Clinical Cancer Investigation Journal-ISSN: 2278-0513

The Relationship between Handedness with Cognitive Styles and Creativity Among high school students in Ghorveh city

Abstract

The current study sets out to examine the connection between handedness and cognitive styles (field-dependent and field-independent), and creativity in guidance school students in Qorveh County. In terms of goal and methodology, the research is applied and uses a correlational approach. The study's population consists of all male first-year high school students in Qorveh City during the second semester of the 2007–2008 academic year, which, according to the announcement of the Education and Training Department of Qorveh, amounted to 830 students. The sample size was determined to be 220 using Cochran's formula. In this study, multi-stage cluster sampling was used to choose samples from the population. For data analysis, the research used the structural equation modeling (SEM) methodology. Participants were asked to complete the Chapman Dominance Hand Test, the Embedded Figures Test, and Abedi's Creativity Test. SmartPLS software was used for data analysis. The findings showed that handedness has a substantial direct impact on cognitive styles, cognitive styles have a substantial direct impact on creativity, and handedness has a substantial direct impact on creativity.

Keywords: *Handedness, Cognitive Styles, Creativity, Guidance School Students, Qorveh County*

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Introduction

We have all encountered individuals who perform certain tasks with their right hand, some activities with their left hand, and others with both hands. In recent years, researchers in the field of neuro-psychology have been intrigued by this phenomenon, leading to extensive investigations. Neuropsychology is an interdisciplinary approach that studies the relationship between brain function and behavioral and higher mental processes (Kolb & Whishaw, 2009). Neuro-psychologists use specific techniques to study brain-behavior relationships in normative individuals, referred to as Lateral Studies. In these studies, information reaches one hemisphere faster through direct pathways, and small differences in accuracy and processing speed in the two hemispheres are measured. Another method used in lateralization studies is the examination of the phenomenon of handedness (Alipour, 2008). Left-handed people exhibit creative artistic skills such as musical abilities, whereas right-handed people perform better in mathematics, according to Shirouni et al. (2008). Barnett & Corballis (2002) demonstrated that left-handed individuals engage in more creative activities. McCrae (2010) and Khosravizadeh and Teimourzadeh (2010) also suggest that right-handed individuals tend towards convergent thinking, while left-handed individuals lean more towards divergent thinking.

Alipour and Akhoundi (2011) demonstrated in their research that left-handed students scored higher in judicial thinking style and overall thinking style compared to right-handed students. However, right-handed students scored higher in executive thinking style and partial thinking style. Left-handed participants exhibited a right visual field bias in Shafiei and Ali-pour's (2011) study, which examined the effect of handedness on emotional face processing lateralization. They perceived emotionally presented faces in the right visual field significantly faster than in the left. Significantly, this tendency applied to agitated faces. Right-handed participants did not exhibit any discernible effects from emotional face processing lateralization. Significant differences were found between left-handed and right-handed people in overall intelligence, verbal intelligence, and many verbal intelligence subscales (information, numerical comprehension, and subject comprehension), according to Alipour and Saleh Mirhoseini (2011). Left-handed individuals scored higher overall and in verbal intelligence than right-handed individuals in this study. Another research effort studied the connection between family handedness and mental rotation ability; the findings showed that family handedness had a major impact on mental rotation ability. Furthermore, there was a substantial variation in the impact of familial handedness (depending on gender) on mental rotation ability (Alipour & Baghban Parshokouhi, 2008). Alipour and Mardanirad (2012) demonstrated that the majority of left-handed participants rotate towards the right, while the majority of right-handed individuals rotate towards the left, indicating a significant difference in handedness and rotation.

