Application of Cooperative Teaching Method in Engineering Education

Xinyu Li

Institute of Physical Education, Yangtze University, Jingzhou 434023, Hubei, China

Abstract

In cooperative learning, learners constitute a team to achieve their common objectives. They make efforts and maximize learning effect for the success of all group members. Among the great number of existing researches on the practical effect of cooperative teaching method, only a few researches focus on the application of cooperative teaching method in civil engineering. Targeting at engineering colleges and universities, this paper discuss the teaching effect of cooperative teaching method for college students majoring in civil engineering, so as to promote further development of the method in colleges and universities. Through comparing the experimental group using cooperative teaching method and the control group using traditional educational method, it analyzes the differences between the academic performance of college students majoring in civil engineering under education with and without the use of cooperative teaching method. The statistical results of the investigation show that cooperative teaching method has positive effect on the improvement of academic performance and psychological health of college students majoring in civil engineering.

Key words: COOPERATIVE TEACHING METHOD, CIVIL ENGINEERING, COLLEGE STUDENTS, TEACHING EFFECT

1. Introduction

The definition of cooperative learning is not unified in academic circles currently. This experience is based on the theory and strategy of Johnson & Johnson in Cooperative Learning Centre of University of Minnesota in USA. Therefore, their definition is adopted. They consider cooperative learning as the use of group in teaching so as to allow students to act jointly and promote their study to the greatest extent. In group cooperative learning, learners constitute a team with common objectives [1]. They make efforts for the success of all members in the group and maximize learning effect. Group members benefit both others and themselves. Reward resources are not limited. They celebrate for common success. After the completion of activities, they evaluate the performance of group learning with the pre-established standard [2]. If group members cooperate with tacit understanding, they can achieve learning effects better than the sum of those of individual members – "the sum of parts is more than the entirety. Therefore, group cooperative learning must have five elements below [3]: positive interdependence, face to face promotive interaction, Individual and group accountability, interpersonal and small group skills and group processing.

Basic methods of cooperative learning with the most in-depth research on cooperative learning that are most widely used include student team-achievement divisions (STAN), team games tournament (TGT), Jigsaw, learning together (LT), group investigation (GI), academic controversy (AC), team assisted individualization (TAI) and cooperative integrated reading and composition (CIRC) [4-6]. Cooperative learning became a commonly used form of active pedagogy in 1980s and continues to be a valuable tool for learning in academic institutions today [1],

as it provides benefits for both students and instructors [7]. Researchers reported, "…students worked significantly harder for and learned more from the cooperative learning components than from the traditional lecture and text-based components" of courses studied [8]. Empirical study of Sun and Li [9] shows that cooperative learning can improve students' interest and self-confidence in English learning and their classroom learning behaviors and is good for improving their abilities of English application, independent thinking and cooperation and communication. Research results of Zhao [10] show that cooperative learning strategy can improve English reading ability of college students not majoring in English effectively. The research of Chen [11] shows that cooperative teaching in college teaching is good for improving achievement motivation level of college students and their tendency to pursue for success.

All in all, cooperative teaching has been applied to courses such as English and Chinese and its teaching effects have been proved by many researchers. However, there are few researches on teaching effects of cooperative teaching method for engineering students. Therefore, with college students majoring in civil engineering as research objects, the experiment in this paper has important enlightenment function for the promotion and application of cooperative teaching in college teaching.

2. Advantage of cooperative learning

Cooperative learning is considered as one of the three learning methods (individual independent learning, competitive learning and cooperative learning). In cooperative learning, learners constitute a team with common objectives. They make efforts for the success of all members in the group and maximize learning effect. Group members benefit both others and themselves. Reward resources are not limited. They celebrate for common success. After the completion of activities, they evaluate the performance of group learning with the pre-established standard. Compared to other learning methods, group cooperative learning has the following advantages:

(1) Improve learners' insight, abilities of cognition, moral reasoning and understanding, critical thinking and memory.

