



Original Article

The impact of successful intelligence on students' critical thinking and tolerance of ambiguity

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Abstract

Introduction: Successful intelligence is the combination of analytical, creative and practical capabilities. This helps individuals to adapt, select and change the environment, in order to achieve their goals in life, regarding to the socio-cultural context. The aim of this study was to determine the effectiveness of successful intelligence on university student, Imam Ja'far Sadeq in Behbahan city.

Materials and Methods: In this descriptive study, using simple random sampling method, 50 students were selected and randomly divided into two groups of 25 patients. They were divided into experimental group and control group. Experimental group were taught by successful intelligence package. Both were measured by Watson-Glaser Critical Thinking and tolerance of ambiguity McLean questionnaires in pre-test and post-test. Multivariate analysis of covariance was used to analyze the data.

Results: Results showed that teaching components of successful intelligence has been able to increase students' critical thinking and tolerance of ambiguity.

Conclusion: Teaching successful intelligence components and teaching based on this approach in the universities of the country, gives new trends in teaching students and students' learning. It also can open new look in issues around.

Keywords: Critical thinking, Intelligence, Students, Tolerance of ambiguity

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Introduction

Today people live in a very complex and dynamic world; a world in which technology, economic and job requirements are evolving and changing continuously. In these circumstances people require to perform their skills well in order to be successful in their lives. Those persons are successful who are able to use analytical, creative and practical thinking abilities to reach success (1). Sternberg's successful intelligence theory is completely different from traditional theories in which the intelligence is introduced as a single structure, sometimes as the g factor or general intelligence, and sometimes with IQ term. Successful intelligence is a combination of analytical, creative, and practical thinking skills that based on the socio-cultural context assists people in adapting, choosing and changing the environment in

order to achieve their life goals. Success is defined only in the person's socio-cultural context. Considering the values accepted by society, success will gained its specific meaning and concept in our social culture i.e., success formed based on a set of values, criteria and expectations of both self and others. The socio-cultural context of Eastern societies, especially our society is different from western societies in terms of pluralism and emphasis on certain religious values.

The combination of three types of analytical, creative, and practical abilities and simultaneously the balance between them will bring people success in life. Analytical ability is used when the person has the power of analysis, evaluation and comparison. In addition, creative ability, one of the high cognitive levels in Bloom's Theory, is used when a person creates, invents or discovers, and finally practical ability emerges when the person moves into action, or applies what he knows or uses what he has learnt. Those persons have successful intelligence that show a balance of these three types of thinking abilities in

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dealing with situations. Unfortunately, in many educational programs, the emphasis is only on the analytical intelligence especially on the low levels, while, far too little attention has been paid to two other aspects of intelligence i.e., creative and practical intelligence which are vital and necessary for success in life or even they are overlooked. Creative and innovative thinking together with problem solving model and conducting research are amongst fundamental skills 21st century students need. The main focus in creative and innovative thinking includes generating original ideas and answering to issues or special situations. This important issue can be learnt through teaching creative thinking to the learners. Unfortunately, in schools, analytical thinking is the most thinking expected of students. But, outside of school and in the real world, creative thinking especially practical thinking is more expected (1).

Thinking is shaped and evolves as the greatest act of human life, but, perhaps it can be said that critical thinking is one of the thinking aspects that everyone can learn during studying time and through education, since it is a kind of solving problem which includes some elements of the analysis and evaluation abilities. Critical thinking is the rational decision making ability about something we should do or believe (2). Furthermore, one of the valuable intellectual abilities learners should acquire in educational centers is to investigate and evaluate hearings and readings, ideas and different beliefs that they encounter in life and make rational decisions on them. Traditional educational systems face limitations regarding critical thinking which is one of the fundamental components of problem solving, learning and careful and strategic decision making in today's world, because traditional educational systems have no capacity for such approaches (3). Successful intelligence components training is an effective and efficient way to foster critical thinking in learners (4), because analytical and creative thinking improvement is amongst effective factors conducive to critical thinking formation. As one of the successful intelligence abilities, creative thinking and critical thinking are related to each other (5). Promoting analytical and creative capability in student teachers can give them a new perspective and improve reasoning power, inventing new solutions for problem solving, correct judging, avoiding one-dimensionalism, investigating the problem from different angles, respecting different viewpoints, and finally critical thinking which is considered as one of the high levels of thinking in student teachers.