Numerous studies show that children with autism have better levels of creative ability and visual-spatial skills than children in the general population, as well as a higher incidence of left-handedness. A case study by Selva (1997) mentions a girl with autism named Nadia, who is also left-handed. At the age of 3.5, Nadia demonstrated beautifully detailed and delicate drawings. When she underwent treatment, her skills experienced some decline and impairment, but it is unclear whether this decline

is due to continued treatment or a result of her natural maturation. Morfit & Weekes (2001) showed that autoimmune diseases are more prevalent in left-handers, and left-handers with a minimum of one autoimmune illness exhibit greater severity of left-handedness compared to those without autoimmune diseases. Crow (1996) states that individuals with psychiatric disorders are more likely to be left-handed or ambidextrous compared to normal individuals and non-psychiatric patients. Dual-handed and left-handed children are more likely to develop psychiatric disorders in the future, and asymmetry in the gyrus area is related to left-handedness (Shapleske, 1999). Pore (1997) examined the relationship between traits of borderline personality disorder and handedness in a non-clinical sample of students. The data showed that individuals who scored higher on the borderline personality disorder questionnaire had a higher degree of non-right-handedness. There is a significant correlation between handedness preference and borderline personality disorder, as well as cognitive and perceptual impairments.

Faustman (1991) investigated the responses of 48 male schizophrenic patients using the Luria-Nebraska Neuropsychological Battery. He compared the responses of 24 left-handed patients with 24 right-handed patients and included a control group consisting of 15 left-handed and 15 right-handed individuals (matched for age and education). The results indicated that left-handed patients exhibited weaker responses in some components of the test, which are more sensitive to cognitive deficits, compared to right-handed patients and the control group. Haken et al. (1971) declared that there is substantial evidence suggesting that left-handedness is more common among children with intellectual disabilities and neurological disorders (Kiani, 2001).

Moreover, if there is a congruence between an individual's cognitive style, handedness, and creativity, it is likely to contribute to their progress and assist them in solving visual-spatial problems. According to Ant's theory (1992, 2002), tasks involving spatial and verbal skills exhibit different relationships with handedness. Individuals with left-handed dominance patterns tend to perform better in spatial and visual tasks, while those with right-handed dominance patterns excel in verbal tasks. Researchers posit that the direct relationship between the right hemisphere and spatial-visual tasks results in different organizational structures in the brains of right-handed and left-handed individuals (Peters, Reimers & Manning, 2006). The GBG model, in medical investigations, has gathered empirical evidence supporting this theory. For instance, Fasmer (2007) reported a positive correlation between left-handedness and mild migraine. It has also been observed that left-handedness in hand and eye dominance is more prevalent in children with autism (Springer, 1998). Various studies confirm the relationship between elevated levels of androgenic hormones during prenatal periods and enhanced performance in visual-spatial problem-solving, as seen in the research by Anders and Hampson (2005) and the results of Resnik and colleagues (1986), aligning with the hypothesis of the impact of androgenic hormones on spatial problem-solving skills during fetal development. Krommydas and colleagues (2004) demonstrated that fetal sensitivity to testosterone increases the likelihood of concurrent left-handedness and bronchial asthma. Shimoda and colleagues (2008) concluded that there are significant differences in visual-spatial cognitive functions related to lateralization between right-handed and left-handed individuals. Thomas Reio and colleagues (2004), who investigated the relationship between handedness and six different types of visual-spatial skills, showed that, overall, left-handers outperformed right-handers. Parsons (2004), in a study on sexual differences in mental rotation and spatial abilities, demonstrated that girls and boys differ in pencil-and-paper tests. Norouzian (2007), in a study on university entrance exam volunteers over five years (1993 to 1998), revealed that left-handers had a higher chance of acceptance in mathematical fields, and this probability was higher for boys than girls.

The results of Hodges and colleagues (2008), Kratzig and Arbuthnott (2006), Cassidy (2006), and Jackson and Williams (2003) indicate a connection between field-independent cognitive styles and academic achievement. Research findings indicate that people with field-independent cognitive styles exhibit greater levels of concentration and accuracy (Guisande et al., 2007), higher decision-making and reasoning abilities (Peters, 2002), higher general intelligence (Richardson & Turner, 2000), and better working memory capacity (Bahar & Hansell, 2000) compared to field-dependent individuals. Elwood and Klenowski (2002) and McAlpine (2000) demonstrated that cognitive styles of students in humanities differ from those in basic sciences and technical fields.