(2) Allow learners to make greater achievements, have more effective behaviors and fewer disruptive behaviors and maintain better psychological health, mental regulation and psychological status, greater self-esteem and confidence and better social ability.

(3) Stimulate learners' achievement motivation and intrinsic motivation and make students hold a positive attitude towards learning.

(4) Allow students to view problems from the perspective of others, establish positive and supportive peer relationship with learners of different race, gender, stratum and health status and gain greater social support.

(5) Help learners transfer the knowledge and skills learnt in daily life.

(6) Manifest learners' implicit thinking process, allow it to be monitored and evaluated more easily and take countermeasures pertinently.

3. Design of experiment

3.1. Experimental object

This experiment used experimental control method and selected 186 sophomores in four classes majoring in civil engineering. They were divided into two groups randomly. The experimental group included 93 students in two classes and cooperative teaching method was used in PE class. The control group included 93 students in 2 classes and traditional teaching method was used in PE class. Their class contents were basketball teaching. After one-semester experimental teaching, questionnaire survey was conducted on experimental objects and relevant statistical analysis was conducted on survey data obtained before and after the experiment. Then, differences of PE course with cooperative and traditional teaching methods in the effect for the improvement of academic performance of college students majoring in civil engineering were compared.

3.2. Experimental period

Students attended PE class in the second semester. The experimental period lasted for 16 weeks from March to June 2015. PE class was implemented once a week with duration of 90 minutes each time. After the completion of teaching experiment, questionnaires were issued to experimental objects respectively.

3.3. Experimental design

Traditional teaching method was used for control group and cooperative teaching method was used for experimental group. Cooperative learning method (group teaching) was used based on students' characteristics in basketball teaching. Students with better techniques acted as group leader in each group and led other students to study and practice. Group leaders became "teachers". They gave a demonstration skillfully with their techniques and guided group members to study actively. Group members guided each other, discussed, debated and exchanged the role and practice experience mutually. Students performed bare-handed practice, imitating practice, basketball holding practice and the practice of complete movement consciously, actively and positively according

to their own situation. After a certain period of time, teachers organized each group for reporting practice and required students to attend the competition with technologies and rules learnt. Under such competitive conditions, students in each group strived to do better, behaved themselves in front of others and meanwhile won honors for their own groups. Measuring tools for experimental class and control class were tested with the same instruction, content and format under the guidance of the same experimenter.

In experimental class, students were divided into multiple groups with intra-group heterogeneity and inter-group homogeneity. Each group included 6 to 7 members. Group members always remained unchanged in the whole experimental process. All members had a common name in each group. A role was assigned to each group member so that they could depend on and promote each other, undertake certain responsibilities and make positive contributions to common objectives of the group.

Teaching contents mainly included shoot with single hand above the shoulder, basketball pass and catching during movement, layup during movement and application of comprehensive technologies of basketball. Let's take the teaching of shoot with single hand above the shoulder for example: in previous conventional teaching method, single progressive teaching process of "explanation, demonstration, practice, error correction, consolidation and application" was generally used. Under cooperative teaching mode, explanation and demonstration were no longer made by teachers alone. Instead, they were performed by group members alternately. Practice and error correction were conducted within group. This method improved the autonomy and consciousness of students in learning. (see Figure 1 and 2)

