

# Comparing the effectiveness of Jigsaw teaching method and Ganieh teaching model on students' academic self-concept and problem solving perception

Mehdi Haghighi-Tabar, Toktam Sadat Jafar Tabatabaee\*, Samane Sadat Jafar Tabatabaee, Mohammad Hassan Ghanifar

*Department of Psychology, Birjand Branch, Islamic Azad University, Birjand, Iran*

*(Communicated by Ehsan Kozegar)*

---

## Abstract

The students of every society are its fundamental assets, and the survival of every society and its status depend more than anything on its students, in this regard, the present study aims to compare the effectiveness of the Jigsaw teaching method and the Ganieh teaching model on self-concept. Academic and problem-solving perception of students was done. The current research is a semi-experimental type with a pre-test and post-test design with a control group. The target population of the present study was formed by the eleventh-grade boys of Birjand in the academic year 2021-2022. 90 male students in the 11th grade of mathematics were randomly selected based on the size of the population and Morgan's table and answered questionnaires on academic self-concept and problem-solving perception. Then, based on the power of the test and the size of the effect, the number of 45 students whose academic self-concept score and problem-solving perception are less than the cutoff score (score 70 and 45), respectively, were selected by the available sampling method and randomly. They were assigned to three experimental groups (15 people using the jigsaw teaching method), the second experimental group (15 people using the teaching method based on the Ganieh model) and the control group (15 people). The results show that the observed difference between the mean scores of self-concept and perception of problem-solving of the participants of the experimental-control groups in terms of group membership in the post-test phase is significant with 95% confidence ( $P < 0.05$ ). The amount of intervention for self-concept is 0.68 and the perception of problem-solving is 0.72. Also, the effectiveness of the jigsaw teaching method and the Ganieh teaching model on academic self-concept and problem-solving perception of students was different, and the difference in averages shows that the jigsaw teaching method is more effective.

Keywords: Jigsaw teaching method, Ganieh teaching model, academic self-concept, problem solving perception  
2020 MSC: 97Cxx

---

## 1 Introduction

Recently, various researchers, while criticizing the current approach of educational systems, considered the link between the emotional and academic functions of students. If academic and emotional functions are paid attention to at the same time in educational planning, it will help to improve the relationship between the learner and the school.

---

\*Corresponding author

*Email addresses:* [m.haghighitabar@gmail.com](mailto:m.haghighitabar@gmail.com) (Mehdi Haghighi-Tabar), [toktamtabatabaee@yahoo.com](mailto:toktamtabatabaee@yahoo.com) (Toktam Sadat Jafar Tabatabaee), [tabatabaee88@yahoo.com](mailto:tabatabaee88@yahoo.com) (Samane Sadat Jafar Tabatabaee), [ghanifar@iaubir.ac.ir](mailto:ghanifar@iaubir.ac.ir) (Mohammad Hassan Ghanifar)

Students in the educational environment. This means that the improvement of academic self-concept among students leads to their academic progress. The academic self-concept of learners is considered an important indicator of the educational process [26].

Self-concept is cognitive generalizations derived from experiences about oneself, and one of its main cores is the relationship with important people in life [27]. Self-concept is a complex and often cognitive structure of person-to-self generalizations that include characteristics, abilities, knowledge, values, attitudes, roles and other issues that define people and continuously integrate their data into it, he knows. Self-concept has three levels, and academic self-concept is a person's belief about the amount of skill involved in studying compared to classmates [13].

According to Pakran's social cognitive model, theoretically, there is a relationship between positive and negative emotions and self-concept, which according to Hansford and Hattie, 1982, there is a positive relationship between general self-concept and academic progress [30]. The student's academic self-concept about having or not having the ability to exercise control over his learning and development activities plays a big role in determining the type of emotions. In fact, if a person has a relatively stable and clear self-concept both in general and in a special dimension such as academic self-concept and achieves a correct understanding of himself, it will eventually lead to better academic performance [34]. As the results of Aghamohammadi et al. [2] indicated the role of academic self-concept in students' academic performance. Herrera et al. [15] also emphasized the role of self-concept in the performance and academic progress of students in research.

When students have a more positive academic self-concept compared to others, this self-concept will lead to their future academic growth and development and the acquisition of skills such as problem-solving skills [39]. In this regard, Atia et al. [5] also showed in research that students' academic self-concept regulates their academic progress and problem-solving skills.