On the other hand, creativity or innovation is one of the fascinating and debatable subjects in various scientific fields, especially psychology. Throughout history, it has been considered as the fundamental power of the human mind and the main goal of schools and educational centers. In the present era, students need to enhance their creative skills to effectively face the astonishing developments of the third millennium for appropriate decision-making and solving complex societal problems (Ganji, Pashasharifi, & Mirhashemi, 2005). Undoubtedly, creativity holds a special place in individual and social human life, as all human achievements and civilizations, past, present, and future, are the products and outcomes of creativity. In the contemporary era, the extraordinary importance and vital necessity of creativity are increasingly recognized, exerting full control over all dimensions and aspects of human life (Golestanhashemi, 2001).

Ganji et al. (2005) demonstrated in a study titled "The Effect of Brainstorming Method on Increasing Creativity" that the brainstorming method effectively increased creativity in experimental groups of boys and girls. Regarding the four components of creativity, the effect of brainstorming on increasing the components of initiative, fluidity, and flexibility in boys and the components of fluidity and expansion in girls was significant. Dabbaghi (2003) compared critical thinking and creativity of third-year high school students in mathematics, humanities, and experimental sciences in Pakdasht. The results showed that critical thinking and creativity of third-year math students were significantly higher than the other two fields.

Vakili and Amini (2010), in a study titled "Investigating the Educational Resources of Creativity Flourishing in Elementary School Students from the Perspective of Elementary School Teachers in Helilan Region, Ilam Province," found that there is a relationship between teacher teaching and creativity flourishing of elementary school students, and there is a relationship between textbook content and creativity flourishing of elementary school students. Maher et al. (2007) showed that intimate and simultaneous relationships with interest and respect play an effective role in the emergence of students' creativity. Jahani (2006) aimed to examine the impact of various creative teaching methods on fostering the research spirit of adolescents. The study was carried out on a sample of 75 students from second and third-grade guidance school students in Shiraz. The results showed that creative teaching promotes argumentative skills and develops creativity among learners.

Studying and researching in the field of cognitive styles, handedness, and creativity is also beneficial for school executives, managers, and teachers. The awareness of school officials about cognitive styles and the issues of handedness and creativity and their impact on academic activities, including problem-solving, one of the practical and fundamental goals in education, necessitates supportive actions in this area. By creating suitable facilities for all students, such as academic counseling and educational programs, other actions increase the educational experiences of students. Additionally, according to the belief of some researchers, if contrary to the child's inner desire, we push them towards right-handedness, it can create unpleasant conflicts in the child and may lead to serious disorders such as language impairment and a sense of humiliation (Dadsetan, 1999). Based on this, the current study aims to examine the connection between handedness, field-dependent and field-independent cognitive styles, and creativity in high school students in Qorveh.

Research Method:

Objective:

- The present study is used in the sense that it is objective and correlational regarding its methodology.

Statistical Population:

- The research's statistical population consists of all male first-year high school students in Qorveh City during the second semester of the academic year 1393–94. According to the announcement of the education and training management of Qorveh city, the population was 830 students. The sample size, determined using Cochran's formula, was 220 students. Multi-stage cluster sampling was used in this study to choose samples from the statistical population. Four male high schools in Qorveh were randomly selected, and within these schools, two classes were randomly chosen. The tests were conducted on the students of these classes (5 classes with 28 students, 2 classes with 27 students, and 1 class with 26 students).

Measurement Tools:

-Chapman's Handedness Inventory:

- This inventory consists of 13 items, with materials extracted from the best items of valid questionnaires. It assesses individuals' handedness in activities such as writing, drawing, throwing, hammering, brushing teeth, erasing, lighting a match, shaking an ink bottle, using utensils, scissors, knife, and opening closing bottle cap. Respondents' answers are scored based on choosing one of the 3 options: right hand (score 1), both hands (score 2), and left hand (score 3). Scores range from 13 (completely right-handed) to 39 (completely left-handed). Participants with scores from 13 to 17 are classified as right-handed, and those with scores from 18 to 39 are classified as non-right-handed (left-handed and ambidextrous). Chapman and Chapman (1987), after administering this test to 2931 participants, reported internal consistency, test-retest reliability, and correlation with behavioral assessment of handedness as 0.96, 0.97, and 0.83, respectively. In Iran, Ali Pour (2006) standardized this questionnaire for guidance school students in Tehran, reporting Cronbach's alpha as 0.94, split-half reliability as 0.97, and test-retest reliability as 0.92. This test has been used in various research studies, including the study by Mohr, Thut, Landis & Brugger (2003).

