

Original Article

The relationship between critical thinking and learning styles and creativity among high school students in Ahvaz

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Abstract

Background: Creativity is a person's ability to create ideas and insights in science and other fields, learning critical thinking includes the development of thought processes beyond self-centered attitudes and perceptions and immediate sensory experience. The purpose of this study was to look at the straightforward and complex connections between students' critical thinking, learning preferences, and creative thinking at Ahvaz High School.

Methods: The survey covered every high school student enrolled in the 2018–2019 academic year in Ahvaz's District 2, which totaled 2000 individuals. 280 of whom were chosen at random in many stages to form the sample. The Kolb Learning Styles Questionnaire, the Abedi Creativity Test, and the California Critical Thinking Test were among the instruments used to collect data. Multiple regression analysis and the Pearson correlation coefficient were utilized for data analysis.

Results: Critical thinking, thoughtful observation, active exploration, and creativity were all significantly correlated. However, there was no significant relationship between concrete experience and abstract conceptualization and creativity in the subjects. Also, based on the results of regression analysis, among the predictor variables, critical thinking and reflective observation, respectively, were the best predictors for students' creativity.

Conclusion: It seems that the educational and lesson planning of students should be reviewed and teachers should revise their teaching methods and use active teaching methods to encourage them to critical learning styles in students and promote creativity.

Keywords: Creativity; Learning; Students; Thinking.

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Introduction

The results of most international studies suggest that only a few high school and university graduates are able to apply high-level thinking skills in the face of everyday life problems. Most students face various problems in identifying problems from different perspectives, recognizing facts and evaluating the consequences of decisions made. Lack of competence in this regard

creates many problems (1). Creativity is one's ability in generation of ideas, insights, new and original objects and reconstruction. Creativity in the Guilford model has dimensions such as problem sensitivity, new ideas, flexibility, analysis, complexity and evaluation (2). Cropley (3) and Sternberg (4) argue that creativity combines the power of initiative, flexibility, and sensitivity to theories that enable the

learner to think of different and generative results outside of usual thinking (5). One of the important variables related to creativity is critical thinking. Dewey, the father of the tradition of modern critical thinking, considers it a careful examination of any belief with hypothetical knowledge based on supportive reasons and the results obtained (6).

One of the prominent characteristics of creative people is having critical thinking (7). Kletke et al., argue that creativity guides the process of construction and generation and the critique of the evaluation and judgment process (5). Thus, it can be said that the critical component is concerned with creativity. Belin emphasizes that creativity is the presentation of better solutions, and this requires critical judgment (8). Liua & Pásztor, argues that the separation of critical thinking and creativity is wrong, and views this separation as oversimplification (7).

Another important variable is learning styles, which indicates how a student learns and likes to learn, and how an instructor teaches to take the first step successfully in identifying and guiding the students' needs (9). Some educational psychologists, including Woolfolk (10) and Bandura (11) coined the term self-centered learning, which states that we should educate students in such a way that they can form their own basic knowledge independently and without dependence on others (12). Since students who will be the nation's future leaders and managers place a high value on critical thinking, learning styles, and creativity, the current study aims to address the crucial question of whether there is a relationship between these factors and creativity among Ahvaz high school students.

Methods

Study design

The present study was a correlational-predictive (regression) study.

Statistical population and sample

The study population included all high school students in the two districts of Ahvaz, which consisted of 2000 people. The sample of this study consists of 250 students. The sample size was determined using Krejcie & Morgan, table and by using multi-stage random sampling (13). Then, among the female and male secondary schools in District 2 of Ahvaz 2, 4 schools and 4 classes from each school were randomly selected and a total of 250 people were selected for research. It should be noted that 250 people fully answered the research questionnaires and finally the information about these people was analyzed.

Measurement tools

In this study, three questionnaires were used to obtain research data.

1- Abedi Creativity Measurement Test: Abedi created this exam in Tehran in 2002 using Torrance's theory of creativity. It was administered to 650 middle school students in Tehran who were in their third year of middle school (14). The redesigned test was initially reported by O'Neil et al. after undergoing many revisions. There are 60 multiple-choice questions in this exam, divided into four subtests: fluidity, expansion, initiative, and adaptability. A score of one denotes high creativity, while the other selections represent low, moderate, and high degrees of originality. The subject's overall score for creativity is determined by adding the scores from all four subtests, and the subject's total score for each subtest indicates the subject's score in that part. Within the range of 60 to 180 is the total originality score for each topic. Of the questions, twenty-two deal with fluidity, eleven with growth, sixteen with initiative, and eleven with flexibility (15). In 1993, the initial form of this test was performed by Abedi, on 650 third-grade middle school students in Tehran. The reliability coefficients of fluidity, initiative, flexibility and expansion components

through retest were obtained at 0.85, 0.84, 0.84, and 0.80, respectively. By employing Cronbach's alpha approach in the current investigation, the reliability of this scale was found to be 0.74 (16).