Moreover, tolerance of ambiguity is one of the important features which play a main role in the beginning and continuation of risk-takings which lead to success. Tolerance of ambiguity is accepting uncertainty, and the ability to continue life is proposed as a part of life with incomplete knowledge about the environment and the desire to initiate an independent activity, without the person's awareness whether he knows he will succeed or not. A person who has a high tolerance of ambiguity does not feel threatened by problems in adapting himself to the new environment since he has accepted some ambiguity as one of the life principles and knows that our information is never complete for decision making. To put it differently, tolerance of ambiguity means that when a person encountered an uncertain situation and a problem, he does not lose his mental and emotional balance but he recognizes the uncertain situation and finds a solution. Tolerance of ambiguity depends largely on having research morale. A person with research morale is aware that it is natural to have ambiguous intellectual horizons and different questions in the acquiring knowledge process. This awareness leads to an increase in the tolerance ambiguity. Tolerance of ambiguity is one of the personality traits which involved in creativity (6). Sternberg (7), emphasized on persons' five personality traits include tolerance ambiguity, constant perseverance, will, risk-taking and personal independence. Ta'vighi, Kakavand and Hokmi (8) reached to this conclusion in their research that tolerance of ambiguity is one of the most important personality infrastructures, and a person is empowered by problem solving skills training and can cope with problems and difficulties in uncertain and unpredictable situations. In this vein, Zonouzian, Gharaei and yekeh yazdandoost (9) concluded that problem solving training as one of the important techniques of successful intelligence leads to change in contrastive strategies and finally will affect the person's tolerance of ambiguity positively. There is a positive relationship between tolerance of ambiguity and each of the creativity components (innovation, fluency, flexibility and the expansion) (10). The higher the person's tolerance of ambiguity, the more complex situations he likes. Usually persons with low tolerance of ambiguity like simple and directive situations. Simpler situations involve less mental aspects of human. Therefore, person's creativity manifests less. Stoycheva (11) showed that there is a positive relationship between tolerance of ambiguity, motivation and creative performance. In this vein, Kornilova and Kornilov (12) assert that

both intelligence and tolerance of ambiguity can increase creativity. So, making a creative work requires tolerating uncertainty generated all over the creative process.

Successful intelligence components can possibly direct students toward problem analysis and choosing the best solution, presenting innovative and creative solutions as well as learning transfer especially in functional and practical areas. In addition, successful intelligence based training can help learners to develop flexibility in themselves considering new learning methods, occupational nature changing, and changing needs of these jobs and social structure rapid changes by creating a balance between analytical creative and practical capabilities through adaptation, modification and selection. As obtaining higher scores is considered as one of the main objectives of all educational/training centers, this training pattern help training centers develop in students the higher level of performance. Therefore the current study aims at investigating the effects of successful intelligence components training on students' critical thinking and tolerance of ambiguity.

Research objectives: the general aim of the current study is to determine the effectiveness of successful intelligence training on critical thinking and tolerance of ambiguity of male student teachers of Farhangian University, Imam Ja'far al-Sadiq (AS) Higher Education Center, Behbahan.

Materials and Methods

Given the subject of the research and based on the designed purposes the pretest-posttest control group design was used. This sample population consists of male student teachers of Farhangian University, Imam Ja'far al-Sadiq (AS) Higher Education Center, Behbahan city. Using simple random sampling method 50 students were selected from these students and were divided in two groups of experimental and control group through simple random method. The experimental group was trained independent variable.