- Abedi's Creativity Test:

- Following Torrance's idea of creativity, Abedi created the test in Tehran in 1363 and administered it to 650 third-graders there. Abdi and Schumacher (1986) reconstructed the test materials in the United States due to access to the original version. The test has undergone multiple revisions and was

first explained by O'Neil et al. (1994). The test consists of 60 three-option questions, covering fluidity, expansion, initiative, and flexibility. Options indicate low, moderate, and high levels of creativity, with scores ranging from one for low creativity to three for high creativity. The participant's score in each subtest is represented by their total score, and their overall creativity score is the result of adding their scores from all four subtests. Each participant's total originality score falls between 60 and 180. Assessments of fluidity, expansion, initiative, 34 to 49, and flexibility, 50 to 60, are made in questions 1 through 22. The Abedi's Creativity Test was shown to be reliable when Tehran guidance school pupils were retested in four parts in 1363. The reliability coefficients for fluidity, initiative, flexibility, and expansion were 0.85, 0.82, 0.84, and 0.80, respectively (Abedi, 1993). Internal consistency utilizing Cronbach's alpha for fluidity, flexibility, initiative, and expansion on 2270 Spanish students was 0.75, 0.66, 0.61, and 0.61, respectively (Azmandi et al., 1996).

Group Embedded Figures Test (GEFT):

Oltman, Raskin, and Witkin created the Group Embedded Figures Test (GEFT) in 1971 to evaluate cognitive styles that are field-dependent and field-independent. There are 25 complex images in the test. The task for each image is to locate a basic geometric shape embedded in a complicated pattern and then mark it with a bold pencil. There are three sections to the test: The first section, which has a two-minute time limit, consists of seven quite complicated images and is solely meant for practice. The second and third sections involve more complex shapes and constitute the main part of the test, with each section containing 9 images and a combined time limit of 10 minutes. During the test, simultaneous viewing of the sample form and test patterns is prevented. For this purpose, the sample form of embedded figures is printed on the back of the test booklet. The participant's ability to find simple geometric shapes within the sample form, without being influenced by the complex pattern, reflects the degree of field dependence or independence. One point is awarded for each correct response, resulting in a score ranging from 0 to 18. A score of 0 indicates a completely field-dependent cognitive style, while a score of 18 reflects a completely field-independent cognitive style. Witkin et al. (1971) reported the test's reliability using a retest method for both men (N=80) and women (N=97). The retest reliability for the Embedded Figures Test (EFT) was 0.82 for men (N=51) and 0.79 for women (N=51). In the same study, the criterion validity coefficient was 0.82 for men (N=73) and 0.63 for women (N=63) Bosaki, Innerd & Towson (1997). Moreover, Witkin and colleagues (1971) reported a reliability coefficient of 0.82 between the second and third sections of the test using the Spearman-Brown formula (Raviv & Nabel, 1988). This test was utilized by Safaripour (2001) to investigate the interaction of gender and cognitive style in the academic achievement of mathematics and social studies. In that study, the reliability coefficient was 0.85 using the retest method and 0.87 using the Cronbach's alpha method.

In this research, in addition to using central and dispersion indices appropriate for the level of measurement of variables, structural equation modeling was employed for data analysis, utilizing SmartPLS software.

Findings

Table 1: Description of research variables

Variable	Sample Size	Mean	Standard Error of Mean	Minimum	Maximum	Range	Variance	Standard Deviation	Skewness	Standard Error of Skewness	Kurtosis	Standard Error of Kurtosis
Handedness	220	15.87	0.304	13	35	22	20.276	4.503	2.871	0.164	7.670	0.327
Cognitive Styles	220	7	0.204	2	17	15	9.173	3.029	1.377	0.164	1.976	0.327
Creativity	220	84.33	1.191	66	150	84	311.967	17.663	2.199	0.164	4.514	0.327

The data in table 1 shows that the mean scores of the participants in handedness are 15.87 with a standard deviation of 4.50, in cognitive styles is 7 with a standard deviation of 3.03, and in creativity is 84.33 with a standard deviation of 17.66.

