Effects of an Optimization Method to Determine Optimal Complementary Learning Clusters on Iranian EFL Learners' Language Proficiency

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Abstract

Cooperative learning has widely been used as a teaching method in English class around the world, and has attracted worldwide attention for its remarkable achievement. This study was an attempt to investigate the effects of an optimization method named genetic algorithm to determine optimal complementary learning clusters on Iranian EFL learners' English proficiency. The subjects of this mixed method study were 40 male students at intermediate level with the age of 12-17, and the study was done in winter, 2016, in a private language institute in Isfahan, Iran. They were divided in two groups, the experimental group (EG) who were taught cooperative learning with optimal clustering, and the control group (CG) who were thought traditional cooperative learning**.** At the quantitative phase, an Independent Samples T-test was used to compare the means of pre and posttests. The results indicated that, in listening, speaking, and vocabulary, the subjects' performances in EG were significantly better than CG. At the qualitative phase, the findings of the interviews revealed that Iranian EFL learners had positive attitudes towards using cooperative learning in improving their English knowledge. This study could benefit teachers, students, and English private institutes in teaching and learning process. It could also help language designers, policy makers, and administrators employing optimization methods to facilitate teaching English skills, and components.

Keywords: Complementary Learning Clusters, Cooperative Learning, Genetic Algorithm, Language Proficiency, Optimization.

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1. Introduction

The ability to speak in a foreign language is one of the most important skills that should be improved in international settings. It is also one of the most difficult skills to develop to a high level of proficiency. Because speaking has been distinctively important both in first and second/foreign languages, cooperative learning is of great interest in the field of speaking research.

This study was conducted to compare the performances, especially speaking, of Iranian intermediate students who were thought cooperative learning traditionally with those who were taught cooperative learning with optimal clustering. In terms of speaking, however cooperative learning cannot teach the learners how to speak, can encourage and motivate them to communicate carefully and correctly, so an important factor which affects foreign language learning is to provide learners' positive attitudes towards language classes.

According to Slavin (1989), cooperative learning is a learning situation in which students work together in small groups toward a group goal. Johnson and Johnson (1990) define cooperative learning as "the instructional use of small groups so that students work together to maximize their own and one another's learning" (p.69). Slavin (2011) refers to cooperative learning as "instructional methods in which teachers organize students into small groups, which then work together to help one another learn academic content" (p.344).

Learning English language is very important. Therefore, teaching techniques are important, too. Using cooperative learning for language learning is a new interesting technique, which is not known for many English teachers and students in Iran. Khan, Javaid and Farooq (2015) studied cooperative learning and founed that cooperative learning is more effective as a teaching learning technique for overcrowded class of English at elementary level and students in cooperative groups have significant superiority in learning writing (parts of speech and tenses) over students learning writing by traditional method.

An amazing variety of practical problems involving decision making can be directed in the form of a mathematical optimization problem. Genetic algorithm is a probabilistic solving optimization problem which is modeled on a genetic evaluations process in biology and is focused as an effective algorithm to find a global optimum solution for many types of problem (Kumar, Husian, Upreti & Gupta, 2010**)**.

These days, there are a lot of English teacher-centered classes, but not all of them are helping the students. So, this research tried to increase the role of leaner in classes. While free discussion in clusters increases learner's outcome, this study intended to find optimal clusters for improving conversation and their performances in four skills (reading, speaking, writing, and listening), vocabulary, and grammar. By helping students to discuss, teachers can help them develop prior knowledge, and as a result, increase other skills like speaking and listening. The study was an attempt to investigate the effects of cooperation in optimal clusters of intermediate students on English proficiency and also on their attitudes towards using cooperation in English classes. It outlines an alternative solving technique using an optimization method (genetic algorithm) to derive the optimal complementary learning clusters, in which students can both teach and learn from each other. Using cooperative learning in educational environments seems to provide a deeper learning compared to using the traditional techniques for teaching. So, this research tried to examine any difference between EG and CG in oral and written skills, vocabulary, and grammar.

Hence, these students with distinct English competencies and skills were clustered into the same group to teach and learn from each other, exchanging their learning methods and experiences in English speaking, reading, and writing. The concept of complementary learning is based on the idea that teaching is learning. When someone else is teaching, students are taught what they do not know. By teaching, they become aware of the shortcomings of their own knowledge.

2. Literature Review

According to Mabrouk (2007), the term cooperative learning (CL) refers to students working in teams on an assignment or project under conditions in which certain criteria are satisfied. Macpherson (2008) mentioned that cooperative learning is part of a group of teaching/learning techniques where students interact with each other to acquire and practice the elements of a subject and to meet common learning goals. It is much more than just putting students into groups and hoping for the best.