Research instruments

- *Critical thinking questionnaire:* in order to identify persons' ability in analytical and logical thinking, Watson–Glaser critical thinking standard questionnaire (13) has 80 items, and has been provided in 5 parts and measures 5 components of making inference, recognizing assumptions, making deductions, explaining, interpreting and coming to conclusions, and evaluating logical arguments. The validity of the questionnaire was examined by Watson and Glaser (13) on a sample of 2440 males

and females. Correlation matrix and specific value is reported to be desirable. In addition the divergent and convergent validity between this test and tests with similar structures is desirable. The reliability of the questionnaire was calculated by Watson and Glaser (13) through test-retest reliability method to be 0.85. The reliability (R=0.78) and validity of this test was evaluated as desirable by Javidi, Ja'farAbadi, and A'bdoli (14). Using Kuder–Richardson Formula 20 (KR-20), test re-test reliability was calculated to be 0.82 in the present study. The validity of the questionnaire in the current study is confirmed by confirmatory factor analysis and results are shown in table 1.

Table 1. Indices of confirmatory factor analysis of critical thinking questionnaire

REMSEA	CFI	TLI	IFI	GFI	CIMIN/DF
0.0001	1.12	1.05	0.796	0.993	0.704

Due to low standard load operation (0.018), evaluating logical arguments sub-scale was not confirmed in this statistical sample.

- *Tolerance of ambiguity questionnaire:* McLin (15) devised tolerance of ambiguity questionnaire in 13 items and confirmed the validity of the test. He investigated the correlation between this questionnaire and other convergent questionnaires (0.6 in Budner's16-item scale, 0.71 in Storey and Aldag's 8-items scale, and 0.58 in MacDonald's 20-items scale). Moreover, for 13-items questionnaire he reported a suitably internal reliability of 0.82. Feizi, Mahboubi, Zare' and Mostafaei (16) calculated this questionnaire content validity through construct validity to be 0.48, and calculated the reliability through Cronbach's alpha test to be 0.85. the questionnaire reliability was calculated to be 0.818 using Cronbach's alpha test. the validity of the questionnaire in the current study is confirmed by confirmatory factor analysis and results are shown in table 2.

Table 2. Indices of confirmatory factor analysis of Tolerance of ambiguity questionnaire

REMSEA	CFI	TLI	IFI	GFI	CIMIN/DF
0.05	0.953	0.935	0.955	0.936	1.52

Due to low standard load operation, questionnaire items 10 and 13 were not confirmed in this statistical sample and deleted.

Intervening Method: training intervention includes successful intelligence abilities training based on Sternberg and Grigorenko’s model (17). with the aim of successful intelligence abilities training, this training package includes 3 general debates about analytical, creative and practical skills for high school and university students. Each debate in this training package includes a number of training sessions; in the following a summary of the sessions is presented.

1st-7th sessions: Analytical ability training includes problems identification, resources recognition, information organizing, choosing solution, monitoring and evaluation.

8th-14th sessions: Creative ability training includes re-introducing the problem, questioning the methods, presenting creative work and the power and ability to defend it, stimulating ideas, multi-dimensional viewing, organizing ideas and questioning the situation.

15th-22th sessions: Practical ability training includes self motivating skills, controlling impulses, persevering- not preserving, applying abilities correctly, acting based on a design, focusing on the final result, personal problems management, determining responsibility and self-pity controlling.

Results

To test research hypotheses multivariate analysis of covariance (MANCOVA) was used. In order to

make sure that this research data met the underlying assumptions of MANCOVA analysis for investigating the first and second hypotheses, they were investigated. To do this, the assumption of homogeneity of variances was tested. Levene's test was used to verify the assumption of that equal variances or homogeneity of variance. The results of this test is presented in table 3.

