (Cohen, Manion, & Morrison, 2000). Karasar (2005) also took attention to the difficulties of the studies conducted in ministerial schools in Turkey

and creating equal experimental groups. In such situations quasi-experimental designs were preferred.

Study Group

The study group of the research consisted of 40 students who attended teaching principles and methods course at Artvin Çoruh University College of Education Department of Social Studies Education. The class was divided to two homogenous experimental groups: jigsaw (n=20) and STAD (n=20) implementation groups. The homogeneousness of two groups was determined according to the grade point averages of the previous year.

Data Collection Tool

Academic Achievement Test (AAT), which was developed by the researcher, was used in the study. To measure the validity and reliability of the test, a pilot study which is a 50 question test was conducted with 150 students, who took the methods and principles of instruction course before.

Within the scope of the validity studies of the achievement test, making factor analysis for each item in the item pool, degree of difficulty and index of distinctiveness of each item were determined. Degree of difficulty of the items was found as between .11 and .97, and index of distinctiveness of the items was found as between .04 and .61.

Accordingly, it is understood that some items in the item pool are not convenient to the indexes of item difficulty and distinctiveness these items were extracted from the achievement test. Average item difficulty of the test, which consists of the remaining 30 items, was determined as .53. This result shows that the test has an average difficulty. The average distinctiveness of the test is calculated as .32. Thus, a fair level of distinctiveness was determined. Besides, it was determined that all the items in the achievement test are at an acceptable level. In accordance with the expert opinions and item analysis results, it can be said that the validity of the 30 question achievement test is high.

To calculate the reliability of the study, Kuder-Richardson-20 reliability coefficient was used. At the end of the analysis the reliability coefficient was stated as .68 and reached to the result that the achievement test is reliable.

Data Collection

After applying the AAT to both jigsaw and STAD groups as pretest, teaching principles and methods course was committed in both two experimental groups for 12 weeks by the researcher. At the end of the implementation process AAT was applied to the experimental groups as posttest. The implementation processes of jigsaw and STAD methods in experimental groups were explained below.

Implementation of Jigsaw

For implementing the method, students were separated into five original groups. Each group has 4 members.

Titles	1st OG	2nd OG	3rd OG	4th OG	5th OG
1st subtitle →	A1	B1	C1	D1	E1
2nd subtitle →	A2	B2	C2	D2	E2
3rd subtitle →	A3	B3	C3	D3	E3
4th subtitle →	A4	B4	C4	D4	E4

Figure 1. Jigsaw original groups and distribution of titles

After assigning the original groups, subtitles were distributed to each member of the original groups as in Figure 1. Subtitles they are responsible of and related materials were given to the each member of the groups. Then, members left from the original groups and were assigned to the expert groups as in Figure 2. Each subtitle was in one expert group's expertise area.

1st Expert group:	A1,	B1,	C1,	D1,	E1
2nd Expert group:	A2,	B2,	C2,	D2,	E2
3rd Expert group:	A3,	B3,	C3,	D3,	E3
4th Expert group:	A4,	B4,	C4,	D4,	E4

Figure 1. Creating jigsaw expert groups

After giving or suggesting necessary recourses by the researcher, each expert group got ready to their subtitle in union until the next class. These preparations involve both individual and group studies in homes, dormitories, and libraries.

The expert groups came to class with materials that they studied individually or together on. They had 30 minutes to study the materials they brought, discuss, combine the studies and review. At the end of this time, each expert group finished and reported their study on the subtitle they specialized on, with a report. During all the studies researcher worked as a guide in case of possible questions, problems.

After finishing the studies in expert groups, participants returned their original groups and each original group member share her study that she prepared in the expert group with a presentation. 30 minutes were given to original groups for this part of the study including the time for question-answer and discussing.

At the last step of the implementation in jigsaw group, all the participants took a four question, multiple-choice quiz. The answers were given to the participants, right after the quiz. And then they were given 20 minutes to correct their deficiencies.

Implementation of the STAD

Like in jigsaw group, the implementation process of the method was explained in details to the STAD group by the researcher in the first hour of the course. And like in jigsaw group, titles were divided in subtitles and committed starting with the second week of the semester and during 12 weeks. Considering AAT pretest results the participants heterogeneously grouped in fours same as in jigsaw group.

