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Investigation of the Effect of Collaborative Learning on the Self-confidence in Solving Mathematical Problems

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A B S T R A C T

This research aims to investigate the effect of collaborative learning on the self-confidence in solving mathematical problems. The statistical population consists of all female students of the district one of Bandar Abbas in year 2014-2015. The sample includes 52 students (26 students in control group and 26 ones in test group). The Questionnaire of Self-confidence in Solving Mathematical Problems was applied as the data collection instrument. Quasi-experimental method was applied. Therefore, control and test groups were gathered before intervention of self-confidence-related data. Then, the control group was exposed to traditional method and the test group experienced the intervention of collaborative learning. After the intervention, when the classes were finished, post-intervention date were collected. The data collected in pre-test and post-test stages was statistically analyzed through ANCOVA. Finally, results indicated that collaborative learning has a significant effect on the self-confidence (p=0.001), ability (p=0.001), interest (p=0.001), and persistence (p=0.001) in problem solving, while it has no significant effect on inability to solve problems (p=0.054). Therefore, collaborative learning is a suitable method to improve self-confidence in solving mathematical problems among the students.

Keywords: Learning, Collaborative Learning, Self-Confidence, Problem Solving, Mathematics.

INTRODUCTION

Self-confidence and self-centeredness are two mental conditions in which the person trusts and believes his own talents and skills in successful performance of a task due to his past experiences. Self-confidence is required as the primary motivation to start and continue a task that reminds the person of his ability to do it. Self-confidence is an essential necessity for a calm and stress-free life. It is also defined as an attitude that allows the person to have a real positive viewpoint towards himself, trust his abilities and feel that he can control his own life[1]. Therefore, one of the essential needs of human beings in all stages of their lives, is to have a determined level of self-confidence that makes a person feel valuable and link his performance to a set of consistent and acceptable social references[2].

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The more ones performed task is in accordance with individual and social standards, the more self-confidence felt by him. Although gaining social skills is among the socialization elements in all cultures, it has been considered by scientists during the two or three past decades. Among all different theories in this arena, the social learning theory has been studied more than the others[3].

In collaborative approach, students proceed to learn thorough collaboration and cooperation in groups and they feel responsible about the learning process. They are willing to help their classmates as soon as they need to since others success and failure is theirs as well[4]. This approach leads to a deeper learning and higher creativity and innovation among students. Collaborative learning is applied in a wide range of activities from teaching different subjects to performing research projects[2].

Johnson and Slavin are among those who have supported this method. This method is opposed to the theory of individual competition and learners learns through helping each other in small groups. According to Johnson, when it comes to collaborative learning, graders and university students either swim or drown together. Collaborative learning is strongly and accurately supported, both theoretically and experimentally, either by the behaviorists and other scholars. According to behaviorists, encouraging a group to success is among the main applications of learning and education promotion. According to the social cognitive theory by Bandura, when an atmosphere is provided for students to observe their friends succeeding in their tasks, they would learn so as well and they would be more willing to do their tasks being encouraged by this success[5]. One needs to be able to select, ratiocinate, make decision and solve problem in order to leave well in the modern society. Education is majorly responsible for developing such abilities. According to programmers, mathematics is among the subjects that should be learnt in line with this objective. Learning mathematics is at least expected to raise the power of thinking and creativity. Therefore, this research tries to investigate the effect of collaborative learning on the students' self-confidence in solving mathematical problems.

METHODOLOGY

Depending on the hypotheses, a quasi-experimental research has been performed. The statistical population included all first grade female high school students of the district one of Bandar Abbas (1548 students acceding to then inquiries from the Bandar Abbas Education Administration). Fifty-two students were selected through replication to be applied as the sample to perform this quasi-experimental study with control group. Twenty-six samples were placed in the control group and the other twenty-six were considered as the test group. After proceeding with the required coordination and official affairs to visit the schools to perform this research, the considered questionnaires were provided and the pretest values were calculated for the control and test groups. The same as before, the control group continues to learn mathematics through traditional methods. For the test group, the collaborative learning method was applied. The intervention

(collaborative learning) lasted for eight weeks. After the intervention took place, the questionnaire (Self-confidence in Solving Mathematical Problems) were applied once more.

- (Standard) Questionnaire of Self-confidence in Solving Mathematical Problems:

This questionnaire includes 20 questions with answers ranging within Likert five-point scale. There are five groups of questions:

First group (questions 5, 9, 10, 11, and 12)

Second group (questions 1, 2, 4, 6, 20, 16, and 7)

Third group (questions 3, 8, and 13)

Furth group (questions 14, 15 and 17)

Fifth group (questions 18 and 19)

The first group refers to ability in problem solving. The second group mentions the interest in problem solving. The third group refers to persistence in problem solving. The fourth group mentions the inability in problem solving. The fifth group indicates the inhibition to solve the problem.