Problem-solving includes a series of behavioural, cognitive and emotional responses that are expressed to adapt to internal and external challenges [17]. Hepner considers problem-solving to include evaluating problems as a challenge, thinking to solve problems, systematic effort, and the need for time to solve problems [9]. The concept of problem-solving is a person's general willingness or readiness to recognize a problem when it occurs in the course of daily life. The perception of problem-solving deals with how much a person is aware of his ability to understand the problem and solve it. The perception of problem-solving is important because it activates other problem-detection schemes in the individual and provides the context for problem-solving [20]. From Hepner's point of view, the perception of problem-solving includes a) self-confidence in problem-solving, b) avoiding the problem and c) personal control in problem-solving [24].

In this regard, cooperative learning is one of the active methods that has attracted the attention of many education experts and is considered a new approach to teaching. Collaborative learning is based on a dynamic and active learning environment where cooperation in learning activities leads to successful learning of students and the learner in this method becomes an active learner, a social learner and a creative learner [25]. One of the forms of collaborative learning that is based on the social psychological analysis of Arnson is the jigsaw method. Jigsaw is a kind of strategy or cooperation strategy that keeps itself away from many problems that may be troubling groups [12]. In this cooperative learning strategy, the walls of traditional teaching methods are removed and the cooperation and cooperation of students with each other is prioritized, at the same time, the competition in the classroom is eliminated and friendship and Afzai take their place [18]. In this model, students are grouped to study a chapter of a textbook, and then each member of the group reads a part of a chapter and is responsible for teaching that part to the other members of their group. That is, they are obliged to teach their learning to other members of the group. Although the results may differ due to the efforts made by the students to learn the material related to themselves, all students with different abilities are given the necessary responsibility. This not only has significant effects on the academic progress of students, but it is also very useful in gaining self-confidence, self-efficacy and more effective presence in class and solving problems [37]; Also, the positive effects of this method on individual attitudes, skills, values and behaviours have been confirmed [33]. For example, the results of Keyhan and Pora's research [19] indicated the effectiveness of the jigsaw teaching method on mathematical self-concept. Hosseini [16] showed in research that the jigsaw teaching method has a significant effect on students' memorization, comprehension and problem-solving. Rahmani Beldaji [29] concluded from his research that the teaching method based on collaborative learning of the jigsaw type is effective on students' academic motivation and sense of belonging to the school.

According to the jigsaw method, students can acquire their skills and information by observing the performance of their peers. In this method, students can find suitable models to model their academic as well as social and moral behaviours in groups that are composed of people similar to themselves but with different performance and academic abilities. In other words, learning the ways of interaction, and talking with peers is also part of the positive

consequences of this method. In this way, by observing models who solve problems in specific ways, students can trust themselves and expand their ability to solve problems; Because according to Bandura's theory, most learning happens through substitution learning [3]. However, for the desired learning in education, it is not possible to act based on trial and error, and it is necessary to proceed based on a logical plan and plan, and in a sense, engage in educational design [36].

Educational design is done on two levels, micro and macro. The micro level includes tactics for teaching a part of the content; But the macro level includes selecting, organizing, combining and summarizing a large chain of content (such as a course) [22]. In this regard, the Ganieh model is one of the system models that can be used both at the micro level and at the macro level. In Ganieh's model, the components of all education are divided into five categories of learning capabilities, and for each of the five capabilities, the existence of two categories of internal and external conditions is necessary. To realize each of the capabilities according to the internal and external conditions, they suggest educational events, which include nine stages: 1) attracting attention, 2) informing the audience about the educational goals, and 3) invoking learning. 4) Providing educational materials 5) Providing learning guides 6) Performance testing 7) Providing feedback related to performance accuracy 8) Performance evaluation 9) Encouraging and facilitating learning recall and transfer [31].

