Original Research

Structural Equations Modeling of Tendency to Critical Thinking, Problem Solving Skills and Self-Esteem Among Students

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Abstract

Background: The aim of this study was structural equations modeling of Tendency to critical thinking, problem solving skills and self-esteem among female students.

Method: The research method was descriptive-correlation type. 175 female students of sixth grade elementary school in Tehran who were studying at one of the elementary schools in the academic year of 97-96, selected using cluster sampling as a sample group. Data were collected using Cooper Smith's self-esteem questionnaire, Heppner's problem-solving skills questionnaire, and California Critical Thinking Inventory. Data was analyzed using descriptive statistics (mean, variance, standard deviation) and using SPSS 22 software and Amos 23 software were used to investigate structural equations model.

Result: According to the results of structural equations, the direct effect of the problem-solving skills construct on self-esteem was calculated to be 0.410, which means that the problem-solving skills construct can predict students' self-esteem. Also, the tendency to critical thinking directly and indirectly (through problem-solving skills) affects self-esteem. The standardization direct and indirect effects of critical thinking on self-esteem were 0.488 and 0.173 respectively, and its overall effect on self-esteem structure was calculated to be 0.661. These results indicate a significant structural relationship between the tendency to critical thinking and self-esteem and the tendency to critical thinking predict self-esteem. So, students who are more inclined towards critical thinking style have higher self-esteem.

Conclusion: In clarifying the above hypothesis, it can be said that children and adolescents who learn problem-solving skills well are more likely to show a high level of self-esteem because they have more positive concept of themselves, and this causes them to evaluate, understand and accept their limitations and abilities in a more correct way, and finally find their true identity.

Keywords: Tendency to Critical Thinking, Problem Solving Skills, Self-Esteem

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Introduction

Today, despite cultural and lifestyle changes, many people lack the necessary capabilities to deal with everyday life issues and this has made them vulnerable to the life's problems. The art of living is in the ability and skill to solve problems and cope with them. Therefore, people need functions that equip them to

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acquire these abilities in order to cope adaptively with different and conflicting life situations. The turbulent conditions of the time require that individuals have a strong self with a clear cognition of their identity, competence and value.

The loss of cultural values, the lack of valuable role models, and the rapid change in the scene of life have placed human at a dangerous juncture in history. Human, unaware of the nature of himself, neither know who he is nor can trust himself. Stability that cannot be found in the world, it must be created in oneself. Living with lack of self-esteem puts people in a highly unfavorable situation.

Self-esteem is a dimension of personality that empowers individuals and protects them against deficiencies, shortcomings, and social inappropriate behaviors. Having a healthy self-esteem is a basic need that people are constantly striving to achieve. Self-esteem is affected by internal and external factors. Internal factors mean factors that originate from within oneself or are created by the person himself such as perspectives, beliefs, actions or behaviors. External factors are environmental factors: messages that are conveyed verbally and non-verbally and the experiences that our parents, teachers, important people in life, organizers and culture founded them (1). Self-esteem is the feeling of self-satisfaction and self-acceptance that results from self-assessment of being valuable, dignity, attractiveness, competence, efficiency, and ability to solve problems. This feeling arises from the sum of thoughts, feelings and experiences during life (2). According to Carl Rogers, everyone needs self-esteem, regardless of age, gender or cultural background. People who feel good about themselves usually also feel good about life and can confidently face problems and cope with them (3). For man, no value verdict is more important than his judgment of himself, and the person's evaluation of him/herself the is the most definite factor in the process of his mental development, and this evaluation has outstanding effects on the flow of thought, feelings, desires, values, and his goals and is the key to understanding his behavior (2). No one can be indifferent to their own judgments about themselves, and it seems that critical thinking affect how people perceive and judge themselves, and critical thinkers have higher self-esteem. People with the ability to think critically will be able to analyze, evaluate and judge things and have better and more adaptive solutions for their life problems (4).

Critical thinking refers to the ability to analyze, combine, and evaluate information and use it in a timely manner. This type of thinking plays a role as a high level of cognitive ability for individuals in the decision-making process in the areas of personal and social life and is necessary for success in the contemporary world where knowledge is increasing rapidly (5).

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Elder & Paul have introduced critical thinking on two levels of limited and broad meaning. On the limited meaning level, critical thinking is a set of technical skills that is only useful for criticizing opposing views. But in a broad sense meaning, it is investigation of self-centered and society-centered tendencies that are hidden in the heart of ideas. Critical thinking is a process in which the learner goes beyond the level of knowledge acquisition and the is not just the receiver of information. Having critical thinking requires a vigilant personality and decision-making power, which is one of the characteristics of self-esteem (6).