There is wide agreement in the research that cooperative methods can and usually have a positive effect on student achievement as long as both group goals and individual accountability are incorporated into the cooperative methods (Slavin, 1980, 1983). Fellers (1996) explored the

use of cooperative learning teams and identified five key elements of the cooperative learning model. They were positive interdependence, face-to-face primitive interaction, individual accountability, social skills, and cooperative process. Delli (2009) stated that "cooperative learning creates multiple opportunities for comprehensible input and output" (p. 44). Researchers have found several roles for students in cooperative learning. Students also play different roles in cooperative learning such as facilitator, time keeper, checker, encourager, recorder, summarizer, elaborator, and observer in their own groups (Farrell & Jacobs, 2010).

Wang (2011) studied collaborative learning as a new method for improving college students' autonomy in China. The findings showed that collaborative learning increased autonomy, and students learned better than the traditional way. In another study, courses for third-year teacher candidates were conducted by using the student team's achievement division technique for the period of twelve weeks, after which it was described that the technique increased the students' deep learning strategies in comparison to direct teaching approaches (Wyk, 2012). Azmahani, Khairiyah, Amirmudin, and Jamaludin (2013) implemented the cooperative problem-based learning approach to first-year university engineering students for three semesters. They found that this pedagogical approach enhanced students' learning and significantly transformed the lifestyle of the future engineers.

There are also a number of studies on vocabulary, reading, and writing learning via collaborative interaction. For example, Newton (2001) investigated vocabulary learning through communication tasks. One of the options was cooperative learning in pre-task. Students looked for meaning of the words in dictionary corporately. The finding showed that cooperative learning helped to improve vocabulary learning process in pre-task. Another study is done by Huong (2006) in Vietnam. Huong investigated learning vocabulary in collaborative groups at a university. The results showed that learning vocabulary was affected by group work.

Krecic and Grmek (2008) explored grammar and elementary school teachers' perceptions of cooperative learning to assess the value of cluster learning in comparison to individual learning. Their results show that cluster learning enables participants to compare their opinions with those of others, yielding deeper insight.

Momtaz and Garner (2010) investigated the effect of cooperative learning on students' reading comprehension. Cooperative reading had significantly shown higher grades than private reading for all the texts. Rahavard (2010) explored the relationship between cooperative learning strategies and reading comprehension. The findings of this study showed that cooperative groups achieved significantly better results compared to their counterparts in reading comprehension test.

Ahangari and Samadian (2014) stated that nowadays that we consider learners as significant information providers with specific background knowledge, and the effect of socio-cultural factors and interactions in the process of learning, the need for collaboration and cooperation in language classes is undeniable. They concluded that cooperative learning activities improve writing skills in EFL classes.

Wei and Tang (2015) investigated advantages and disadvantages of cooperative learning. According to their research, cooperative learning method had three advantages. They were arousing students' interest in learning English, involving students in cooperating and learning, and fostering students' confidence. They found that cooperative learning had many merits but its drawbacks could not be overlooked. They were diffusing the responsibility, having vague objective, and lacking time for learning individually.

Boyd and Vandenberghe (2009) reported that mathematical optimization has become an important tool in many areas. It is widely used in engineering, in electronic design automation, automatic control systems, and optimal design problems arising in civil, chemical, mechanical, and aerospace engineering. Genetic algorithm is a probabilistic solving optimization problem which is modeled on a genetic evaluations process in biology and is focused as an effective algorithm to find a global optimum solution for many types of problem (Kumar, Husian, Upreti & Gupta, 2010**)**. According to Kumar et al., genetic algorithm is a probabilistic search algorithm based on the mechanics of natural selection and natural genetics.

Wang, Li, and Liao (2011) have used a genetic algorithm to determine optimal complementary learning clusters for ESL in Taiwan. The results showed that students in the optimal clusters have higher performances in the listening, speaking, and reading sections than those in the traditional clusters. Furthermore, some techniques of genetic algorithm have been presented for finding optimal fitness results (Jalali Varnamkhasti & Lee 2012, 2013). In other

research, Jalali and Hassan (2012) proposed an adaptive- learning fuzzy system in genetic algorithm based on gender selection. They indicated that, this method can improve premature convergence of the GA.

Research Questions

1. Does learning in optimal clusters have any effect on Iranian EFL learners' English proficiency in terms of productive and receptive skills?

2. Does learning in optimal clusters have any effect on Iranian EFL learners' English proficiency in terms of vocabulary and grammar sections?