2- California Critical Thinking Test (Form B) (CCTST): The California Critical Thinking Skills Test (Form B) was one of the questionnaires utilized in this investigation. In 50 minutes, participants will complete 34 4- to 5-choice questions covering five critical thinking cognitive ability domains (analogy, induction, assessment, analysis, and inference), each with one right answer. The primary questions take the form of narrative fragments or unique analytical scenarios, for which the participants must choose the most accurate response by looking over the theories and assessing the circumstances. There are four possibilities in 20 questions, and there are five options in 14 questions. Developed by Feldhusen & Clinkenbeard, this questionnaire is one of the most useful instruments available for evaluating critical thinking abilities. Some questions have been adjusted as a result of cultural adaptation following its translation into Persian (17). Daemi & Moghimi Barforoosh have looked at the test's validity and reliability. As a consequence, Richardson's Kuder technique was used to determine the test's reliability. Factor analysis was then used to determine the construct validity of the test, and the results showed that it is composed of five factors: analysis, inference, evaluation, inductive reasoning, and deductive reasoning. The overall test result showed a strong and positive association with all five parameters. Using the Cronbach's alpha approach, the reliability of this scale in the current investigation was found to be 0.82 (18).

3- Learning Styles Questionnaire: In this study, Learning Styles Questionnaire was used using the Kolb, Learning Style Questionnaire. This list is a self-report scale that consists of 12 four-part questions, each

of which assesses one of four types of learning styles. The scale of this questionnaire was of the Likert type (1-4), in which a score of 4 indicates that the learning style fully corresponds to the suggested answer and a score of 1 indicates learning style lowly corresponds to the suggested answer. Four scores are generated from the total of these twelve questionnaire items, with a minimum of 12 and a maximum of 48 possible. The first option in each question is the concrete experience learning style, the second option is reflective observation learning style, the third option is the conceptualization learning style, and the fourth option is the active experimentation learning style. Kolb, conducted a study in 1985 and described the reliability coefficient of his learning style questionnaire as follows: the alpha coefficient for concrete experience, reflective comprehension, abstract concept, active experimentation, and concrete experiment, abstract conceptualization, reflective-observational and active experimentation at 0.82, 0.73, 0.83, 0.78, 0.88, and 0.87, respectively (19). The findings of this study showed that the utilized questionnaire had good validity (20). Additionally, the content validity of this test was tested in the research done by Boles et al. For tangible experience, reflective observation, conceptualization, and active experimentation, the reliability of this scale in the current study was determined using the Cronbach's alpha technique. The results were 0.67, 0.74, 0.73, and 0.84, respectively.

Analysis methods

In order to accomplish the study goals and validate or refute the research theories, descriptive statistical techniques, including frequency, percentage, mean, and standard deviation, were applied. The reliability coefficients were then determined using statistical techniques such as regression analysis, Cronbach's alpha, and the Pearson correlation coefficient. The study data was analyzed using SPSS-25 software. In this

investigation, the significance threshold was set at 0.05.

Results

Demographic information of the respondents is as follows. There are a total of 112 (44.8%) female sample members and only 138 (55.2%) of the sample members are male. Also, the total number of subjects is 250.

Table 1 presents the descriptive results for the sample of respondents pertaining to the factors of the current investigation. Table 1 shows that critical thinking has a mean of 16.58 and a standard deviation of 6.39, respectively. The tangible experience's mean is 31.1, and its standard deviation is 0.7. The reflected observation's mean and standard deviation are 30.25 and 7.44, respectively. In terms of abstract conceptualizing, the mean is 30.26 and the standard deviation is 6.19. In terms of active experimentation, the mean and standard deviation are 28.38 and 6.43, respectively, while in terms of

Table 1. Mean, standard deviation, maximum and minimum scores

| Indicator / variable | mean | SD | Min | Max |
|----------------------------|--------|-------|-----|-----|
| Critical Thinking | 16.58 | 6.39 | 2 | 34 |
| concrete experience | 31.1 | 0.7 | 20 | 47 |
| Reflective observation | 30.25 | 7.44 | 16 | 46 |
| Abstract conceptualization | 30.26 | 6.19 | 16 | 45 |
| Active experimentation | 28.38 | 6.43 | 12 | 45 |
| Creativity | 137.99 | 20.66 | 70 | 179 |