Table 3. Levene's Test of equality of error variances

Dependent Variable	F	DF1	DF2	Sig
Critical thinking	0.166	1	45	0.686
Tolerance of ambiguity	0.029	1	45	0.865

Box measure obtained from Box test was not meaningful at 0.229 level, therefore the assumption of homogeneity of variance-covariance matrices met to implement (MANCOVA). In addition, the assumption of homogeneity of regression slopes was met. The research main hypotheses findings (the effectiveness of successful intelligence training on students’ critical thinking and tolerance of ambiguity) are presented in table 4.

Table 4. Multivariate tests on critical thinking and tolerance of ambiguity

Effect	Value	Hypothesis df	Error df	F	Sig	Partial Eta Squared
Pillai's Trace	0.261	2	42	7.40	0.002	0.261
Wilks' Lambda	0.739	2	42	7.40	0.002	0.261
Hotelling's Trace	0.353	2	42	7.40	0.002	0.261
Roy's Largest Root	0.353	2	42	7.40	0.002	0.261

As shown in table 4. The significant level of all tests indicate that at least in terms of one of the dependent variables (critical thinking and tolerance of ambiguity) there is a meaningful difference between experimental and control group (F=7.40

and P<0.002). To identify this difference a one-way analysis of variance (ANOVA) was conducted in the context of MANCOVA on dependent variables, results are presented in table 5.

Table 5. Tests of between-subjects effects

Dependent Variable	Type III Sum of Squares	df	Mean Square	f	Sig	Partial Eta Squared
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Critical thinking	80.84	1	80.84	5.614	0.022	0.115
Tolerance of ambiguity	326.51	1	326.51	8.075	0.007	0.158

As shown in table 5 there is a significant difference between control group and experimental group in terms of critical thinking variable ($F=5.614$ and $P<0.022$). Therefore, the first hypothesis indicating that successful intelligence components training (analytical, creative and practical) causes an increase in the students' critical thinking is supported. Moreover, there is a significant difference between control group and experimental group in terms of tolerance of ambiguity variable

($F=8.075$ and $P<0.007$). Therefore, the second hypothesis indicating that successful intelligence components training (analytical, creative and practical) causes an increase in students' tolerance of ambiguity is confirmed.

Multivariate analysis of covariance (MANCOVA) was used to test the critical thinking sub-hypotheses. After testing and confirming the multivariate analysis of covariance presuppositions, results presented in table 6 and 7.

Table 6. Multivariate tests on critical thinking sub-hypotheses

Effect	Value	Hypothesis df	Error df	F	Sig	Partial Eta Squared
Pillai's Trace	0.304	4	38	4.155	0.007	0.304
Wilks' Lambda	0.696	4	38	4.155	0.007	0.304
Hotelling's Trace	0.437	4	38	4.155	0.007	0.304
Roy's Largest Root	0.437	4	38	4.155	0.007	0.304

As shown in table 6, all tests significant levels indicate that there is a significant difference between control group and experimental group at least in terms of one of the critical thinking subscales

($F=4.155$ and $P<0.007$). To find out this difference, a one-way analysis of variance (ANOVA) was conducted in the context of MANCOVA, results presented in table 7.

Table 7. Tests of between-subjects effects

Dependent Variable	Type III Sum of Squares	df	Mean Square	f	Sig	Partial Eta Squared
inference	0.340	1	0.340	.108	0.744	0.003
identifying assumptions	15.23	1	15.23	12.93	0.001	0.240
deduction	0.132	1	0.132	.064	0.802	0.002
interpretation	31.7	1	31.7	9.079	0.004	0.181

As shown in table 7, there is no significant difference between control group and experimental group regarding inference subscale ($F=0.108$ and $P<0.744$). Therefore, the first sub-hypothesis indicating that successful intelligence components training (analytical, creative and practical) has a positive and meaningful effect on inference subscales, is not confirmed. In addition there is a significant difference between control group and

experimental group regarding identifying assumptions subscale ($F=12.93$ and $P<0.001$). thus, the second sub-hypotheses indicating that successful intelligence components training (analytical, creative and practical) has a positive and meaningful effect on identifying assumptions subscales is confirmed. According to table 7, there is no significant difference between control group and experimental group in terms of deduction subscale