Reliability

Cronbach's alpha was applied in pre-test in order to obtain reliability of the questionnaire. Therefore, before the final performance, thirty individuals were randomly selected from the sample. Then the questionnaire was distributed among them and applying the achieved data and using SPSS, the reliability was obtained through Cronbach's alpha. Results are illustrated in table …. As it is observed, Cronbach's alpha is higher than 0.7 which refers to stability and internal consistency of the questionnaire. In order to obtain Cronbach's alpha, the first step is to calculate the variance of the scores in each sub-category of question and the also total variance. Then, the value of Cronbach's alpha was calculated through the following equation.

$$r_{\alpha} = \frac{J}{J-1}\left(1 - \frac{\sum_{j=1}^{n} s_j^2}{S^2}\right)$$

In which J represents the number of the subcategories of questions, S_j^2 is the variance the J^{th} sub-test, and S^2 refers to the total variance of questionnaire.

Table 1. Cronbach's alpha for the self-confidence in solving mathematical problems

number	Group	Cronbach's alpha
1	Control pretest	0.856
2	Test pretest	0.869
3	Control posttest	0.893
4	Test posttest	0.894

Internal consistency reliability: Spit-half coefficient is a significant and well-known method to calculate this type of reliability. In this method, the correlation of internal elements is obtained when the test is applied once. I.e. after the performance of the test, the correlation between the questions indicates the test reliability. Another method to calculate internal consistency reliability is half-split

through separation of odd and even questions. I.e. the correlation between the scores of even questions should be calculated along with odd questions.

In this method, odd questions were considered as one test and even questions formed another. The strong correlation between them indicates that the test is reliable, while their low correlation shows the lack of reliability in the test. The primary and reliability cannot be considered as two separated half tests, because the effect of factors such as practice, tiredness, etc. is not equal among them. For example, in a test with 40 questions, the 20 first questions and the rest 20 cannot be considered as two half tests, instead, they must be split into even questions (2, 4, 6, etc.) and odd questions (1, 3, 5, etc.), the scores would be calculated separately in order to obtain the correlation.

Table 2. The correlation between even and odd questions for ability in problem solving

number	Group	Guttmann Split Half Coefficient
1	Control pretest	0.810
2	Test pretest	0735
3	Control posttest	0.842
4	Test posttest	0.755

An extremely high correlation is observed between odd and even questions. Hypotheses were tested through ANCOVA.

RESULTS

Mean, standard deviation, and the minimum and maximum scores of citizenship skills among the students under pretest and posttest are illustrated in table 4.

Table 4. Mean and standard deviance of the aspects of self-confidence in solving mathematical problems for the whole sample

variable	Number	Minimum	maximum	mean	Standard deviation
Pretest-ability in problem solving	52	8	23	15.21	4.381
Pretest-interest in problem solving	52	13	35	23.02	4.877
Pretest-persistency in problem solving	52	3	15	10.95 7	2.463
Pretest-inability to solve the problem	52	3	15	9.82	3.552
Pretest-inhibition to solve the problem	52	2	10	7.42	1.815
Pretest-self-confidence in problem solving	52	37	89	66.44	10.608
Posttest-ability in problem solving	52	7	22	16.21	3.749
Posttest -interest in problem solving	52	9	32	23.4	4.795
Posttest -persistency in problem solving	52	5	15	11.4	2.483
Posttest -inability to solve the problem	52	3	15	2.725	10.23

Posttest -inhibition to solve the problem	52	2	10	6.91	2.293
Posttest -self-confidence in problem solving	52	31	81	68.17	10.813

According to table 4, findings on the aspects of self-confidence in solving mathematical problems in the whole sample indicate that the pretest mean values of ability, interest, persistency, inability, and inhibition in problem solving are respectively equal to 15.21, 23.02, 10.67, 9.82, and 7.42, while the pretest mean value for the self-confidence in solving the mathematical problem is 66.44. Findings related to the posttest performed on the whole sample indicated that the posttest mean values of ability, interest, persistency, inability, and inhibition in problem solving are respectively equal to 16.21, 23.4, 11.4, 10.23, and 6.91, while the pretest mean value for the self-confidence in solving the mathematical problem is 68.17.