In these stages, using conceptual questions, presenting examples related to the problem, phasing the problem-solving process and also providing homework to internalize the learning and relate the issues to the daily life of the learners can be Students' problem-solving strategies should be effective [36]. Also, stating the objectives of the lessons and using attention in this model seems to be a factor in creating self-confidence in learning for learners and increasing their desire and enthusiasm to participate in learning and on their academic performance be effective [7]. In this regard, the results of Golzari Moghadam, et al. [11] indicated the effectiveness of Ganieh's educational design model on students' academic motivation. Salemian, et al. [36] showed in research that Ganieh's model has a positive effect on problem-solving ability. Ab-Niki [1] concluded from his research that educational design based on Ganieh's model is effective in learning, memorizing and motivating students' academic progress. Hamzai, et al. [14] showed in research that learning based on Ganieh's educational design model is effective in self-regulation and learning skills. The results of the research of De Witte et al. [8] indicated the effectiveness of learning with the help of Ganiye's model on students' mathematical progress. Kultu and Menzi [21] also emphasized the effectiveness of implementing an Internet-based educational model based on Ganieh's educational events model on academic success.

Now, according to the contents of this research, it was tried to compare the effectiveness of the jigsaw teaching method and the Ganieh teaching model on the student's academic self-concept and problem-solving perception.

## 2 Research method

The type of research method is semi-experimental with a pre-test and post-test design with a control group. The target population of the present study was formed by the eleventh-grade boys of Birjand in the academic year 2021-2022. Several 90 male students in the eleventh grade of mathematics in Birjand city were randomly selected based on the size of the population and Morgan's table in the academic year of 2021-2022 and answered the questionnaires of academic self-concept and problem-solving perception. Then, based on the power of the test and the size of the effect, the number of 45 students whose academic self-concept score and problem-solving perception are less than the cutoff score (score 70 and 45), respectively, were selected by the available sampling method and randomly. They were assigned to three experimental groups (15 people using the jigsaw teaching method), the second experimental group (15 people using the teaching method based on the Ganieh model) and the control group (15 people).

The criterion for entering the research is living in the city of Birjand and not being hindered or restricted in participating in educational classes; not using other psychological treatments and interventions; having a minimum grade point average of 16 in mathematics and physics; Having the age of 16 to 18 years and the participants should have a score of academic self-concept and perception of problem-solving lower than the cut-off score (score 70 and 45) respectively. The criterion for leaving the research was the use of other psychological interventions or the absence of more than two.

To measure academic self-concept, Fazli's academic self-concept questionnaire [10] was used, which includes 28 5-choice questions with options (completely true, often true, do not know correctly, often not true, not true at all). The scoring of the questionnaire is based on the Likert scale from 1 (not at all true) to 5 (completely true) and the score will range from 28 to 140. This questionnaire was approved by Fazli [10] and the content validity of this test was confirmed by professors and experts. Cronbach's alpha coefficient was 0.83 for this questionnaire.

Also, Hepner and Peterson's scale was used to measure the perception of problem-solving, which includes 32

statements. The answers to these statements are set on a 6-point Likert scale and range from 1 (completely agree) to 6 (completely disagree). The minimum problem-solving skill score is 32 and the maximum is 192, and a score lower than the average indicates a higher problem-solving ability. This tool includes three components of self-confidence in problem-solving: avoidance approach to the problem and personal control. To determine the scientific validity of the questionnaires, the content validity index (CVI) and content validity coefficient (CVR) were used.

### 2.1 Research implementation method

After the implementation of the pre-test, the educational program of the Jig Saw teaching method was implemented by the researcher for the experimental group. In this way, in the 11th grade of mathematics, students were taught topics based on this in 8 sessions during one month. In the first session, the students were divided into groups of four and one of the students of each group was appointed as the leader of the group (jig-saw group), then the lessons of each session were divided into four groups. Then, each of the students read their respective sections at least twice, in the same way, the materials are distributed among the people of each group. The teacher specified the period for the students to study. After the end of the time, the people of each group who had a common topic gathered around and formed a new group. Again, they shared their knowledge about that subject during the specified time. Finally, each person returns to his group and presents his material to the other members of the group. In this way, the contents were repeated and reviewed three times for each person. For the control group, the traditional teaching method was presented by the 11th-grade mathematics course colleague. Finally, the questionnaire and post-test were implemented. For the other experimental group, an educational program was presented based on Ganieh's educational model, from the first stage, which was attracting attention and acceptance, to the last and ninth stages, which was increasing learning, transfer and generalization. For the control group, training was provided traditionally. After completing the training course, the post-exam was implemented. The data were analyzed.