3. What are the attitudes of the students towards the use of cooperative learning to improve English proficiency?

3. Method

In order to study the effect of genetic algorithm (an optimization method) to determine optimal complementary learning clusters on Iranian EFL learners' language proficiency, a mixed method design was used. This study was conducted in two phases: a quantitative phase and a qualitative phase.

In the quantitative phase, the quasi experimental method was used. In the quasi experimental method, there were two homogenous groups of students, one experimental group (EG) which received the treatment and one control group (CG) which received a placebo. Then, statistical procedures were used in order to see to what extent Iranian EFL learners could take the advantages of cooperative learning with an optimization method for clustering.

In the qualitative phase, interviews were used to describe and analyze the results of the subjects' performance in the learning and teaching process. Therefore, the main task of this phase of the study was to gain students' attitudes towards the use of cooperative learning in their learning process, so that their attitudes could help to reach a more comprehensive conclusion and to increase the reliability of the study.

3. 1. Subjects

This study was conducted in a private language institute named Bartar in Isfahan in 2016. The total sample size for this study consisted of two English teachers and 40 English learners. The subjects were assigned into two groups. Experimental group were 20 students and 20 students were in the control group. They were all male students with the age 12-17 at intermediate level. The courses were taught using communicative approach covering four skills, vocabulary, and grammar. In every session, the teacher taught related textbook for seventy minutes, and then the students had discussion about twenty minutes. In the experimental group, the students were clustered based on genetic algorithm. In contrast, the students in the control group were allowed to form their own learning clusters. Both groups had discussions in their clusters.

3. 2. Instruments

The study employed four different instruments were employed to collect the data. They were the genetic algorithm software, pretest, posttest, and the interview. The optimization method that used in this study was genetic algorithm (GA). Order-based GA was adopted as the solving method to determine the optimal complementary learning clusters.

Both the control group and the experimental group took the pretest covering listening (L), speaking (S), reading (R), writing (W), vocabulary (V), and grammar (G). The test consisted of six sections. On the last week of the semester, after implementing the treatments of the study, all the subjects answered the posttest**.** The similar version of pretest with different item arrangement as well as option arrangement was used as posttest to identify learning achievement of the subjects, and to compare the differences in learning improvement of two groups. To evaluate the attitudes of the students towards the use of cooperative learning, a semi-structured interview also conducted.

3. 3. Data Collection Procedure

As mentioned before, this study was designed with subjects at intermediate level. Then the subjects were randomly assigned into two groups, The English scores of the previous semester were applied to the previous students and for new students, their scores on a placement test taken

by the experts were used. GA software was applied to those initial scores to determine optimal clusters.

The data collection procedure was carried out in quantitative and qualitative phases. In the quantitative phase, after grouping procedure, the subjects were pretested in four skills, vocabulary, and grammar. The pretest scores indicated the ability of students' competencies in those six sections. Then, the treatment was applied to the experimental group. At the end of the semester, all the subjects were post tested. In the qualitative phase, interviews were conducted to gain students' attitudes towards the use of cooperative learning in their learning process.

3. 4. Data Analysis Procedure

After the required data were collected, all the data entered into SPSS software. Prior to conducting the study, an Independent Sample T-test was run on the two groups' pretest scores to ensure that the two groups were homogeneous. After the treatment, an Independent Samples T-test was run to compare the two groups' posttest scores to analyze whether the two groups performed significantly different, and if so, which group performed better than the other. For the four skills, vocabulary, and grammar, Independent Samples T-tests were run.

The qualitative analysis of the interview transcripts completed the data and improved the findings of this study. The qualitative data were analyzed by classifying the students' attitudes. In addition, a series of frequency and percentage were performed to analyze the interview as well as to answer the research questions.

4. Results

4. 1. Results of Genetic Algorithm (GA)

First of all, students' initial English scores of experimental group were normalized. This normalization was applied to avoid the various effects of adopting different standards for measuring students' distinctive and distinguished English proficiencies. This normalization obtained by division of every initial score in English proficiency on the maximal score in that English proficiency.