After distributing the students to groups, researcher made a 40 minutes presentation. During 12 weeks implementation process, researcher used techniques like direct instruction, question-answer, and visual presentation dependently on the characteristics of subjects. Following the researcher's presentation, participants went to the groups they assigned and started to "team study". For this study to provide interdependency in group, one work sheet was given to each two participants. Groups have 40 minutes to complete their studies. During all the studies researcher worked as a guide and answer the questions if nobody could in the group.

Finishing team studies, participants took a four question quiz. Also for each participant, 5 points below was accepted as her "starting point". By comparing the starting point and quiz score, "individual improvement score" was determined. And with the sum of individual improvement scores of each member in teams, the "team scores" were provided. Lastly, to appreciate the successful team, team scores were announced to whole class.

Data Analysis

Data were analyzed with SPSS and using independent samples t-test and one way analysis of variance (ANOVA).

Findings

For understanding if any significant difference between pretest points to make test of normality first and because number of participants is lower than 50, to determine distribution of data, Shapiro-Wilk test was made (Shapiro & Wilk, 1965). The results of Shapiro-Wilk test showed that pretest point averages of both two groups have a normal distribution. Thus, to compare jigsaw and STAD groups' pretest point averages independent samples t-test was used.

Table 1. Independent samples t-test results regarding Jigsaw and STAD groups' AAT pretest point averages.

Variable	Group	N	Mean	SD	df	t	p
Academic Achieve-ment	Jigsaw	20	15.95	2.35	38	0.60	0.547
	STAD	20	15.50	2.32			

As stated in Table 1, at the end of the independent groups t test it was determined that there is no significant difference between social studies pre-service teachers' academic achievement pretest points ($t_{(38)}$= .60, p> .05).

To determine the effects of jigsaw and STAD on social studies pre-service teachers' academic achievement, one way analysis of variance (ANOVA) was used. For this purpose, a statistical process was applied by taking the mean difference of pretest and posttest points of social studies pre-service teachers in jigsaw and STAD groups.

Table 2. Analysis of variance results regarding the effects of Jigsaw and STAD methods on academic achievement.

Group	SS	df	MS	F	p	Significant Difference
Between groups	140.62	1	140.62	12.19	0.001	Jigsaw-pretest-posttest< STAD-pretest-posttest
Within groups	438.35	38	11.53			
Total	578.97	39				

As seen in Table 2, at the end of the ANOVA it is determined that there is significant difference regarding the mean difference of jigsaw and STAD groups' academic achievement pretest and posttest points ($F_{(1, 38)}$ =12.19, p<.005).

The study reached to the conclusion that using jigsaw and STAD is effective on pre-service teachers' academic achievement. To understand that which group was more effective, Tukey test, which is one of the PostHoc test, was done. At the end of the analysis, jigsaw group's pretest-posttest mean difference (X=1.10, Ss=3.66) was found lower than STAD group's pretest-posttest mean difference (X=4.85, Ss=3.09), ($p<0,05$).

Discussion, Conclusion and Implications

Academic achievement which is the dependent variable of the study was increased in STAD group significantly at the end of the study. This situation verifies Slavin's (1991, p. 90) statement that "STAD are most appropriate for teaching well-defined objectives with single right answers. Because, both Academic Achievement Test that was applied pretest and posttest in teaching principles and methods course the experimental process applied in, and the quizzes are consisted of single answer, multiple choice questions.

The results of this study that compares jigsaw and STAD in terms of their effects on academic achievement overlaps with Slavin's (1980) results he reached with six different studies that to improve the basic skills in mathematics and language lessons STAD is more effective than jigsaw. In another study (Zetty, 1992) that compares jigsaw and STAD different results were found. In that study jigsaw was found more effective than STAD.