In this research, hypothesis analysis and testing were also done using multivariate covariance analysis, and in case of differences between groups, post-comparative tests were used. In addition, all stages of describing combining and testing the hypotheses were done using the SPSS-22 software package.

## 3 Results

In this research, out of a total of 45 participants in the current research, most of the students had a GPA between 17 and 20 (48

Table 1: Mean and standard deviation of self-concept scores, problem solving perception in two stages of measurement according to experimental and control groups

Group	Variable	Pre-exam		Post-exam	
		Average	The standard deviation	Average	The standard deviation
Experiment (jigsaw teaching)	Academic self-concept	69.86	4.38	94.86	7.03
	Perception of problem solving	99.39	8.34	61.12	6.16
Experiment (Ganieh's teaching model)	Academic self-concept	68.40	4.17	89.33	6.47
	Perception of problem solving	99.59	8.49	75.20	9.60
Control	Academic self-concept	70.46	3.90	69.47	4.40
	Perception of problem solving	97.26	8.76	94.40	8.73

As can be seen, the average scores of the control group in the post-test compared to the pre-test do not show much difference. However, the self-concept scores in the test groups have increased more in the post-test than in the pre-test. Also, the problem-solving perception scores in the test groups decreased more in the post-test than in the pre-test.

In the Kolmogorow Smirnov statistic, the significant level of academic self-concept is 0.62, self-confidence is 0.37; Avoidance-closeness is 0.41 and personal control is 0.46, which indicates the normality of the data.

Also, in the examination of the statistical assumptions of covariance analysis to check the effectiveness of training, it showed that the test of the equality of the slope of the regression line and the precondition of equality of variances (using Levine's test) is the same for the experimental and control groups (interaction between the experimental conditions and the covariance variable is not significant) and the use of covariance analysis is unimpeded ( $P > 0.05$ ). The significance level of Levin's test was 0.112.

Table 2: Summary of ANCOVA to determine the effectiveness of jigsaw teaching method and Ganieh teaching model on academic self-concept

Sources of changes	SS	df	MS	F	p	$\eta^2$
Pre-test self-concept	34.54	1	34.54	0.93	0.34	0.02
Main work (education)	5377.91	2	2688.96	72.61	0.001	0.68
Residual error	1518.26	41	37.03			

The results show that the observed difference between the average scores of the participants of the experimental and control groups according to group membership in the post-test stage is significant with 95% confidence ( $P < 0.05$ ). The intervention rate is 0.68. To investigate the difference between the mentioned teaching methods, a post hoc test was used:

Table 3: Bonferroni multiple comparison test table

Component	Group 1	Group 2	Average difference	Significance level
Self-concept	Teaching jigsaw	Gani's teaching model	5.21	0.03
		Control	25.53	0.001
Self-concept	Gani's teaching model	Teaching jigsaw	-5.21	0.03
		Control	20.32	0.001

The level of significance in the above table shows that the effectiveness of the jigsaw teaching method and the Ganieh teaching model on students' academic self-concept is different. The difference in the averages also shows that the jigsaw teaching method is more effective.

The results of the covariance analysis assumptions for the effectiveness of the jigsaw teaching method and the Ganieh teaching model on students' problem-solving perception showed that the regression line slope equality test and variance equality precondition (using Levine's test) for the groups The experiment and control are the same (the interaction between the experimental condition and the covariance variable is not significant) and the use of covariance analysis is unimpeded ( $P > 0.05$ ). The significance level reported in Levin's test was 0.25.

Table 4: Summary of ANCOVA to determine the effectiveness of jigsaw teaching method and Ganieh teaching model on problem solving perceptio

Sources of changes	SS	df	MS	F	p	$\eta^2$
Perception of pre-test problem solving	3785.40	1	785.40	15.30	0.001	0.27
Main work (education)	8839.16	2	4419.58	86.11	0.001	0.72
Residual error	2104.32	41	51.32			

The results of covariance analysis show that the observed difference between the average scores of problem-solving perception of the participants of the experimental and control groups according to the group membership in the post-test stage is significant with 95% confidence ( $P < 0.05$ ). The intervention rate is 0.72. To investigate the difference between the mentioned teaching methods, a post hoc test was used:

Table 5: Bonferroni multiple comparison test

Component	Group 1	Group 2	Average difference	Significance level
Perception of problem solving	Teaching jigsaw	Gani's teaching model	-13.96	0.001
		Control	-34.35	0.001
Perception of problem solving	Gani's teaching model	Teaching jigsaw	13.96	0.001
		Control	-20.38	0.001

The level of significance in the above table shows that the effectiveness of the jigsaw teaching method and the Ganieh teaching model on students' problem-solving perception is different. The difference in means also shows that the jigsaw teaching method is more effective. A lower score indicates. The understanding of problem-solving is greater.