Research shows that high self-esteem is associated with critical thinking (3). Erickson believes that critical thinking, problem solving and intellection abilities are the main goals of upbringing and Lipman, Ennis and Paul believe that the first goal of upbringing should be the growth of rational thinkers (quoted by Abdi, 2014) (7). According to Ivanov et al. (2016), success in any society depends on one's ability to analyze issues and make decisions, and the development of democracy depends on having thinkers who are able to critique and think creatively about issues (8). Critical thinking and problem-solving skills have intertwined relationship because critical thinking takes the form of problem solving or analysis (9).

Problem solving skills are a logical and regular thinking process that helps a person to look for multiple solutions when facing problems and then choose the best one (10). "Problem solving" is a cognitive-behavioral process that is led by the individual and the he/she tries to find effective or adaptive solutions for problems of his daily life. Thus, problem solving is a conscious, logical and purposeful process (11).

Problem solving skills affect a person's sense of self-sufficiency, self-confidence and self-esteem and therefore have a great impact on mental health. This ability enables the person to effectively solve life problems. In a study by Cengiz Sahin and Hatice Kumcagiz in 2017, authors examined the relationship between the level of critical thinking, problem solving and critical thinking tendencies of counseling candidates and a positive relationship was found between critical thinking, problem solving and the level of critical thinking tendencies (12).

In another study in 2016, Malamiri and Shariati investigated the relationship between teachers' critical thinking, self-esteem, and classroom management, and the results showed that these three variables were significantly correlated with each other (13). Also, Soleimanifar, Shabani, Rezaei and Nikobakht in 1397 in a study found a positive relationship between the tendency to critical thinking and self-esteem and self-assertiveness (14). In another study, Shelly Wismath, Doug Orr and Maggie Zhong (2014) claimed the effect of problem-solving skills training on increasing students' self-esteem is positive (15).

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Childhood is an important stage of development and the cornerstone of the identity formation. Proper nurturing of self-esteem in early childhood as well as adolescence can provide a solid and reliable foundation for children in later life in facing with the pressures of peer groups, school, social environment, etc. And give them the opportunity to be able to use appropriate and doctrinaire methods in dealing with various problems (3).

Martin Seligman says that in order for children to feel good about themselves, they must feel that they can do things on their own. Having decision-making power and problem-solving skills, initiative and creativity are related to the degree and manner of self-esteem (Sirostova, Ki Ran and Manisha, 2015) (16). In order for children and adolescents to be able to enjoy their maximum mental capacity and potential abilities, they must have a positive attitude towards themselves. One of the most prominent characteristics of divergent thinkers and creative people is having high self-esteem and a sense of self-worth (Afrooz, quoted by Azizi and Sedaghat, 2017) (17).

reasons of conducting this research were: the importance of the abovementioned and the lack of research in this field for children, as well as the lack of a model that can show the relationship and the contribution of each of these components in the development of self-esteem. Therefore, the present study sought to answer the question of whether a model for predicting self-esteem of female students can be obtained using critical thinking and problem-solving skills.

Method, statistical population, sample and sampling method:

This research sought to discover the prevailing relationships between variables, therefore, the research method was descriptive-correlation. The statistical population of the study was all female students of the sixth grade of elementary school in Tehran in the academic year of 2017-18 and the sample size was calculated 175 people using G-Power software. This number were determined using the cluster sampling. In this way, district one was randomly selected from the twenty districts of Tehran. In the next stage, the list of all public girl's primary schools in district one of Tehran (29 schools) was prepared and then three schools of Narges public primary school, Shahid Soleimani public primary school and Kashefi public primary school were randomly selected.

Data collection method:

After preparing the research questionnaires and determining the sample group and receiving permission from the education authorities of Tehran as well as district one of Tehran and coordinating with the selected schools to participate in this research, the questionnaires were distributed among sixth graders.

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Participants were asked to complete the questionnaires. Necessary assurance was given to participants in this study that the results were confidential.

Data collection tool:

In this study, Coopersmith self-esteem inventory, Heppner Problem Solving inventory and California Critical Thinking skills test were used to collect information.

Coopersmith self-esteem inventory: This questionnaire was developed by coopersmith in 1967 to assess students' worthiness in the social and educational fields and has 58 items.