Table 2: Results of the Kolmogorov-Smirnov and Shapiro-Wilk tests for normality of distribution of the research variables

Variable	Kolmogorov-Smirnov	Degrees of freedom	significance level	Shapiro-Wilk	Degrees of freedom	significance level
Handedness	0.330	220	0.0001	0.565	220	0.0001
Cognitive Styles	0.168	220	0.0001	0.868	220	0.0001
Creativity	0.211	220	0.0001	0.721	220	0.0001

The results of the Kolmogorov-Smirnov test show that the distribution of data for the handedness variable ($Z = 0.330$ and $p < 0.01$), cognitive styles ($Z = 0.168$ and $p < 0.01$), and creativity ($Z = 0.211$ and $p < 0.01$) is not normal (Table 2).

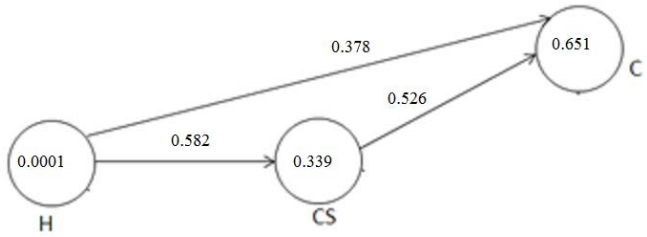

Figure 1: R^2 values and path coefficients of the structural conceptual model

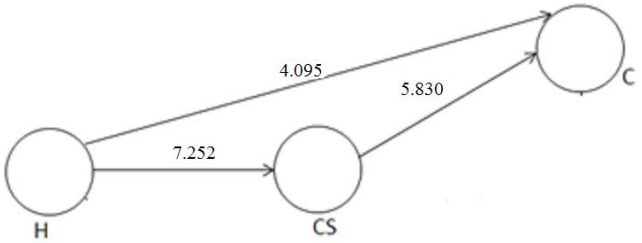

Figure 2: t-values of the structural conceptual model

Table 3: Cronbach's alpha values

Variable	Cronbach's alpha	Composite reliability
Handedness	0.916	0.929
Cognitive Styles	0.715	0.729
Creativity	0.946	0.949

The reliability coefficients of the variables based on Cronbach's alpha were 0.916 for handedness, 0.715 for cognitive styles, and 0.946 for creativity, indicating acceptable reliability. The reliability coefficients based on composite reliability were 0.929 for handedness, 0.729 for cognitive styles, and 0.949 for creativity, also indicating acceptable reliability (Table 3).

Table 4: Average variance extracted values

Variable	AVE
Handedness	0.611
Cognitive Styles	0.559
Creativity	0.641

The average variance extracted for handedness was 0.611, for cognitive styles 0.559, and creativity 0.641, indicating acceptable validity values (Table 4). Next, the shared variance coefficients of the variables are presented, and the determination coefficients of the research variables are provided in Table 5.

Table 5: Determination coefficients of the research variables

Variable	shared coefficients	R^2
Handedness	0.611	——
Cognitive Styles	0.559	0.339
Creativity	0.641	0.651

The calculated shared variance coefficients were 0.611 for handedness, 0.56 for cognitive styles, 0.64 for creativity, and 0.47 for problem- solving, indicating acceptable validity. The determination coefficient was 0.339 for cognitive styles, 0.651 for creativity, and 0.602 for problem -solving, which shows that the stated values are moderately acceptable (Table 5).