This study that shows the positive effects of STAD, gave similar results with Tiantong & Teemuangsai (2013), Jalilifar (2010) and Brooks's (2009) studies that conducted with university students. Also Slagle's (2009) study, which done by trying STAD in secondary school social studies course, has similar results overlap the results with this study. The results of this study, support the results of the studies (Amornsinlaphachai, 2014; İbraheem, 2011; Efe, 2011; Gençosman, 2011; Conring, 2009; Özsarı, 2009; Tarım & Akdeniz, 2008; Alkaya, 2006; Bilgin, 2004; Vaughan, 2002) that tried STAD in elementary and secondary schools. But they do not support the results of Erdoğan (2008), Gelici & Bilgin (2007), Ergin (2007); Yıldırım-Kayabaş (2007) and Slavin (2007)' studies.

On the other hand, jigsaw is less effective than STAD on pre-service teachers' academic achievement and this situation is consistent with the studies (Arslan, 2012; Fies, 2008; Ross, Seaborn, & Wilson, 2002; Holliday, 1995; Webb, 1992) in the area that jigsaw was compared with and could not found any significant effect. But in the literature there are also studies (Şimşek, Örten, Topkaya, & Yılar, 2014; Huang, Liao, Huang, & Chen, 2014; Evcim & İpek, 2013; Jurhill, 2011; Öner, 2007; Avşar & Alkış, 2007; Şimşek, 2007; Acar, 2006; Wang, 2006; Sönmez, 2005) that jigsaw is more effective than the methods compared with in terms of academic achievement and their results are not consistent with this study. With its results the research suggests to prepare curriculums that would pave the way for cooperative methods to take places in schools and teacher education adequately.

References

Acar, A. (2006). *İşbirliğine dayalı öğrenme yönteminin ortaöğretim coğrafya dersi yerleşme konusunun öğretilmesinde başarıya etkisi* (master's thesis). Gazi Üniversitesi. Eğitim Bilimleri Enstitüsü, Ankara.

Alkaya, F. (2006). *Eleştirel düşünme becerilerini temel alan fen bilgisi öğretiminin öğrencilerin akademik başarılarına etkisi* (master's thesis). Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü, Hatay.

Amornsinlaphachai, P. (2014). Designing a learning model using the STAD technique with a suggestion system to decrease learners' weakness. *Procedia-Social and Behavioral Sciences,* 116, 431-435.

Arslan, A. (2012). Sözcük türleri öğretminde Jigsaw tekniğinin etkisi. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi, 32* (1), 157-168.

Ascher, C. (1986). *Cooperative Learning in the Urban Classroom.* Clearinghouse on Urban Education, New York.

Avşar, Z., & Alkış, S. (2007). The effect of cooperative learning "Jigsaw I" technique on student success in social studies course. *Elementary Education Online, 6* (2), 197-203.

Bayrakçeken, S., Doymuş, K., & Doğan, A. (2013). İşbirlikli öğrenme modeli ve uygulanması. Ankara: Pegem Akademi Yayınları.

Bilgin, T. (2004). İlköğretim yedinci sınıf matematik dersinde (çokgenler konusunda) öğrenci takımları başarı bölümleri tekniğinin kullanımı ve uygulama sonuçları. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi, 17* (1), 19-28.

Brooks, A. (2009). *Regular college preparatory students' perceptions of the student teams achievement divisions approach in an academic college preparatory biology class* (Doctoral dissertation). Walden University, Minneapolis.

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education.* London and New York: Falmer.

Coke, P. K. (2005). " Practicing what we preach: An Argument for Cooperative Learning Opportunities for Elementary and Secondary Educators". *Education, 126* (2), 392-398.

Conring, J. M. (2009). *The effects of cooperative learning on mathematic achievement in second graders.* (Doctoral Thesis). Walden University, Minneapolis.

Efe, M. (2011). *İşbirlikli öğrenme yönteminin, öğrenci takımları başarı bölümleri ve küme destekli bireyselleştirme tekniklerinin ilköğretim 7. sınıf öğrencilerinin matematik dersi "istatistik ve olasılık" ünitesindeki başarılarına, tutumlarına ve motivasyonlarına etkisi* (master's thesis). Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü, Hatay.