## 4 Discussion and conclusion

The results of the covariance analysis of the first hypothesis showed that the effectiveness of the jigsaw teaching method and the Ganieh teaching model on students' academic self-concept is different. Also, the average difference showed that the jigsaw teaching method is more effective.

The results obtained from the present research are in line with the findings of Alipour et al. [4], Keyhan and Pora [19], Azadi Talai, et al. [6], Sadraei and Seprian-Azar [32], Mohammadkhani and Salekhani [23], Taghizadeh and Abdoli Sultan-Ahmadi [38], Hamzai, et al. [14].

The results of Keyhan and Pora's research [19] indicated the effectiveness of the jigsaw teaching method on mathematical self-concept. Azadi Talai, et al. [6], showed in research that the jigsaw teaching method is effective on academic self-efficacy. Self-concept is cognitive generalizations derived from experiences about oneself, and one of its main cores is the relationship with important people in life [27]. Self-concept is a complex and often cognitive structure of person-to-self generalizations that include characteristics, abilities, knowledge, values, attitudes, roles and other issues that define people and continuously integrate their data into it, he knows. Self-concept has three levels, and academic self-concept is a person's belief about the amount of skill involved in studying compared to classmates [13].

As stated, the jigsaw method has been one of the collaborative learning teaching models for nearly three decades, which helps students to do their homework correctly in various dimensions of education, motivation, independence and increasing learning. According to education experts, students who learn through active learning not only learn better but also enjoy learning more. Because instead of being mere listeners, they actively participate in the learning process and consider themselves responsible for their learning, which is considered an effective step in improving their academic self-concept. In other words, jigsaw collaborative learning emphasizes the cooperation of students with each other independently and automatically, students' motivation to participate in solving challenging problems, increasing students' cognitive, metacognitive and motivational skills. Also, compared to the lecture group, these students are better able to plan for their learning and their self-awareness increases, by monitoring their homework and their classmates, they become self-regulating people who have a great motivation for academic progress in they create themselves and in this way, their academic self-concept is also improved [38].

In the further explanation of this hypothesis, it can be said that the cooperative teaching method based on the jigsaw method compared to the Ganieh teaching model, due to the structure of this method and the special rules that govern it, such as running the competition in a healthy and group atmosphere. With the supervision of a specialist (teacher), grouping based on different abilities, speaking and presenting ideas and supervision by individual students in specialized and reference groups in the classroom, the teacher practices according to the lecture and explanation of the relevant specialized topic. Observing justice in the class, respecting the rights of each student, treating them equally, giving them individual and group responsibility, paying attention to positive aspects, abilities and successes and encouraging and confirming them, providing appropriate corrective feedback, Considering the merits and skills of each student alone and comparing each person with himself and..., the possibility of individual success in a group environment is provided without the need to fail others, which can It will show the person's capabilities and increase his academic self-concept more compared to Ganieh's teaching method, and at the same time, it will lead to the growth of self-esteem in all stages of education and learning.

Also, this finding can be investigated from the point of view of social learning. According to the jigsaw teaching method, students can acquire their skills and information by observing the performance of their peers. Students in cooperative learning methods in groups that are formed by people similar to themselves but with different academic performances and abilities can be suitable models for modelling their academic as well as social and moral behaviours. In other words, learning the ways of interaction, and talking with peers is also part of the positive consequences of this method. In this way, students can trust themselves, reduce their anxiety and expand their ability to solve problems by observing models who solve academic problems in specific ways. Because according to Bandura's theory, most of the learning happens through vicarious learning, and this is an effective step in improving their academic self-concept. Therefore, it can be said that the effectiveness of the jigsaw teaching method and the Ganieh teaching model on the academic self-concept of the students is different, and this confirms the results obtained from the present research.