Table 1

Normalization Scores in Different English Proficiency Sections

Student Number	Listening	Grammar	Vocabulary	Reading	Speaking	Writing
1	0.87	0.60	0.60	0.53	0.65	0.80
2	0.80	1.00	0.75	1.00	0.80	0.80
3	1.00	0.87	0.70	0.80	0.70	1.00
4	0.80	0.87	0.65	0.73	0.70	0.67
5	0.40	0.53	0.50	0.27	0.40	0.53
6	0.87	0.80	0.75	0.67	0.75	0.73
7	0.73	0.67	1.00	0.73	0.70	0.67
8	0.67	0.60	0.55	0.47	0.55	0.60
9	0.67	0.80	0.65	0.67	0.65	0.73
10	0.73	0.67	0.65	0.73	0.40	0.67
11	0.87	1.00	0.80	0.87	1.00	0.93
12	1.00	0.87	0.75	0.67	0.75	1.00
13	0.87	0.80	0.70	0.67	0.60	0.80
14	0.67	0.67	0.70	0.73	0.60	0.67
15	1.00	0.93	0.80	1.00	0.85	0.93
16	0.67	0.80	1.00	1.00	0.90	0.87
17	0.47	0.53	0.50	0.40	0.60	0.53
18	0.47	0.47	0.55	0.47	0.60	0.47
19	0.40	0.53	0.60	0.47	0.65	0.40
20	0.40	0.53	0.63	0.40	0.65	0.40

After normalizing students' initial English scores, GA software was applied to determine optimal clusters. Table 2 showed the optimal clusters. These students with distinct English competencies were clustered into the same group to teach and learn from each other.

Table 2
Optimal Clusters for Complementary Learning

Cluster Number	Student Number
1	{ 2, 3, 8, 19 }
2	{ 4, 10, 11, 17 }
3	{ 6, 9, 12, 20 }
4	{ 13, 14, 16, 18}
5	{ 1, 5, 7, 15 }

The data collected from 40 students made the analyses possible. They were assigned into two groups of experimental (EG) and control (CG). To compare subjects in the two groups, independent-samples t-test was carried out twice. The first time, at the very outset of the study, to make sure the control and experimental group subjects were at the same level of English proficiency, and the second time after the completion of the experiment to see whether the treatment, had been effective or not. According to results of the pretest, there was not a statistically significant difference in pretest scores for CG and EG in L, S, R, W, V, and G.

After the treatment, an Independent-Samples T-test was carried out to check the value of p under the Sig. (2-tailed) column.

4. 2. Posttest Results

Table 3

Results of the Independent-Samples T-test for Posttest Scores in L, S, R, W, V, and G

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
L	EVA	3.108	.086	1.975	38	.046	1.700	.861	-.042	3.442
	EVNA			1.975	34.645	.046	1.700	.861	-.048	3.448
S	EVA	.591	.447	2.897	38	.006	2.400	.828	.723	4.077
	EVNA			2.897	37.003	.006	2.400	.828	.721	4.079
R	EVA	4.445	.042	-.743	38	.462	-.600	.808	-2.235	1.035
	EVNA			-.743	31.715	.463	-.600	.808	-2.246	1.046
W	EVA	6.829	.013	.930	38	.358	.650	.699	-.765	2.065
	EVNA			.930	28.486	.360	.650	.699	-.781	2.081
V	EVA	.034	.855	1.981	38	.045	1.650	.833	-.037	3.337
	EVNA			1.981	37.996	.045	1.650	.833	-.037	3.337
G	EVA	24.788	.000	-.227	38	.822	-.150	.660	-1.487	1.187
	EVNA			-.227	24.839	.822	-.150	.660	-1.511	1.211

In Table 3 this test was done for all sections (L, S, R, W, V, and G) in two parts, when equal variances assumed and when equal variances not assumed. According to Table 3, based on Levene's Test and when equal variances assumed, the sig. of listening, speaking, and vocabulary were more than .05. Therefore, sig. (2-tailed) based on t-test for equality of means and when equal

variances assumed, was investigated. They were less than .05, so it indicated that there was a statistically significant difference in posttest scores in listening, speaking, and vocabulary for CG and EG. The sig. of reading, writing, and grammar based on Levene's Test, were less than .05; and sig. (2-tailed) based on t-test were more than .05. Therefore, it implied that there was not a statistically significant difference in posttest scores in reading, writing, and grammar.

These results demonstrated that the students who received optimal clusters showed a significant improvement in the oral skills and vocabulary, but they didn't show a significant improvement in the written skills and grammar over time.