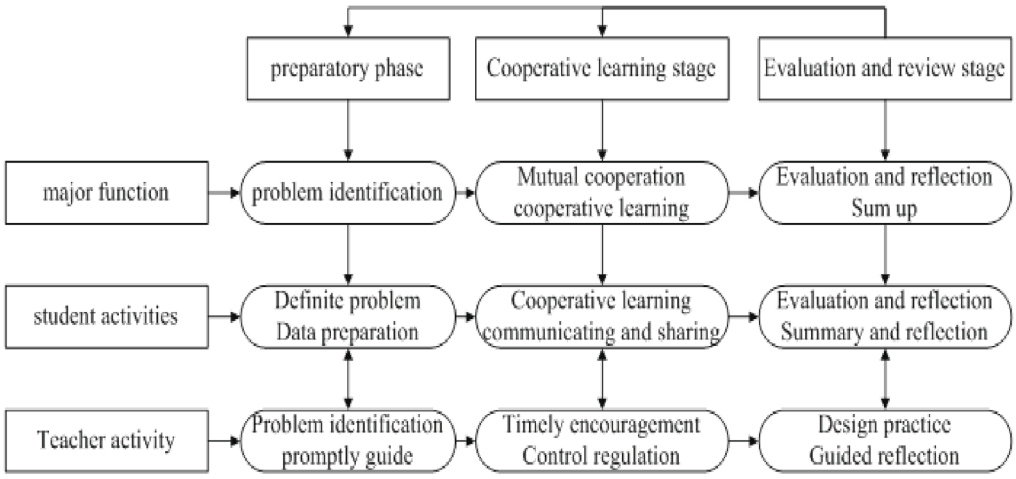

Figure 1. The implementation steps of the cooperative teaching method

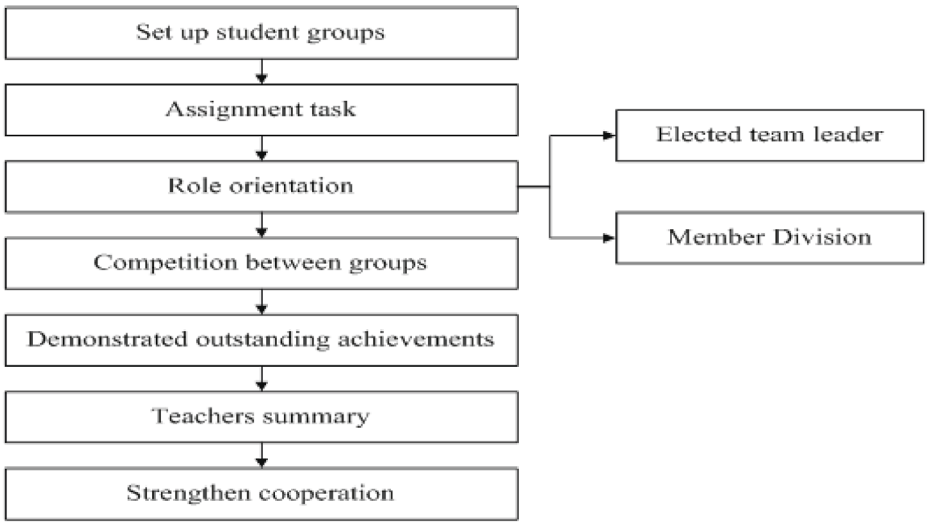

Figure 2. The implementation steps of the cooperative teaching method in the student competition

3.4. Effect evaluation

This experiment mainly selected anxiety, psychological resilience and test score as three indicators for evaluating teaching effects of the application of cooperative teaching method in civil engineering through communication and exchange with relevant teachers and psychological experts in combination with setting requirements of modern cooperative teaching method.

(1) State-Trait Anxiety Inventory (STAI) [12]: STAI prepared by Spielberger et al. was used, including instruction and two scales, involving 40 items in total. The first 20 questions were State Anxiety Inventory (S-AI) and the last 20 questions were Trait Anxiety Inventory (T-AI). Four-point scoring method of Li Kete was used for scoring and each item was scored with 1 to 4 points. The highest score was 80 and the lowest score was 20, respectively reflecting the degree of state or trait anxiety. Lower score represented lower anxiety level. This scale has satisfying consistency, convergence, discrimination and structural performance and can evaluate the anxiety level of a person [13, 14].

(2) Psychological resilience scale [15]: it was prepared jointly by Hu and Gan and composed of target concentration, interpersonal assistance, family support, emotional control and positive cognition, including 27 items. The scale used five-point scoring method with full inconformity to full conformity. Among 27 items, 12 items were subject to reverse scoring. The research proves that the internal consistency coefficient of this scale is 0.83 in retest and it has good reliability and validity [15].