The results of the covariance analysis of the second hypothesis showed that the effectiveness of the jigsaw teaching method and the Ganieh teaching model on students' perception of problem-solving is different. Also, the average difference showed that the jigsaw teaching method is more effective.

The results obtained from the current research are in line with the findings of Golzari Moghadam, et al. [11], Salemian, et al. [36], Hosseini [16], Salemian [35], and Pelobillo [28].

The results of Hosseini's research [16] indicated the effectiveness of the jigsaw teaching method in improving the understanding of problem-solving. Salemian [36] showed in research that Ganieh's model is effective in improving problem-solving. Pelobillo [28] also examined and verified the effectiveness of the jigsaw teaching method in improving the problem-solving dimensions of students in research.

Problem-solving includes a series of behavioural, cognitive and emotional responses that are expressed to adapt to internal and external challenges [17]. Hepner considers problem-solving to include evaluating problems as a challenge, thinking to solve problems, systematic effort, and the need for time to solve problems [9]. The concept of problem-solving is a person's general willingness or readiness to recognize a problem when it occurs in the course of daily life. The perception of problem-solving deals with how much a person is aware of his ability to understand the problem and solve it. The perception of problem-solving is important because it activates other problem-detection schemes in the individual and provides the context for problem-solving [20]. From Heppner's point of view, the perception of problem-solving includes self-confidence in problem-solving, avoidance of closeness to the problem, and personal control in problem-solving [24] and since increasing the perception of problem-solving requires an environment with It has practice, so teaching by jigsaw method can provide such an environment; Because first, the student studies the material individually, in the next stage he presents the learned material in the specialized group and on the other hand, he adds the findings of others to his information and Finally, in his group, he presents the material again; Therefore, as a result of these repetitions and discussions, deep learning is formed in the individual, and it seems that this deep learning leads to mastery of the subject of the lesson and increases the understanding of problem-solving in students [16].

In further explanation, it can be acknowledged that the jigsaw teaching method, compared to the Ganiye teaching model, creates a pleasant atmosphere in the classroom, which makes students more motivated in the activity. Learn to participate, which itself causes meaningful learning in students and increases their understanding of problem-solving.

Compared to Ganiye's teaching model, students in collaborative learning of jigsaw pay attention to issues such as time control, planning how to study, paying attention to the division of time between group members, etc., and these issues of power increase their problem-solving. Also, collaborative learning of Jigsaw emphasizes the cooperation of students with each other independently and automatically, students' motivation to participate in solving challenging problems, increasing students' cognitive, metacognitive and motivational skills. Also, these students are better able to plan for their learning than the Ganieh teaching group, and their self-awareness increases, by monitoring their homework and their classmates, they become self-regulating people who are highly motivated. They create in themselves to solve problems. According to these materials, it is clear that collaborative learning in the jigsaw style is more effective in improving students' understanding of problem-solving compared to Ganieh's teaching model, and this is the same result obtained from the present study.

Although the use of self-reporting tools and the lack of follow-up studies due to time constraints are among the limitations of the current research, but according to the results obtained from the current research, it is suggested that teachers use more cooperative teaching methods. And especially, the jigsaw teaching method compared to the Ganieh teaching model, creates a suitable environment for students' cooperative learning, so that in this way, their academic self-concept and problem-solving perception are strengthened, and the authors and authors of the system's textbooks. It is recommended that educators, knowing the theoretical and scientific foundations of the cooperative learning-teaching approach, pay special attention to these approaches in selecting and organizing learning content.

## References

- [1] M. Ab-Niki, *Comparison of the effectiveness of educational design based on Ganieh and Bayibi model on learning, memorization and motivation of students' academic progress in the subject of human and environment*, Master's thesis, Payam Noor University, 2019.
- [2] M. AghaMohammadi, Z. Esmail-Zadeh, and A. Araghieh, *The relationship between self-concept and academic burnout with the academic performance of Islamshahr University students*, The 4th National Conference of Cognitive Educational Psychology, Tehran, **2018** (2018).
- [3] A. Aghili, *Effectiveness of Jigsaw teaching method on self-efficacy, attitude towards mathematics and mathematical performance of 9th grade students of Mobarake city*, Master's thesis, Payam Noor University, 2018.
- [4] S. Alipour Katigeri, H. Heydari, M. Narimani, and H Davoudi, *Comparison of effectiveness of cooperative teaching method and traditional teaching method on academic enthusiasm, academic self-efficacy and self-regulation in students*, J. Res. Educ. Syst. **3** (2019), no. 5, 23-39.