Table 2 shows the average, standard deviation, and highest and lowest scores of participants for the research variables according to gender.

| Indicator / variable | | mean | SD | Min | Max |
|----------------------------|--------|--------|-------|-----|-----|
| Critical Thinking | female | 16.57 | 6.44 | 2 | 33 |
| | male | 16.59 | 6.37 | 3 | 34 |
| concrete experience | female | 31.26 | 6.77 | 20 | 47 |
| | male | 30.99 | 7.21 | 20 | 47 |
| Reflective observation | female | 29.9 | 7.82 | 13 | 46 |
| | male | 30.54 | 7.14 | 16 | 46 |
| Abstract conceptualization | female | 30.78 | 6.19 | 18 | 45 |
| | male | 29.58 | 6.18 | 17 | 44 |
| Active experimentation | female | 28.06 | 6.75 | 12 | 45 |
| | male | 28.64 | 6.17 | 12 | 45 |
| Creativity | female | 137.59 | 21.05 | 70 | 179 |
| | male | 138.31 | 20.4 | 81 | 177 |

they are 137.9 and 20.66, respectively.

Table 3. Correlation coefficient between critical thinking and learning styles and creativity in the subjects

| Criterion variable / predictor variable | Creativity | | |
|---|------------|-----|-------|
| | r | N | P |
| Critical Thinking | 0.521 | 250 | 0.001 |
| concrete experience | 0.004 | 250 | 0.95 |
| Reflective observation | 0.238 | 250 | 0.001 |
| Abstract conceptualization | 0.075 | 250 | 0.23 |
| Active experimentation | 0.208 | 250 | 0.001 |

The research variables depending on gender are presented in Table 2, together with the subjects' mean, standard deviation, maximum, and minimum scores.

The correlation coefficient between critical thinking, learning style, and creativity in the topics is displayed in Table 3.

Table 4 data indicates that there is a substantial positive correlation ($r = 0.52$) between the individuals' critical thinking and creativity, which is supported at the significance level of $P < 0.05$. The respondents' active experimenting and creativity have a significant association ($r = 0.208$), while their tangible experience and creativity do not have a significant relationship ($r = 0.004$). Also, there is no significant relationship between abstract conceptualization and creativity in the subjects ($r = 0.075$).

Table 4. Results of multiple regression analysis for the interaction of critical thinking and learning styles and creativity in students with simultaneous enter method

| Model | SS | df | MS | F | P | MR | R ² |
|------------|---------|-----|---------|-------|-------|-------|----------------|
| Regression | 3228.6 | 8 | 8157.15 | 27.12 | 0.001 | 0.554 | 0.307 |
| Residual | 73680.3 | 311 | 300.73 | | | | |

The findings of multiple regression analysis for the relationship between students' critical thinking, learning styles, and creativity while using the simultaneous entry approach are displayed in Table 4.

Table 5 data indicates that MR = 0.554 is the multiple correlation coefficient for the linear combination of predictor factors with creativity. As a result, at the p<0.05 level,

Hypothesis 6 is validated. The predictor factors account for around 31% of the variation associated with the creativity variable. It is also possible to see the beta coefficients associated with each of the predictor variables and their importance, which indicates that the beta coefficient for the tangible experience is non-significant and the beta coefficient for the other variables is substantial.

Table 5. Summary of regression model and statistical characteristics by simultaneous regression method

| Predictor variables | B | Beta | t | P |
|--------------------------------|-------|-------|-------|-------|
| X1- Critical thinking | 1.58 | 0.49 | 9.06 | 0.001 |
| X2- Concrete experience | 0.34 | 0.116 | 1.86 | 0.063 |
| X3= Reflective observation | -0.45 | -0.17 | -2.93 | 0.001 |
| X4= Abstract conceptualization | 0.48 | 0.146 | 2.45 | 0.001 |
| X5= active experimentation | 0.63 | 0.199 | 3.24 | 0.001 |
| - constant number | 68.25 | - | - | - |

Additionally, the stepwise regression approach was employed to find an appropriate prediction equation utilizing the smallest set of the strongest combination of predictor variables. The findings of a multiple regression analysis

pertaining to the relationship between students' critical thinking, learning styles, and creativity when utilizing the stepwise approach are displayed in Table 6.