($F=0.064$ and $P<0.802$). Therefore the third sub-hypothesis indicating that successful intelligence components training (analytical, creative and practical) has a positive and meaningful effect on deduction subscales is not supported. Moreover, there is a significant difference between control group and experimental group in terms of explanation and interpretation subscale. So, the fourth sub-hypothesis indicating that successful intelligence components training (analytical, creative and practical) has a positive and meaningful effect on interpretation and explanation subscales is confirmed.

Discussion

Education systems increasingly tend to pay attention to memory abilities and partially to analytical abilities, they overlook learners' creative and practical abilities a lot, therefore they are unable to take advantage of the maximum ability of students. The best way to achieve this important and fundamental goal is to create an extended domain of skills; so that allow students compete with other students by different patterns of abilities, discover their important and prominent abilities and master in them. In fact, this can be created through successful intelligence components training and fostering the three analytical, creative, and practical abilities in learners (18).

Considering this research hypotheses, successful intelligence training can foster critical thinking and tolerance of ambiguity in students which is consistent with results of different researches (4,5,8,9). Successful intelligence training could affect positively the assumption identification and explaining and interpreting subscales in this research. Analytical ability training and critical thinking growth allow for analysis, comparison and evaluation in students in different situations and lead to the critical thinking growth which is of professional qualification requirements in many jobs and even social life. This training was unable to improve inference and deduction -two other subscales of critical thinking- perhaps this is due to the more complexities of these two subscales which require more skills of analytical capability. Traditional educational systems face limitations regarding critical thinking which is an essential component of problem solving, because traditional educational systems have no capacity for such approaches (3). It seems that successful intelligence components training is an effective and efficient way to foster critical thinking in learners, because analytical and creative thinking improvement is

amongst effective factors conducive to critical thinking formation. Promoting analytical and creative capability in students can give them a new perspective and improve reasoning power, inventing solutions for solving new problem, correct judging, avoiding one-dimensionalism, investigating the problem from different angles, respecting different viewpoints, and finally critical thinking which is considered as one of the high levels of thinking in students.

It seems that there are relationships between problem solving which is one of the successful intelligence analytical ability techniques and tolerance of ambiguity. The successful intelligence components training has been able to improve tolerance of ambiguity in students (8). The problem identification and problem statement stage is one of the important stages of problem solving. The given problem should be investigated from different angles in this stage. Everyone who defines the problem should write all data, facts, feelings, guesses, beliefs and questions related to the problem situation. The correct definition of the problem from different angles helps us reach the answer. The four decision making styles are directive, analytical, conceptual and behavioral; the tolerance of ambiguity in persons who use analytical style is higher than those who employ directive style. They need a great deal of data before decision making; analytical decision makers are characterized for being careful decision makers who are able to adapt to unique situations (19). Often a cursory look at a problem fails to provide us with a successful answer. Therefore we should have a deep look. Those who have a higher tolerance of ambiguity can put together better data, facts, feelings, guesses, beliefs and questions related to the problem situation and solve the problem. In addition, researches show that creativity and tolerance of ambiguity are closely related to each other (20), therefore, the higher the tolerance of ambiguity the more the persons tend to create. Thus, creative ability training can pave the way for creating tolerance of ambiguity feature in students. The higher the person's tolerance of ambiguity, the more complex situations he likes. Usually persons with low tolerance of ambiguity like simple and directive situations. Simpler situations involve less mental aspects of human.

Conclusion

In the present study seems add critical thinking skills to be successful intelligence training textbook the other sub-scales on promoting critical thinking, have a positive effect which unfortunately did not

happen in this research. The results of this study will lead University administrators which teaching Successful intelligence components and teaching based on this approach in the universities of the

country, gives new trends in teaching students and students' learning. It also can open new look in issues around.

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