Reliability:

The reliability of this test has been confirmed by several researches (Coopersmith, 1967 and Campbell, 1990). Also, Pour Shafei (1992) reported the coefficient of 0.83 using split-half method and Falsafinejad (1993) and Golbargi (1994) using the test-retest method reported the reliability coefficient is equal to 0.80. Also Shariat nia, Agha dadashi, Najbaei and Sabet obtained the test reliability of 0.80, 0.79, 0.84 and 0.89 using Cronbach's alpha coefficient (18).

Validity:

The correlation coefficient of the scores of Coopersmith and Eysenck self-esteem scales was 0.79 and it can be said that there is about 63% common variance between the raw scores of these two scales. Factor analysis of this questionnaire showed that it is saturated with five factors (Agha dadashi, 2005). To determine the content validity, the mentioned list was presented to ten psychology professors and they confirmed that the list measures the self-esteem construct. Akbari (1992) research showed that the correlation coefficient between Coopersmith self-esteem test and Alice Pope self-esteem test is 0.65. These results can be considered as convergent validity of Coopersmith self-esteem test (18).

Heppner Problem Solving inventory:

The Problem Solving Skills Questionnaire contains 35 questions based on the 6-point Likert scale. The problem-solving skills questionnaire was designed and tested with several samples of subjects and has a relatively high internal consistency with alpha values between 0.72 to 0.85 in the subscales (PC: 0.72, AA: 0.84 and PSC: 0.85) and 0.90 for the overall scale (Heppner and Petersen, 1982). The validity of the test showed that the instruments measure constructs that are related to personality variables and are significantly at control center (Heppner and Petersen, 1982). Test-retest reliability of the total score of the questionnaire in a two-weeks period has been reported in the range of 0.83 to 0.89, which indicates that the problem solving questionnaire is a reliable tool for measuring problem solving ability.

Reliability:

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This questionnaire, under the guidance of Khosravi, was translated by Rafati and was used for the first time in Iran in 1996 (19). Cronbach's alpha obtained in Khosravi, Darvizeh and Rafati (1998) research is 0.86 and in Bazl (2004) research is 0.66 which is acceptable (20). Also, in the research of Rastgoo et al. (2010), the reliability of this questionnaire based on two performations in two weeks has been reported between 83% to 89% (21).

Validity:

According to the alpha coefficient (85% confidence in problem solving, 84% tendency or avoidance of problem solving activities and 72% control of emotions and personal behavior during problem solving), the factors had optimal and acceptable internal consistency. Due to the fact that the questionnaire was in English, the researcher translated it with the help of a language expert and then corrected it several times with the help of colleagues and performed it among 100 students. Cronbach's alpha coefficient was 80% for confidence in solving the problem, 78% for tendency or avoidance of problem-solving activities and 70% for controlling emotions and behavior while solving a problem.

California Critical Thinking Skill Questionnaire:

Facione, in a two-year effort to obtain an agreed definition of tendency to critical thinking by Delphi method, asked 46 experts in various fields to define it. (22) The questionnaire consists of 75 items, and students mark their agreement or disagreement with the items on a six-point Likert scale. The tool used in this study to measure the tendency to critical thinking is the Persian version California's tendency to critical thinking with eight factors and 26 items. The components of this questionnaire are: truth-seeking, open-mindedness, analyticity, systematicity, confidence in reasoning, inquisitiveness and maturity of judgment. Rani and Cleary (2006) believe that the tendencies to critical thinking inventory benefits both adolescents and adults. This is a up-to-date tool and has good validity and reliability. Its implementation is simple and measures the tendency of critical thinking well (23).

Validity:

Validity answers the question of how well the measurement tool measures the desired trait. This questionnaire was translated by Badri in 2007 and then the translated inventory was given to two professors who graduated from universities in English-speaking countries to translate it into English and the translation was approved with the text. Professors of educational sciences of Tabriz University approved its face validity. The reliability of the translated instrument, for the whole test and for the seven indicators, was calculated 0.7 for 50 students of Educational Science of Tabriz University. Only the reliability coefficient obtained for the self-confidence component

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was equal to 0.56 and the rest of the coefficients were higher than 0.6 (23). In 2008, Badri used factor analysis on the responses of 394 students to evaluate the validity of the above test. High correlation coefficients were obtained between the questionnaire items. After factor analysis, the Varimax orthogonal rotation method was used to achieve a simple factor structure. The number of components increased to 8 and the number of irems decreased to 26. The content validity of this test is based on the consensus of 46 experts on the attitude of critical thinking (24). Since these questionnaires have already been used in studies in Iran and their validity have been determined (Badri, 2008), there was no need to check the content validity and face validity (25).