Table 6: Effect of research variables on problem- solving

Variable	Direct Effect			Total Effect		
	b	t	p	b	t	p

Handedness on Cognitive Style	0.582	6.904	p<0.01	0.582	6.904	p<0.01
Cognitive Style on Creativity	0.526	5.795	p<0.01	0.526	5.795	p<0.01
Handedness on Creativity	0.378	4.042	p<0.01	0.684	8.345	p<0.01

The results show that handedness has a significant direct effect on students' cognitive styles (p<0.01, t=6.90 and b=0.58). The results show that cognitive styles have a significant direct effect on students' creativity (p<0.01, t=5.79 and b=0.53). The results show that handedness has a significant direct effect on students' creativity (p<0.01, t=4.04 and b=0.38). Also, the results indicate that the total effect of handedness on creativity through cognitive styles is significant (p<0.01, t=8.34 and b=0.68) (Table 6).

Discussion

The results indicate that superiority in cognitive styles has a significant direct effect on students' cognitive styles. Considering extensive reviews and research, the examination of the relationship between superiority and cognitive styles, both domain-dependent and independent, has not been investigated so far, and although this study can be considered novel in this regard, it is not possible to compare the results obtained in this section with the findings of other studies. However, the findings of the current research in this regard can be consistent with the findings of Shimoda et al. (2008), Reio, Czarnolewski, and Elliot (2004), Norouzian (1386), and Springer (1998). In explaining these findings, reference can be made to the Geschwind-Behan-Galaburda theory (1982), famous for the GBG model.

According to this model, an increase in testosterone levels during the prenatal period can delay neuronal migration from the neural plate to the cerebral cortex, especially in the left hemisphere. As a result, a decrease in the degree of specialization of the left hemisphere is observed, ultimately leading to a delay in the growth of the prefrontal part of the right hemisphere and an increase in the growth of the posterior part of the right hemisphere. This, in turn, results in the weak development of social skills and improvement in spatial and mathematical abilities. According to the GBG model, high levels of testosterone hormone increase the likelihood of a set of traits such as being male, left-handedness, superiority in mathematics, architecture, and visual-spatial abilities (Bishop, 1990).

Results show that cognitive styles have a significant direct impact on students' attitudes toward creativity. The findings of this research are consistent with the findings of Bal (1988), Chaddha (1985), and McCrea (1994). Numerous studies have emphasized the relationship between domain-dependent and domain-independent cognitive styles and creativity. For instance, Bal (1988) conducted a creativity test, including the Torrance Creativity Test and the Hidden Figures Test, on 150 Indian female students. The results revealed a significant correlation between domain-independent cognitive styles and fluidity, flexibility, and originality in the Torrance Creativity Test. Chaddha (1985) concluded in his research that individuals with low creativity are more dependent on the domain. Kohen, Sordoni, and Phillips (1996) explored creativity in domain-dependent and domain-independent individuals, showing that domain-dependent individuals are less creative compared to domain-independent individuals. Hesaker (1981) demonstrated in his study that domain-dependent individuals are more compliant and receptive, and they exhibit lower levels of creativity compared to domain-independent individuals. Additionally, McCrea found a meaningful correlation between an individual's tendency toward cognitive complexity and creativity (Anastazi, 1374). Therefore, one can argue that the influence of the domain is minimal or nonexistent in highly creative individuals (Witkin, Moore, Goodenough, & Cox, 1977). Domain-dependent individuals do not separate a part from the visual field and have difficulty in discerning visual details, patterns, and designs (Woolfolk, 1995). On the other hand, domain-independent individuals perceive parts of a pattern separately and have a high ability to perceive complex patterns and images, which is evident in problem-solving and creativity (Witkin & Goodenough, 1981).

Results indicate that superiority has a direct and significant impact on student's attitudes toward creativity, and the overall effect of superiority on creativity is meaningful through cognitive styles. The findings of this research align with the findings of Miho et al. (2010), McCrea (2010), and Khosravizadeh and Teimorzhad (2010). In explaining these findings, reference can also be made to the Geschwind-Behan-Galaburda theory (1982), known for the GBG model. According to this model, an increase in testosterone levels during the prenatal period can delay neuronal migration from the neural plate to the cerebral cortex, especially in the left hemisphere. As a result, a decrease in the degree of specialization of the left hemisphere is observed, ultimately leading to a delay in the growth of the prefrontal part of the right hemisphere and an increase in the growth of the posterior part of the right hemisphere. This, in turn, results in the weak development of social skills and improvement in spatial and mathematical abilities, as well as cognitive abilities, including

creativity. According to the GBG model, high levels of testosterone hormone increase the likelihood of a set of traits such as being male, left-handedness, superiority in mathematics, architecture, and visual-spatial and cognitive abilities.