Ergin, M. (2007). *İlköğretim fen ve teknoloji konularının öğretiminde işbirlikli öğrenme yönteminin öğrenci başarısı ve tutumlarına etkisi* (master's thesis). Selçuk Üniversitesi Fen Bilimleri Enstitüsü, Konya.

Evcim, H., & İpek, Ö. F. (2013). Effects of jigsaw II on academic achievement in English prep classes. *Procedia-Social and Behavioral Sciences,* 70, 1651-1659.

Fies, C. (2008). Online jigsaw science inquiry for preservice teachers. *Journal of Computing in Teacher Education, 24* (3), 85-92.

Gelici, Ö., & Bilgin, İ. (2007). İşbirlikli öğrenme tekniklerinin öğrencilerin cebir öğrenme alanındaki başarı, tutum ve eleştirel düşünme becerilerine etkileri. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 12* (1), 9-32.

Gençosman, T. (2011). *Fen ve teknoloji öğretiminde kullanılan öğrenci takımları başarı bölümleri tekniğinin öğrencilerin öz-yeterlilik, sınav kaygısı, akademik başarı ve hatırda tutma düzeylerine etkisi* (master's thesis). Akdeniz Üniversitesi Sosyal Bilimler Enstitüsü, Antalya.

Hannafin, M. J., & Land, S. M. (1997). The foundations and assumptions of technology-enhanced student-centered learning environments. *Instructional science, 25* (3), 167-202.

Holliday, D. C. (1995). *The effects of the cooperative learning strategy jigsaw II on academic achievement and cross-race relationships in a secondary social studies classroom* (Doctoral dissertation). The University of Southern Mississippi.

Huang, Y. M., Liao, Y. W., Huang, S. H., & Chen, H. C. (2014). Jigsaw-based cooperative learning approach to improve learning outcomes for mobile situated learning. *Journal of Educational Technology & Society, 17* (1), 128-140.

Ibraheem, T. L. (2011). Effects of two modes of student teams–achievement division strategies on senior secondary school students' learning outcomes in chemical kinetics. *Asia-Pacific Forum on Science Learning and Teaching 12*(2), 1-21.

Jalilifar, A. (2010). The effect of cooperative learning techniques on college students' reading comprehension. *System, 38*(1), 96-108.

Johnson, D. W., Johnson, R. T., Holubee, E. J., & Roy, P. (1984). *Circles of learning. Cooperation in the classroom.* Association for Supervision and Curriculum Development, St., Alexandria.

Jurhill, D. A. (2011). *Propelling students into active grammar participation.* US Department of Education Educational Resources Information Center.

Kagan, S. (1989). The structural approach to cooperative learning. *Educational Leadership, 47* (4), 12-15.

Karasar, N. (2005). Bilimsel araştırma yöntemi. Ankara: Nobel Yayın Dağıtım.

Leming, J. S., (1985) Cooperative Learning in Social Studies Education: What Does the Research Say?, US Department of Education Educational Resources Information Center.

Muhammad, Z. (2010). *Effects of cooperative learning intervention on mathematics achievement outcomes and attitudes of non-science college majors.* Doctoral dissertation. Southern University and A & M College.

Neuman, W. L. (2013). *Toplumsal araştırma yöntemleri.* (Çev. S. Özge). Ankara: Yayın Odası.

Öner, Ü. (2007). *İlköğretim 7. sınıf sosyal bilgiler dersi tarih konularının öğretiminde işbirlikli öğrenme yönteminin öğrenci başarısına etkisi.* (master's thesis). Fırat Üniversitesi Sosyal Bilimler Enstitüsü, Elazığ.

Özsarı, T. (2009). *İlköğretim 4. sınıf öğrencileri üzerinde işbirlikli öğrenmenin matematik başarısı üzerine etkisi: Probleme dayalı öğrenme (PDÖ) ve öğrenci takımları-başarı bölümleri (ÖTBB).* (master's thesis). Ege Üniversitesi Sosyal Bilimler Enstitüsü, İzmir.

Ross, M. C., Seaborn, A. W., & Wilson, E. K. (2002). *Is cooperative learning avaluable instructional method for teaching social studies to urban african american students?* Paper presented at the National Association of African American Studies, Baton Rouge, LA.