Table 6. Multiple correlation coefficients related to the interaction of critical thinking and learning styles with creativity in students using the Stepwise method.

| Statistical index | Regression coefficients (β) | | F ratio P probability | Constant value (a) | |
|------------------------|-----------------------------|-------|--------------------------|---|---|
| | MR | RS | | 1 | 2 |
| Critical thinking | 0.521 | 0.271 | F=62.42 p<0.001 | B=1.68 β=0.521 t=9.61 P=0.001 | - 110.06 |
| Reflective observation | 0.549 | 0.301 | F=53.16 p<0.001 | B=1.61 β=0.498 t=9.28 P= 0.001 | B=-0.48 β=-0.173 t=-3.22 P=0.001 |

As shown in Table 6, according to the results of stepwise regression analysis, among the predictor variables, critical thinking and reflective observation are the best predictors for students' creativity, respectively, and a prediction equation can be obtained by combining 2 predictor variables, based on which the multiple correlation coefficient for the linear combination of predictor variables is $MR = 0.549$ and $RS = 0.301$, which is significant at the level of $p < 0.001$.

Therefore, it can be said that the combination of two variables of critical thinking and reflective observation can explain 30% of the variance of students' creativity. The following equation may be used to predict students' creativity score (y') based on the scores of critical thinking variables and learning styles (X), as shown by the column of non-standard coefficients (B) and constant number via hierarchical technique:

$$y' = 68.25 + 1.25(X_1) + 0.34(X_2) - 0.45(X_3) + 0.48(X_4) + 0.63(X_5)$$

According to the column of non-standard coefficients (B) and constant number by stepwise method, students' creativity score (y') can be predicted from the scores of critical thinking and reflective observation (X) by using the following prediction equation:

$$y' = 125.81 + 1.61(X_1) - 0.48(X_2)$$

Discussion

There is a strong and positive correlation between critical thinking and creativity in the subjects, according to the current study, which looked into the simple and multiple relationships between learning styles, creativity, and critical thinking among high school students in Ahvaz ($r = 0.52$). This study's findings align with those of research by Ashouri (21), Mohammadi et al. (22), Kadayifcia et al. (23), Hove (24), and Alias & Hadi (25). In light of this, it is possible to interpret the study's finding by saying that critical thinking and creativity are

significantly correlated. It implies that as individuals become more critical thinkers, they will be more creative. In both creativity and critical thinking, we are dealing with a process, not an outcome. In this process, we challenge previous assumptions and knowledge and retest existing information to present a new solution that is not always the best possible solution and needs to be evaluated.

The capacity to generate several types of potential solutions from given knowledge through the development of concepts that prioritize fluency, flexibility, novelty, and detail is known as creative thinking capabilities. In the modern world, creativity is an essential ability, and education is giving it the attention it deserves. Pupils that possess strong creative thinking abilities will be adaptable, able to recognize possibilities and overcome obstacles in a world that is changing quickly. Proficiency in creative thinking is a fundamental competency required for 21st-century education.

Creativity is the systematic and thoughtful generating new ideas, concepts and perceptions of values, and this can only be achieved by re-examining and evaluating existing ideas and concepts. Since creativity and critical thinking intersect, it follows that the development of one will always lead to the development of the other. Furthermore, there is no significant correlation ($r = 0.004$) between the individuals' inventiveness and their tangible experience. The findings of this investigation align with those of research projects carried out by Hessaker (29) and Demirbas & Demirkan (28) as well as by Mohammadi et al. (22) and Sepehrian Azar & Eghbali (27). Therefore, in explaining this result of the study, it can be said that there is no significant relationship between the concrete experience learning style and creativity in students.

People with this learning style learn from first-hand experiences and enjoy running a map and engaging in challenging tasks.

They have ability to do things and to plan and adapt immediately to requirements and conditions, so they focus on tendency to concrete experience, engage with immediate experiences and behaviors in human situations. Emotion is viewed as the opposite point of thinking. There is also a significant negative relationship between the reflective observation and creativity in the subjects ($r = -0.238$). Thus, in explaining this result of study, it can be said that a student who has a reflective observation learning style is less creative. At this stage of the learning cycle, the person is more likely to perceive ideas and situations from different perspectives. In this situation, the person learning relies on patience, objectivity, and precise judgment, but does not necessarily take action and he or she refers to thoughts and theories to form his or her ideas.