Conclusion

Considering the results obtained in this research, it can be concluded that superiority in cognitive styles has a direct and significant effect on cognitive styles, cognitive styles have a direct and meaningful impact on attitudes toward creativity, and superiority in attitudes toward creativity has a direct and meaningful effect. Superiority in problem-solving does not have a direct effect, but the overall effect of superiority on problem-solving is meaningful.

Since, according to Witkin, there is a relationship between cultural-social factors and cognitive styles, it can be said that one of the limitations of this study is that the participants in this study may differ in terms of cultural-social factors, including language. Another limitation of this research is that it only considers domain-dependent and domain-independent cognitive styles, neglecting other cognitive styles.

Given the expected differences in mental and cognitive performances between left-handers and right-handers, it is recommended that school counselors and specialized psychology centers guide students toward relevant fields of study, considering this. Additionally, familiarizing teachers and professors with the cognitive styles of students can help them align their teaching programs and methods with the cognitive styles of the learners.

Conflict of interest:
None.
Financial support:
None.
Ethics statement:
None.

References

Abedi, J. (1993). Creativity and a new approach to measuring it. Psychological Research, 1(2), 46-55.

Anastazi, A. (1995). Individual Differences (J. Tahorian, Trans.). Mashhad: Astane Ghodse Razavi.

Alipour, A. (2006). Examining the reliability and validity of the Chapmann handedness inventory among junior high school students. Quarterly Journal of Iranian Psychologists, 2(7-8), 197-206.

Alipour, A., & Baghban Parshokouhi, A. (2008). Familial handedness and mental rotation ability. Advances in Cognitive Science, 3(10), 63-74.

Alipour, A., & Saleh Mirhosseini, V. (2011). Handedness and intelligence: Comparing verbal and performance intelligence and their subscales between left-handers and right-handers. Educational Psychology, 21(7).

Alipour, A., & Mardanirad, M. (2012). Examining rotation in left-handers and right-handers to provide suggestions for driving behavior. Research Studies, 2(1), 35-53.

Anders , S.M. , & Hampson , E.(2005). Testing the prenatal androgen hypothesis Measuring digit ratio , sexual orientation and spatial abilities in adult .Horm and Behav ,47,92-8.

Bahar, M., & Hansell, M. H. (2000). The relationship between some psychological factors and their effect on the performance of grid questions and word association tests. Educational Psychology, 20, 349-365.

Bal,Sudesh.(1988).Greativity cognitive style and academic achievement amongst university students. Psychological studies,33,10-13.

Barnett , K. J., & Corballis, M. (2002). Ambidexterity and magical ideation laterality &, Asymmetries of Body. Brain and Cognition , 7 (1), 75-84.

Bishop , D.(1990). Handedness and developmental disorders .First Edition LEA publishment.

Bosaki,s ., Innerd,w., & Towson,s.(1997) .Field independence-dependence and self-steem in preadolescents.Does gender make a difference? Journal of Yourth and Adolescence,26(6),691-703 .

Cassidy, S. (2006). Learning style and student self-assessment skill . Education Training, 2(48) , 170-177.

Chaddha,N.K.(1985).creativity and cognitive styles.Psycholingua,15,81-88.

Dabbaghi, A. A. (2003). A comparative analysis of the effect of different approaches to teaching creativity on fostering a spirit of research in elementary and high school students in Pakdasht (Unpublished master's thesis). Islamic Azad University, Tehran Central Branch, Iran.

Dadsetan, P. (1999). Abnormal and developmental psychology, Vol. 1. Tehran: Samt Publication.

Edgin , J. O., & Pennington , B. F. (2005). Spatial cognition in autism spectrum disorders: Superior, impaired, or just intact? Journal of Autism Development Disorder , 35, 729-745.