Sherman, L. W. (1991). *Cooperative Learning in Post Secondary Education: Implications from Social Psychology for Active Learning Experiences.* American Educational Research Association, Chicago.

Slagle, D. R. (2009). *The Use of the Cooperative Learning Strategy STAD to PromoteAcademic Achievement In a High School Social Studies Class.* Master thesis. Defiance College.

Slavin, R. E. (1977). *Student Teams and Achievement Divisions: Effects on AcademicPerformance, Mutual Attraction, and Attitudes.* Johns Hopkins University.

Slavin, R. E. (1978). Using Student Team Learning. *The Johns Hopkins Team Learning Project*. Johns Hopkins University.

Slavin, R., & Karweit, N.L. (1979). *An extended cooperative learning experiencein elementary school.* US Department of Education Educational Resources Information Center.

Slavin, R. E. (1980). *Student Team Learning.* US Department of Education Educational Resources Information Center.

Slavin, R. E. (1988). *Student team learning: An overview and practical guide.* US Department of Education Educational Resources Information Center.

Slavin, R. (1991). Group rewards make groupwork work. *Educational Leadership,* 5,89-91.

Sönmez, S. (2005). *İşbirliğine dayalı öğrenme yöntemi, birleştirme tekniği ile bilgisayar okur-yazarlığı öğretiminin akademik başarıya ve kalıcılığa etkisi.* (master's thesis). Çukurova Üniversitesi Sosyal Bilimler Enstitüsü, Adana.

Sönmez, V. & Alacapınar, F. G. (2011). *Örneklendirilmiş bilimsel araştırma yöntemleri.* Ankara: Anı Yayıncılık.

Şimşek, U., Örten, H., Topkaya, Y., & Yılar, B. (2014). Sosyal bilgiler öğretmen adaylarının işbirlikli öğrenme teknikleri hakkındaki görüşleri, *Turkish Journal of Social Research 18* (1), 231-257.

Şimşek, Ü. (2007). Çözeltiler ve kimyasal denge konularında uygulanan Jigsaw ve birlikte öğrenme tekniklerinin öğrencilerin maddenin tanecikli yapıda öğrenmeleri ve akademik başarıları üzerine etkisi. (Doctoral dissertation). Atatürk Üniversitesi Fen Bilimleri Enstitüsü, Erzurum.

Tarım, K., & Akdeniz, F. (2008). The effects of cooperative learning on Turkish elementary students' mathematics achievement and attitude towards mathematics using TAI and STAD methods. *Educational studies in Mathematics, 67* (1), 77-91.

Tiantong, M., & Teemuangsai, S. (2013). Student team achievement divisions (STAD) technique through the moodle to enhance learning achievement. *International Education Studies, 6*(4), p85.

Turgut, M. F., & Baykul, Y. (2012). *Eğitimde ölçme ve değerlendirme.* Ankara: Pegem Akademi Yayınları.

Vaughan, W. (2002). Effects of Cooperative Learning on Achievement and Attitude AmongStudents of Color. *The Journal of Educational Research, 95* (6) 359-364.

Wang, R. S. (2006). *The effects of Jigsaw cooperative learning on motivation to learn Englishat Chung-wa Institute of Technology, Taiwan.* Doctoral dissertation. Florida International University, Miami.Webb, M. D. (1992). *The effects of the Jigsaw cooperative learning technique on racial attitudes and academic achievement (*master's thesis). California State University, Fresno.

Yıldırım-Kayabaş, S. G. (2007). *İşbirliğine dayalı ve bireysel bilgisayar destekli öğretimin öğrencilerin başarısına ve öğrenilenlerin kalıcılığına etkisinin karşılaştırılması.* (master's thesis). Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

Zakaria, E. & Iksan, Z. (2007). Promoting cooperative learning in science and mathematics education: A Malaysian perspective. *Eurasia Journal of Mathematics, Science & Technology Education, 3* (1), 35-39.

Zetty, N. (1992). *A comparison of the STAD and Jigsaw cooperative learning methods in a college-level microcomputer applications course* (Doctoral dissertation). West Virginia University, Morgantown.