Also, there is no significant relationship between abstract conceptualization method and creativity in the subjects ($r = 0.075$). Therefore, in explaining this result of study, it can be said that there is no significant relationship between abstract conceptualization learning style and creativity. In this stage of learning, more logic and thought are used to understand issues and situations than emotion. People who have this learning style have a high ability to acquire and understand extensive information and combine it in an accurate, concise and logical way. People who use this learning style focus on using logic, ideas, and concepts. They emphasize thought to create emotion, and comprehensive theories. These people enjoy regular programming and manipulation of abstract symbols and their quantitative analysis, and attach great value to the accuracy and method of analyzing ideas and the aesthetic quality and conceptual system. However, no such relationship was found in this study. The findings indicate a strong correlation ($r = 0.208$) between the subjects' active experimenting and creativity.

According to Muhlisin, critical thinking is a rapid process that involves formulating an idea, putting it into practice, analyzing it, synthesizing it, and assessing data gleaned from reflections, experience, and observation. Students who have the ability to think creatively will succeed both academically and socially. Students who possess creative thinking abilities will think clearly and profoundly, be more engaged in a task, choose the best course of action, and become smarter. A variety of educational resources, including curricula, learning environments, learning models and tactics, instructional media, and societal and governmental support, can enhance students' capacity for creative thought. The reason for students' poor critical thinking skills might also be attributed to their rare or nonexistent exposure to educational programs that enhance their creative thinking abilities. Instructors have to be able to integrate training to improve their pupils' capacity for creative thought into their lesson plans (30).

Thus, in explaining this result of study, it can be said that with increasing active experimentation learning style in students, they will be more creative. Learning at this stage takes an active form, that is, it takes the form of experimentation and changing situations. At this stage of learning, the person will have an active approach and a real interest in working rather than just observing a situation. People with this learning style have the greatest ability in the practical application of ideas and theories. According to the findings, $MR = 0.555$ is the multiple correlation coefficient for the linear combination of predictor factors and creativity. As a result, the predictor factors account for around 31% of the variation in the creativity variable. It is also possible to see the beta coefficient associated with each of the predictor factors and their significance, which indicates that the beta coefficient is significant for certain variables but non-significant for concrete experience style.

Additionally, stepwise regression analysis findings show that the two predictor factors that may be used in conjunction to predict students' creativity are critical thinking and reflective observation, which are the best indicators of students' creativity among the predictor variables. In light of this, the multiple correlation coefficient for the predictor variables' linear combination is $MR = 0.549$ and $RS = 0.301$, both of which are significant at the $P < 0.001$ level. It follows that critical thinking and reflective observation style together account for thirty percent of the variation in students' creative output.

Therefore, in explaining this result of study, it can be said that among the predictor variables, critical thinking and reflective observation style, respectively, are the best predictors for students' creativity. Creativity gives a person the high power of action to make the most of the available facilities. People who have this ability can perform better than those who do not have this ability in an equal situation. Creativity enables people with this ability to make the most of available resources, enhance their learning and, consequently, their performance, and achieve a higher level of academic achievement. Critical thinking supports and follows creativity, since when the focus on creativity increases, critical thinking will evaluate the ideas. It can be done by limiting the focus to a list of ideas and identifying the most rational ideas. Encouraging students to think critically includes helping them to distinguish between theory and reality, evaluate evidence, and avoid superficial and irrational thinking and creativity.

Recommendations

Since the results of the present study were obtained for high school students in Ahvaz, a survey research to assess the overall state of creativity in students seems necessary. Also, it is recommended that school administrators pay much attention to teaching methods and holding educational seminars on critical thinking and students'

learning styles due to their significant relationship with increasing students' creativity. It is also recommended that counseling centers, schools and parents have more interaction and cooperation to control critical thinking and learning styles so that young people improve their creativity in addition to learning.

Limitation

Among the limitations of this study is that the study is limited to a specific age group with a specific educational situation. The present study was conducted with only 225 participants. In addition, the participating students could not be divided into age groups, because although the students were of the same age, their personal and family circumstances were different.

Conclusion

Paying attention to the thinking and learning styles in schools, where provide specialized training to students, can make it possible for teachings to be combined with abilities and grow creativity. Based on the results of this research, it seems that the educational planning and curriculum of students should be reviewed and teachers should reconsider their teaching methods and use active teaching methods to encourage them for critical learning styles in students and use it to increase their creativity, since, as expected, students who have more tendency to critical thinking and learning styles were more creative.

Author's contribution

Abbas Rohani developed the study concept and design. Abbas Rohani acquired the data. Abbas Rohani analyzed and interpreted the data, and wrote the first draft of the manuscript. All authors contributed to the intellectual content, manuscript editing and read and approved the final manuscript.

Informed consent

Questionnaires were filled with the participants' satisfaction and written

consent was obtained from the participants in this study.

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Conflict of interest

The authors declare that they have no conflict of interests.

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