4. Experimental result and analysis

SPSS11.5 software was used for relevant mathematical statistical analysis on questionnaires collected. Statistical methods used include pairing t test and independent sample t test. Experimental results obtained are shown as below.

4.1. Influence of cooperative teaching method on anxiety of college students majoring in civil engineering

In terms of state anxiety dimension, differences of scores of experimental group (60.2±8.7) and control group (69.2±8.8) did not have statistical significance (P=0.392) before intervention. After intervention, state anxiety score of experimental group decreased greatly (54.2±8.1) and differences from that before intervention had statistical significance (P<0.001). State anxiety score of control group decreased slightly after intervention (57.2±9.7), but its differences from that before intervention did not have statistical significance (P=0.142). According to the change of scores of both groups after intervention, the change of score of experimental group was greater than that of control group and their differences had statistical significance (P<0.001). Therefore, cooperative teaching method has the function of improving state anxiety. In terms of trait anxiety dimension, differences in inter-group comparison, intra-group comparison and the change before and after intervention did not have statistical significance (P>0.05), indicating that cooperative teaching method cannot improve trait anxiety. (See table 1)

Table 1. Influence of cooperative teaching method on anxiety of college students majoring in civil engineering

Indicators	Group	Before intervention	After intervention	Intra-group comparison	Comparison of inter-group change before and after intervention
State anxiety	Experimental group	60.2±8.7	54.3±8.1	P<0.001	P<0.001
	Control group	69.2±8.8	57.5±9.7	P=0.142	
Trait anxiety	Experimental group	54.5±8.4	53.2±7.8	P=0.276	P=0.410
	Control group	53.8±8.9	52.2±8.7	P=0.217	

4.2. Influence of cooperative teaching method on psychological resilience of college students majoring in civil engineering

Differences of scores of experimental group (3.51±0.42) and control group (3.48±0.39) in psychological resilience did not have statistical significance (P=0.614) before intervention. After intervention, psychological resilience score of experimental group decreased greatly (3.33±0.37) and differences from that before intervention had statistical significance (P=0.002). Psychological resilience score of control group decreased slightly after intervention (3.45±0.41), but its differences from that before intervention did not have statistical significance (P=0.610). According to the change of scores of both groups after intervention, the change of score of experimental group was greater than that of control group and their differences had statistical significance (P=0.037). Therefore, cooperative teaching method has the function of improving psychological resilience. (See table 2)

Table 2. Influence of cooperative teaching method on psychological resilience of college students majoring in civil engineering

Group	Before intervention	After intervention	Intra-group comparison	Comparison of inter-group change before and after intervention
Experimental group	3.51±0.42	3.33±0.37	P=0.002	P=0.037
Control group	3.48±0.39	3.45±0.41	P=0.610	

4.3. Influence of cooperative teaching method on athletic performance of college students majoring in civil engineering

In terms of theoretical score, the score of experimental group was 84.2±8.2 after intervention, significantly higher than 79.5±8.7 of control group and their differences had statistical significance (P<0.001). In terms of skill performance, the score of experimental group was 82.8±9.2 after intervention, significantly higher than 79.6±8.9 of control group and their differences had statistical significance (P=0.017). (See table 3)

Table 3. Influence of cooperative teaching method on athletic performance

Group	Theoretical score	Skill performance
Experimental group	84.2±8.2	82.8±9.2
Control group	79.5±8.7	79.6±8.9
P	P<0.001	P=0.017