Reliability:

The reliability of the tool translated by Badri was evaluated in 2008. The internal reliability of the whole questionnaire by Cronbach's alpha method is equal to 0.73. In Reed's (1998) study, the pretest and posttest Cronbach's alpha was 0.9 and 0.92, respectively. Due to the experimental nature of this study, a preliminary study was conducted to determine the reliability of the tests and the reliability of the pilot study for the critical thinking test, which was performed on 55 second grade middle school students, for the whole test by Cronbach's alpha was 0.671 (25).

Data analysis method

Descriptive statistics (mean, variance and standard deviation of data) and inferential statistics (Pearson correlation coefficient) were used to analyze the data. In order to determine the relationship, its type and direction between the research variables, Pearson correlation coefficient and to analyze the data SPSS 22 software were used. To determine which components of the independent variables can best predict the dependent variable and to obtain the causal model, AMOS 23 software was used.

Findings

After collecting all the questionnaires, the items of the questionnaire were scored. Then, the obtained data were entered into SPSS software for entering in AMOS software. The normality of the data was checked in AMOS software by checking the kurtosis and skewness of the data. According to the critical ratios obtained for each variable (C.R <2.58), the hypothesis of abnormal distribution of data was rejected. The general model test includes the test of measurement model and structural model.

The model indices of fit are listed in Table (1):

As can be observed, the above model has all goodness of fit indices.

Table (2) shows the factor loadings and the P-value and beta coefficients. It can be seen that

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all paths of critical thinking tendency to problem solving skills, critical thinking tendency to self-esteem and problem solving skills to self-esteem are significant (all P-value values are less than 0.05). 74% of the variance of overall self-esteem, 26% of the variance of social self-esteem, 15% of the variance of family self-esteem and 5% of the variance of academic self-esteem is explained by the latent variable of self-esteem. Also, 79% of the problem-solving confidence variance, 15% of the tendency-avoidance style, and 40% of the variance of personal control are explained by the latent variable of problem-solving skills. Similarly, 50% of the variance of the tendency to the problem situation, 38% of the variance of regular action, 27% of the variance of self-control, 6% of the variance of truth-seeking and 8% of the variance of maturity of judgment are explained by the latent variable of tendency to critical thinking.

R2 values show that 18% of the variance of the latent variable of problem solving skills is explained by the latent variable of tendency to critical thinking. Also, 58% of the variance of the latent variable of self-esteem is predicted by the latent variables of tendency to critical thinking and problem solving skills.

The direct effect of problem-solving skill construct on self-esteem was calculated to be 0.410, which means that the problem-solving skill construct can predict self-esteem. Also, critical thinking tendency affects self-esteem both directly and indirectly through the mediator role of problem-solving skills. The standardized direct and indirect effects of the critical thinking tendency on self-esteem are 0.488 and 0.173, respectively, and the total effect on the self-esteem construct is 0.661. These results indicate a significant structural relationship between the tendency to critical thinking and self-esteem and critical thinking tendency can predict self-esteem. In other words, students who are more prone to critical thinking style have higher self-esteem.

Model test

The measurement model test in Amos software includes confirmatory analysis. This means how accurately the observed variables measure their intended construct. First, the research questionnaires were confirmatory analyzed and then the whole measuring instrument was confirmatory analyzed. In the confirmatory analysis of the Critical Thinking Skill Questionnaire, the scales of analyticity, inquisitiveness and confidence in reasoning did not have a significant factor loading and were removed from the model. The problem solving skills and self-esteem inventories were also confirmatory analyzed and then the structural model was designed and tested. The optimal structural model is shown in Figure (1).

Discussion and conclusion

The results showed a significant structural relationship between the tendency to critical thinking and problem-solving skills and self-esteem. This means that critical thinking

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tendency and problem-solving skills constructs can predict students' self-esteem. The ability to predict self-esteem through the tendency to critical thinking is consistent with the results of Borzoo Amirpour (26). Predicting self-esteem through problem solving skills is in line with the results of Alavi Ghiri, Moin and Ghaderi (2014) (27) and *Erdal Hamarta* (2009) (28).