Table5. The results of ANCOVA on the effect of collaborative learning on students' self-confidence in solving mathematical problems

variable	Total sum of squares	Degree of freedom	Mean squares	F	P
Self-confidence in solving mathematical problem	2062.981	1	2062.981	25.379	0.001

Results of ANCOVA illustrated in table 5 indicates that collaborative learning has a significant effect on the self-confidence of students in solving mathematical problems (F=25.379, P=0.001). ANCOVA was applied in order to test the effect of collaborative learning on the ability of students in solving mathematical problems. Results are illustrated in table 6.

Table 6. The results of ANCOVA on the effect of collaborative learning on students' ability in solving mathematical problems

variable	Total sum of squares	Degree of freedom	Mean squares	F	P
Ability in problem solving	280.535	1	280.535	24.096	0.001

Results of ANCOVA illustrated in table 6 indicates that collaborative learning has a significant effect on the ability of students in solving mathematical problems (F=24.096, P=0.001). ANCOVA was applied in order to test the effect of collaborative learning on the interest of students in solving mathematical problems. Results are illustrated in table 7.

Table 7. The results of ANCOVA on the effect of collaborative learning on students' interest in solving mathematical problems

variable	Total sum of squares	Degree of freedom	Mean squares	F	P
Interest in problem solving	315.189	1	315.89	17.212	0.001

Results of ANCOVA illustrated in table 7 indicates that collaborative learning has a significant effect on the interest of students in solving mathematical

problems (F=17.212, P=0.001). ANCOVA was applied in order to test the effect of collaborative learning on the persistency of students in solving mathematical problems. Results are illustrated in table 8.

Table 8. The results of ANCOVA on the effect of collaborative learning on students' persistency in solving mathematical problems

variable	Total sum of squares	Degree of freedom	Mean squares	F	P
persistency in problem solving	34.867	1	34.867	17.212	0.004

Results of ANCOVA illustrated in table 8 indicates that collaborative learning has a significant effect on the persistency of students in solving mathematical problems (F=9.253, P=0.004). ANCOVA was applied in order to test the effect of collaborative learning on inability of students to solve mathematical problems. Results are illustrated in table 9.

Table 9. The results of ANCOVA on the effect of collaborative learning on students' inability to solve mathematical problems

variable	Total sum of squares	Degree of freedom	Mean squares	F	P
Inability to solve problems	20.203	1	20.203	3.909	0.054

Results of ANCOVA illustrated in table 9 indicates that collaborative learning has no significant effect on the inability of students to solve mathematical problems (F=3.909, P=0.054). ANCOVA was applied in order to test the effect of collaborative learning on the inhibitors of students in solving mathematical problems. Results are illustrated in table 10.

Table 10. The results of ANCOVA on the effect of collaborative learning on students' inhibitors to solve mathematical problems

variable	Total sum of squares	Degree of freedom	Mean squares	F	P
Inhibition to solve problems	19.469	1	19.469	6.418	0.01

Results of ANCOVA illustrated in table 10 indicates that collaborative learning has a significant effect on the inhibitors of students to solve mathematical problems (F=9.253, P=0.004).

CONCLUSION

This research aims to investigate the effect of collaborative learning on self-confidence of students in solving mathematical problems in year 2014-2015. Results indicated that collaborative learning can have a role in promotion of students' self-confidence in solving mathematical problems. In fact, findings indicated that collaborative learning can be applied as a suitable method to promote self-confidence in solving mathematical problems, since a significant difference was observed between the control and test groups before and after the intervention of collaborative learning. Therefore, according to the results, collaborative learning has significantly prompted the self-confidence of students in

solving mathematical problems. Dargahi[6] concluded that collaborative learning helps the students to learn their subjects successfully through collaboration and cooperation. Therefore a higher level of success is achieved by the group. When students proceed to solve problems together, they would encounter it more professionally. This also increases their self-confidence.

In fact, through providing a situation for students to work together in academic groups to solve problems and cooperate in learning process, collaborative learning promotes their mental and motivational condition and increase their confidence in learning and problem solving. Dargahi[6] also concluded that collaborative learning causes the students to learn their subjects better through cooperating and helping each other. Thus they achieve a higher level of success when they work in groups. This self-confidence in solving mathematical problem relies on a condition in which students consult and share their knowledge to solve a problem. On the other hand, theorists have agreed that students' knowledge of mathematics is considerably developed when they work in small groups, where they face different viewpoints to solve a single problem. This promotes their perception of mathematics, self-confidence, and self-reliance[7]. In fact, collaborative learning helps the students do the problem solving process together and achieve a common and acceptable answer in a perfect level of self-confidence.

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