- [5] N. Atia, S. Ali, S. Sorour, and H. Maqsood, *Effectiveness of social problem solving training program on enhancing self-concept of adolescents in Zagazig city*, *Zagazig Nurs. J.* **14** (2018), no. 1, 171–187.
- [6] B. Azadi Talai, F. Baghernjadian, F. Ayane, and S. Valipour, *Effectiveness of cooperative teaching method on academic self-efficacy in secondary school students of Helilan city*, 3rd Int. Conf. Psycho. Educ. Sci. Soc. Stud., Tehran, 2019.
- [7] H. Dehghanzadeh, H. Dehghanzadeh, M. Shahalizadeh, and H. Rostgarpour, *Comparing the effectiveness of four-component educational design models, Ganiye and conventional methods in students' learning*, *Two-quarterly journal of cognitive strategies in learning*, **8** (2016), no. 5, 93–112.
- [8] K. De Witte, C. Haelermans and N. Rogge, *The effectiveness of a computer assisted math learning program*, *J. Comput. Assisted Learning*, **31** (2015), no. 4, 314–329.
- [9] H. Erkian, *Problem solving skills*, Tehran: Senjesh and Danesh, 2019.
- [10] G.B. Fazli, *Investigating the relationship between self-concept and the popularity of high school students*, Master's Thesis in Counseling, Azad University, 1994.
- [11] N. Golzari Moghadam, V. Mehdi-Nejad and Z. Nik-Manesh, *Comparison of the effect of Ganieh's educational design model and Keller's educational-motivational model on the academic motivation of first-year high school students*, *Sociology of Education*, **3** (2020), no. 2, 143–153.
- [12] V.A. Goodyear and A. Casey, *Innovation with change: Developing a community of practice to help teachers move beyond the 'honeymoon' of pedagogical renovation*, *Education and Sport Pedagogy*, **20** (2015), no. 2, 186–203.
- [13] R. Habibi Kaliber, *The effectiveness of social skills training on students' self-concept and academic performance*, 6th International School Psychology Conference, Tehran, **2019** (2019).
- [14] L. Hamzai, M. Bagheri, and S. Mousavipour, *The effect of mobile learning based on the Ganieh educational design model on students' self-regulation and learning skills*, *New J. Res. Curriculum Planning*, **5** (2016), no. 3, 69–77.
- [15] L. Herrera, M. Al-Lal, and L. Mohamed, *Academic achievement, self-concept, personality and emotional intelligence in primary education. Analysis by gender and cultural group*, *Front. Psychol.* **10** (2020), 3075.
- [16] F. Hosseini, *The effectiveness of jigsaw teaching method on students' memorization, comprehension and problem solving in the science course of the fifth grade of elementary school*, Master's Thesis, Payam Noor University, 2019.
- [17] W. Jin and S. Lee, *Designing in virtual reality: A comparison of problem-solving styles between desktop and VR environments*, *Digital Creat.* **30** (2019), no. 2, 107–126.
- [18] A. Karacop, *The effects of using jigsaw method based on cooperative learning model in the undergraduate science laboratory practices*, *Univer. J. Educ. Res.* **5** (2017), no. 3, 420–434.
- [19] J. Keyhan and M. Pora, *Effectiveness of reverse jigsaw teaching method on mathematical self-concept and mathematical epistemological beliefs*, 6th Int. School Psycho. Conf., Tehran, 2019.
- [20] A. Krishnan and P. Onkar, *Virtual reality references in design problem solving: towards an understanding of affect-cognition interaction in conceptual design*, *Augmen. Real. Virtual Real.* **989** (2019), no. 28, 247–260.
- [21] M.O. Kutlu and N. Menzi, *The effect of implementation of internet based teaching model considers Gagne's instructional events model in information technology course for primary (elementary) education to academic success and retention*, *Int. J. Human. Soc. Sci.* **18** (2013), 3.
- [22] H. Mohagheghi, A. Mohagheghi and M. Afshar, *Investigating the effect of educational software based on the Ganieh and Briggs model on the cognitive levels of learning and attitude in the mathematics lesson of third grade elementary school students*, *Cogn. Strateg. Learn. Bi-Quart.* **15** (2019), no. 8, 129–144.
- [23] M. Mohammadkhani and P. Salekhani, *The effectiveness of Jigsaw teaching method on academic self-efficacy, academic resilience and academic anxiety in male students of the first secondary level*, *First Nat. Conf. New Find. Field Teach. Learn.*, Tehran, 2017.
- [24] H. Moradi and T. Imani, *Resilience, courage and problem solving skills*, Tehran, Mojak Pub., 2019. [In Persian]
- [25] C. Munafò, *Cooperative learning as formative approach in physical education for all*, *Int. J. Sci. Culture Sport* **4**