In clarifying the above hypothesis, it can be said that children and adolescents who learn problem-solving skills well are more likely to show a high level of self-esteem because they have more positive concept of themselves, and this causes them to evaluate, understand and accept their limitations and abilities in a more correct way, and finally find their true identity. According to the research results, critical thinking tendency can lead to the proper evaluation and understanding of people of their worthiness and self-image (positive self-esteem) as well as the ability to express themselves and their evaluated opinions. Flavell (2012) for the first time introduced a new approach called metacognition, which was based on cognitivism. According to him, metacognition refers to the individual's awareness of his cognition process, his cognitive products and everything else related to it (29). Heppner and Krauskopf (1987) consider problem solving to include a set of behavioral, cognitive, and emotional responses that have been expressed in order to adapt to internal and external challenges. (3) Heppner (1988) suggests there are three structures in the problem-solving process, which are: a sense of competency in problem-solving, personal control over emotions and behaviors, and tendency-avoidance styles (Larson, Pantra, & Vanstedt, 1995, quoted by Amir Hosseini, 2011) (31).

According to Gestalt, self-esteem is achieved according to inner abilities. Proponents of gestaltism consider that paying attention to inner abilities and competencies can lead to cultivate self-esteem. Smith and Vivian Harte also consider enthusiasm for new challenges, independence in action, and decision-making about issues as characteristics of people with high self-esteem. Tendency to critical thinking refers to the constant motivation of people to use critical thinking for problem solving, tendency and confidence in themselves to use this thinking and the degree to which they enjoy it. Critical thinking includes attitudes, mental characteristics and personality traits that affect the way a person approaches a problem situation (Kamali and Khavari, 2011) (32). A person’s tendency to use critical thinking have characteristics which includes: curiosity about a wide range of issues about different worldviews, open-mindedness or intellectualism, analyticity or analytical nature, a systematic inquiry or Systematicity, confidence in Reasoning, eager to seek knowledge or inquisitiveness, Maturity of Judgment. According to *Lumsden*, people with the ability to think critically, will be able to analyze, evaluate and judge matters and they

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will find better and more adaptable solutions for their life problems. *Lumsden* considers having critical thinking skills as a prerequisite for students to solve problems. According to Christopher Winch (2006), critical thinking is the ability to evaluate goals from a different perspective. Before this ability can be used, it must be trained and practiced. The most important element of this thinking is to recognize the ability to evaluate the weaknesses and strengths of some choices and to examine their possible consequences (Kamali and Khavari, 2011).

The ability to think critically is a fundamental way to respond to the moral emphasis on self-respect because this type of thinking teaches how to think, creates the ability to make good decisions and differentiate between information, and is important in promoting human self-esteem. People who develop and apply critical thinking skills are able to think independently, recognize the limitations of their knowledge, and analyze the problem before acting and dealing with issues adaptively. Therefore, it seems that teaching critical thinking and problem-solving skills to students will increase their self-esteem.

The present study, like other researches in the field of humanism, faced limitations that are mentioned in this section: The statistical population of this study was only female students of the sixth grade of elementary school and generalization of the results to boys or other educational grades should be done with caution. The present study was conducted at primary schools level of district one of Tehran, so we should be careful in generalizing the results of this study to other districts of Tehran. Since there are geographical, cultural and economic differences between different regions of the country, one should be careful in generalizing the results of this research to other regions of the country. Also, the findings of the present study are based on self-reporting scales and it is possible that there was a bias in the response. Given the existing theoretical scope, findings and limitations, it is suggested that research be conducted on students of other educational grades, in other areas of Tehran and other cities of the country.

Given that boys did not participate in the present study and the statistical population is limited to girls, it is suggested that the same research be done on boys. According to the obtained result, it seems predicting students' self-esteem through the tendency to critical thinking and problem-solving skills is one of the goals that education department should address and should develop critical thinking ability and problem-solving skills in students. Students' ability to think critically does not develop during their education without the help of teachers and simply by listening to lectures and reading textbooks and taking exams. tight curricula, crowded classrooms, limited classroom time, and accumulated and complex curriculum content hinder efforts to create such learning environments. Therefore, the officials

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and teachers of different educational centers are suggested to provide opportunities for students to practice problem-solving skills and critical thinking methods.