Table 4

Paired Samples T-test for EG and CG

			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
Pair	Group	Pre/Posttest								
1	CG	L	-1.700	1.031	.231	-2.183	-1.217	-7.373	19	.000
	EG		-1.250	1.997	.446	-2.184	-.316	-2.800	19	.011
2	CG	S	-2.500	1.395	.312	-3.153	-1.847	-8.012	19	.000
	EG		-.950	1.605	.359	-1.701	-.199	-2.647	19	.016
3	CG	R	-1.200	1.281	.287	-1.800	-.600	-4.188	19	.000
	EG		-1.350	1.496	.335	-2.050	-.650	-4.034	19	.001
4	CG	W	-.400	.598	.134	-.680	-.120	-2.990	19	.008
	EG		-.250	.910	.204	-.676	.176	-1.228	19	.234
5	CG	V	-2.450	1.050	.235	-2.941	-1.959	-10.434	19	.000
	EG		-.700	1.302	.291	-1.309	-.091	-2.405	19	.027
6	CG	G	-.500	.827	.185	-.887	-.113	-2.703	19	.014
	EG		-.150	1.137	.254	-.682	.382	-.590	19	.562

After the post tests, a Paired Samples T-test was done to determine whether the difference in means between the two sets of related scores (pre and posttest) was significant or not. Table 4 showed the results of the t-test for six pairs of scores. All mean differences were negative that meant, all posttest mean scores were more than pretest mean scores. For EG, in four sections named L, S, R, and V, sig. (2-tailed) was less than .05 that meant there was significant difference between pairs of scores. So the students' learning in L, S, R, and V were developed significantly after the genetic algorithm clustering.

4. 3. Interview Results

Table 5

Results of Interview with the Students

Students' Answer	Frequency	Percentage
Have a Good Sense about Using GA Clustering	9	90%
Usefulness of GA Clustering for Learning	8	80%
Advantages of GA Clustering:		
1. Improvement in Competences	8	80%
2. Lack of Anxiety	7	70%
3. Enjoyable Activity	9	90%
4. Increasing Motivation to Learn Better	6	60%
5. Sharing Knowledge and Interacting	9	90%
6. Fostering Students' Confidence	8	80%

Disadvantages of GA clustering:		
1. Time Consuming	6	60%
2. Having Unclear Objectives	4	40%
3. Lack of Necessary Facilities	3	30%
4. Weak Managing Students and Time	3	30%
Using GA Clustering as a Tool for Communication	7	70%
Factors of Promoting the Use of GA Clustering:		
1. Being Interesting for Students	7	70%
2. Providing Authentic Environment	8	80%

N= 10

At the end of the project, a semi-structured interview consisting of six parts and some subparts was conducted in order to elicit information from the subjects. Ten students voluntarily took part in the interview. The subjects' points of view about the project, the advantages, the disadvantages of cooperative learning, and the effects of cooperative learning on their competences were questioned. Almost all of the students had a positive attitude toward using GA clustering as a tool for communication and reflection in class. Most of the students stated that the use of the GA clustering for cooperative learning would be effective because the environment of GA clustering was more interesting than books. Most of the students believed that cooperative learning had more advantages than disadvantages**.** Most of the students mentioned the factors that promote the use of GA clustering.

5. Conclusion

There was a significant difference between the learners' performance before and after receiving the treatment. In other words, using optimal clusters in cooperative learning had significantly affected the English knowledge of the students.

The findings of the present study demonstrated that cooperative learning through optimal clusters could improve the oral skills and vocabulary of Iranian L2 learners comparing to traditional way of teaching but it couldn't improve the written skills and grammar. In other words, cooperative learning through optimal clusters significantly differs from cooperative learning through traditional clusters. The findings of this study are consistent with those of Lichtenstein (2005) who found that participation in learning communities can improve communication as well as technical content knowledge. These findings are consistent with those of Newton (2001) who found that cooperative learning helped to improve vocabulary learning process in pre-task; and also consistent with those of Huong (2006) who investigated that learning vocabulary was affected by group work.

The descriptive statistics showed that the Iranian EFL learners had positive attitudes towards using cooperative learning in improving their English knowledge. Studying the results of this study and the participants' points of view about cooperative learning, as well as, looking back at the previous literature in the domain of using cooperation in education, it is recognized that cooperative learning can be an effective tool which can motivate students to learning, particularly is suitable for practicing speaking. These findings are consistent with those of Wang (2011) emphasizing that collaborative learning increased autonomy and students learned better than the traditional way. The findings are also in agreement with Wei and Tang (2015) who found advantages and disadvantages of cooperative learning.

A further study can be organized with a larger sample of subjects, with different age levels, with females or both genders, and with different language proficiency levels. In terms of micro level, this study could benefit teachers, students, and English private institutes in teaching and learning process in English language classes. Therefore, in terms of macro level, this study could benefit language designers, policy makers, and administrators to how they can use cooperation to facilitate teaching English skills, and components. It also could help researchers who are willing to conduct a similar study in the future. However the findings of this study are limited to the variables of this study. Further research is needed to confirm findings of this study.

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