5. Conclusions

According to the experimental result and analysis above, the application of cooperative teaching method in the teaching of civil engineering has good effect. Statistical data of the experiment show that cooperative teaching method has greater influence on college students in three aspects compared to traditional course. (1) In cooperative teaching method, the individuality of students can be considered well. Learning tasks with different complexity are selected for different students according to their practical situation so that students can get a sense of achievement more easily. Such sense of achievement can well reduce students' anxiety in learning. (2) In cooperative teaching method, the autonomy of students in learning is fully exerted and exploratory teaching provides an opportunity and platform for students to discover and solve problems. Students are more willing to face difficulties in problems discovered by themselves and spend time and energy solving problems. This can improve their psychological resilience correspondingly. (3) Compared to traditional educational method, cooperative teaching method has greater influence on college students' awareness of physical exercise. With stronger awareness of physical exercise, students spend more time on physical exercise activities. They can release some negative emotions and fatigue in effective physical exercise. Meanwhile, more attractive parts in PE course can be understood better from a non-professional perspective through interaction among students and between students and teachers in cooperative teaching method. For students, the influence of cooperative teaching method is longer and greater than that of traditional teaching method and their athletic performance can be improved correspondingly.

In conclusion, in teaching process, cooperative teaching method delivers the training of ability and thinking mode and the development of humanistic quality. Their influence on students is long-term and stable. Therefore, it is necessary to apply cooperative teaching method to each discipline effectively in future higher education so as to give play to the effect of cooperative teaching method in civil engineering teaching to the greatest extent.

References

1. Johnson, D.W., Johnson, R.T., Smith, K. (2007) The state of cooperative learning in postsecondary and professional settings. *Educational Psychology Review*, 19(1), p.p.15-29.
2. Wittrock, M.C. (1978) The cognitive movement in instruction. *Educational Psychologist*, 13(1), p.p.15-29.
3. Chen, T.S., Zheng, H., Cheng, C.W., Zhang, H.J. (2000) Discussions on Rationality in Application of PE Teaching Mode. *Fujian Sports Science and Technology*, 18(5), p.p.29-31.
4. Wang, S.T. (2003) Exploration on New PE Teaching Mode. *Journal of Shenyang Institute of Physical Education*, No.4, p.p.19-21.
5. Gillies, R.M., Boyle, M. (2008) Teachers' discourse during cooperative learning and their perceptions of this pedagogical practice. *Teaching and Teacher Education*, 24(5), p.p.1333-1348.
6. Heba, E.L.D., Nouby, A. (2008) Effectiveness of a blended e-learning cooperative approach in an Egyptian teacher education programme. *Computers & Education*, 51(3), p.p.988-1006.
7. Shimazoe, J., Aldrich, H. (2010) Group work can

be gratifying: Understanding & overcoming resistance to cooperative learning. *College Teaching*, 58(2), p.p.52-57.
8. Carlsmith, K.M., Cooper, J. (2002) A persuasive example of collaborative learning. *Teaching of Psychology*, 29(2), p.p.132-135.
9. Sun, Q.Y., and Li, H.L. (2009) Research on Application of Cooperative Learning in Intensive Reading of English Majors. *Journal of Hebei Normal University of Science and Technology (Social Science Edition)*, 8(4), p.p.45-49.
10. Zhao, J.H. (2008) Empirical Study on Small-class Cooperative Learning in College English Reading. *Journal of Chengdu University (Educational Science Edition)*, 22(8), p.p.81-84.
11. Chen, X.D. (2012) Experimental Study on Influence of Cooperative Learning on Achievement Motivation of College Students. *China Journal of Health Psychology*, 20(3), p.p.446-448.
12. Spielberger, C.D. (2010) *State:Trait anxiety inventory*. John Wiley & Sons, Inc.
13. Iwata, N., Mishima, N., Shimizu, T., et al. (1998) Positive and negative affect in the factor structure of the State-Trait Anxiety Inventory for Japanese workers. *Psychological reports*, 82(2), p.p.651-656.
14. Håseth, K., Hagtvet, K.A., Spielberger, C.D. (1990) Psychometric properties and research with the Norwegian state-trait anxiety inventory. *Cross-cultural anxiety*, (4), p.p.169-181.
15. Hu, Y.Q., Gan, Y.Q. (2008) Development and Psychometric Validity of the Resilience Scale for Chinese Adolescents. *Acta Psychologica Sinica*, 40(8), p.p.902-912.