- (2016), no. 2, 195–205.
- [26] S.M. Najafi and A.M. Rezaei, *Psychometric features of Yesen Chen's academic self-concept scale*, Second Cong. New Find. Field Family Mental Health Disorders Prevent. Educ., Tehran, 2019.
- [27] S. Nolen-Hoeksema, B.L. Fredrickson, G.R. Loftus, and W.A. Wagenaar, *Atkinson and Hilgard's Introduction to Psychology*, Cengage Learning EMEA, 2009.
- [28] G. Pelobillo, *Jigsaw technique in learning physics and problem-solving dimensions of senior high school students*, JPAIR Multidiscip. Res. J. **32** (2018), no. 1, 43–57.
- [29] A. Rahmani Beldaji, *Investigating the effectiveness of the teaching method based on collaborative learning of the jigsaw type on academic motivation and sense of belonging to the school in the sixth grade students of Tehran city in the science course*, Master's Thesis, Payam Noor University, Tehran, 2019.
- [30] S.S. Razavi, *The role of students' self-concept based on personality traits and academic achievement motivation*, 7th Sci. Res. Conf. Dev. Promot. Educ. Sci. Psycho. Iran, Tehran, 2019.
- [31] B. Rittle-Johnson, A.M. Loehr and K. Durkin, *Promoting self-explanation to improve mathematics learning: A meta-analysis and instructional design principles*, ZDM **49** (2017), no. 4, 599–611.
- [32] H. Sadraei and F. Seprian-Azer, *Investigating the effectiveness of Jurchin (Jigsaw) collaborative teaching method on self-efficacy test anxiety and academic adjustment of fourth grade male students*, Teacher's Profess. Dev. Quart. **2** (2019), no. 5, 85–96.
- [33] O. Sagsoz, O. Karatas, V. Turel and M. Yildiz, *Effectiveness of Jigsaw learning compared to lecture-based learning in dental education*, Eur. J. Dental Educ. **21** (2015), no. 1, 28–32.
- [34] A. Salahi and S. Kaousi, *Investigating the relationship between achievement motivation and self-concept with academic performance*, 3rd Conf. Psycho. Knowledge Technol. Educ. Sci. Sociol. Iran, Tehran, 2018.
- [35] F. Salemian, *The effect of using Ganieh's model on external cognitive load and problem solving ability in the first high school mathematics lesson*, Master's Thesis, Allameh Tabatabai University, 2014.
- [36] F. Salemian, H. Abbasi Kahini, and M.H. Amirtimori, *Investigating the effect of using the Ganieh model on the level of external cognitive load and problem solving ability*, Sci. J. Educ. Technol. **1** (2019), no. 15, 10–21.
- [37] S. Shafiei and Z. Sabzianpour, *Comparison of the teaching method based on jigsaw education and common teaching methods on self-discipline of learning, self-efficacy and intelligence beliefs of students*, Nat. Virtual Local. Conf. Updat. Effic. Educ. Manag. Educ. Organ., Tehran, 2019.
- [38] R. Taghizadeh and J. Abdulli Sultan-Ahmadi, *The effectiveness of the jigsaw teaching method on math self-efficacy and math anxiety in statistics and modeling among humanities students of the second year of high school*, J. School Psycho. **2** (2016), no. 6, 7–25.
- [39] Z. Vegharniaragh, *The effectiveness of George Polia's problem solving training on the self-efficacy and mathematical self-concept of elementary school girls in Ardabil city*, Master's Thesis, Mohaghegh Ardabili University, 2015.