It is also suggested that teachers, in addition to teaching analytical frameworks to students, cultivate interest, curiosity, and truth-seeking in them. With the help of these strategies, teaching critical thinking to students can improve education. Therefore, according to the obtained results, it is suggested that teachers distance themselves from traditional teaching methods and shift classrooms from passive programs and memorizing the contents to critical thinking as a component for facilitating learning so that students are not only passive recipients of information. Finally, the officials and teachers of different educational centers are suggested to take effective measures to increase students' self-esteem by teaching problem-solving skills and a tendency to critical thinking. In the end, all the sixth grade elementary students of Narges and Shahid Soleimani public primary schools in district one of Tehran, who sincerely participated in this research, will be appreciated.

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Conflict of interest

There is no conflict of interest for the authors of this article.

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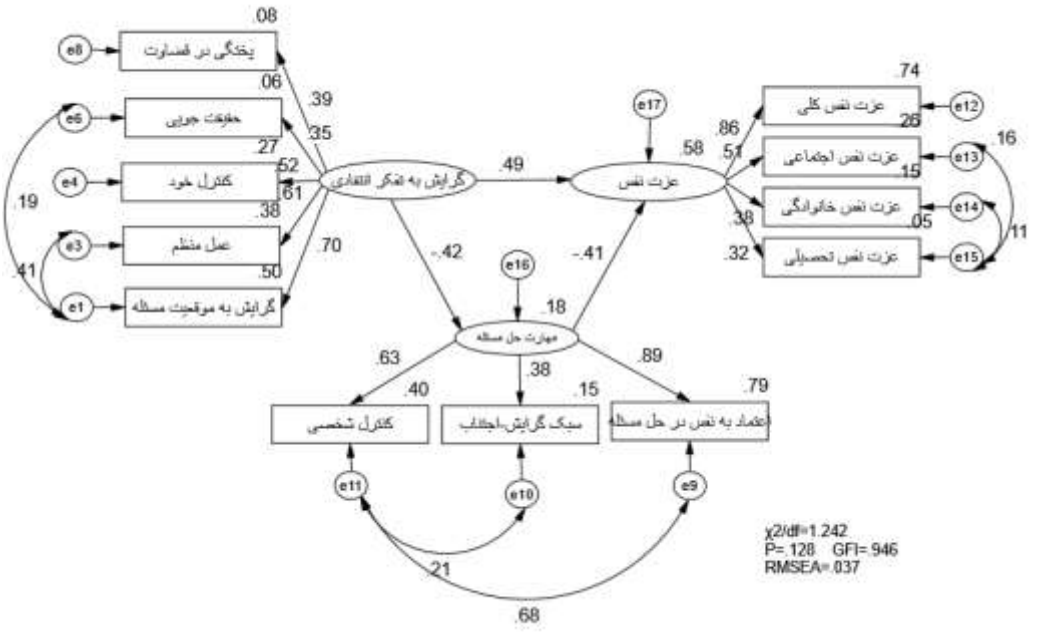

Figure (1). Optimal structural model

Table (1). Optimal structural model fit indices

model	GFI	AGFI	CMIN/DF	RMSEA
Default model	0/946	0/907	1/242	0/037

Table (2). R^2 values, P-value, beta coefficients, standard error of the estimat

			R^2	S.E.	C.R.	P	B
problem solving skill	<---	tendency to critical thinking	0/179	0/207	-3/521	***	-0/423
self-esteem	<---	problem solving skill	0/575	0/082	-2/244	***	-0/410
self-esteem	<---	tendency to critical thinking	.378	0/119	3/181	0/003	0/488
Total self-esteem	<---	self-esteem	0/744				0/863
Social self-esteem	<---	self-esteem	0/263	0/103	5/311	***	0/513
Family self-esteem	<---	self-esteem	0/146	0/052	4/086	***	0/383
Educational self-esteem	<---	self-esteem	0/046	0/040	2/427	0/007	0/315
maturity of judgment	<---	tendency to critical thinking	0/082	0/088	2/749	0/005	0/386

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Truth seeking	<---	tendency to critical thinking	0/064	0/123	2/551	***	0/354
Regular action	<---	tendency to critical thinking	0/377	0/150	4/695	***	0/614
Self-control	<---	tendency to critical thinking	0/273	0/106	4/322	***	0/522
Tendency to problem situation	<---	tendency to critical thinking	0/495				0/704
Confidence in problem solving	<---	problem solving skill	0/794				0/891
Tendency-avoidance style	<---	problem solving skill	0/145	0/172	2/730	***	0/381
Personal control	<---	problem solving skill	0/403	0/138	4/227	***	0/635

β Weights: (Group number 1 - Default model)

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