Elwood , J., & Klenowski, V. (2002). Creating communities of shared practice: the challenges of assessment use in teaching and learning. Assessment and Evaluation in Higher Education , 3(27) , 78-89.

Faustman , W. O . (1991). Left-handed in male schizophrenic patients is associated with increased impairment on the Luria-Nebraska neuropsychological battery. Physiol Behav, 51, 511–518

Guisande , M. A., Paramo, M. F., Tinajero, C., & Almeida, L. S. (2007). Field dependence- independence (FDI) cognitive

style an analysis of attentional functioning. Psiciothema , 4 , 572-577.
Golestanhashemi, S. M. (2001). Creativity technology. Journal of Rahyaft, 26, 112, 85-98.
Ganji, H., Pasha Sharifi, H., & Mirhashemi, M. (2005). The effect of brainstorming on increasing students' creativity. Journal of Education and Training, 11(46), 74-82.
Hodges , C. B., Stackpole-Hodges , C. L., & Cox , K. M. (2008). Self-efficacy, self- regulation and cognitive style as predictors of achievement with podcast instruction. Journal of Educational Computing Research , 2 , 139-153.
Jackson , R.H.G., & Williams, M.R. (2003). Are undergraduate preferences as to method of assessment well-founded and rational? Educational Psychology, 15 (3), 74-85.
Jahani, J. (2006). An analytical and comparative study of the effect of different approaches to teaching creativity on nurturing a spirit of research in children and adolescents. _Journal of Social and Humanistic Sciences of Shiraz University, 4(1), 47-61.
Khosravinezhad , P. , & Teimourzadeh , S. (2010). Handedness and lateralization of the brain. Broad Research in Artificial Intelligence and Neuroscience 2 , 13957-2067 و.
Kolb,B.,& Whishaw ,I.(2009).Fundamental of human neuropsychology .7th .edition.USA .New York Oxford University Press.
Kratzig , G., & Arbuthnott , D.(2006). Perceptual Learning Style and Learning Proficiency: A Test of the Hypothesis . Journal of Educational Psychology , 98 (1), 238-246 .
Krommydas , G ., Gourgoulianis, K.I., Andreou , G., Kotrotsiou ,E.,Raftopulos,V.,Paralikas, T.H., & Molyvdas, P.A.(2004).Fetal sensitivity to testosterone , left-handedness and development of bronchial asthma:A new approach .Med - Hypotheses , 62,143- 5.
Kiani, M. (2001). A comparative study of the extent of brain lateralization functions in mentally disabled children with mental age of 5-6 years in exceptional children's education and rehabilitation centers (Unpublished master's thesis). University of Social Welfare and Rehabilitation Sciences, Tehran.
Maher, F., Aghaei, A., Barjali, A., & Rouhani, A. (2007). Comparing descriptive evaluation with traditional grading system based on classroom environment, emotional traits, and creativity of elementary students. Knowledge and Research in Educational Sciences, 41(2).
McAlpine, D. (2000). Assessment and the gifted . Tall Poppies, 1(25) , 45-57.
McCrea , S. M. (2010).Intuition ,insight, and the right hemisphere: Emergence of higher sociocognitive functions. Psychology Research and Behavior Management,3,1-39.
Mihov, K. M., Denzler, M., & Forster, J. (2010). Hemispheric specialization and creative thinking: A meta analytic review of lateralization of creativity. Brain and Cognition, 72, 442-448.
Morfit , N.S. , & Weekes , N.Y. (2001). Handedness and immune function. Clin Neurophysiol , 18 , 89- 96 .
Nourouzian, M. (2007). Left hemisphere, right hemisphere, right-handedness and left-handedness (Unpublished doctoral dissertation). Tehran University of Medical Sciences, Iran.
Oltman , K.P., Raskin , E. , & Witkin , H.(1971). Amanual for the embedded figures test by witkin , Oltman , Raskin .Conculing psychologists press INC.577.
Parsons , T.D. , & Larson , P.(2004). Neuropsychologia ,42(4):555-620.
Peters , M. , Reimers , S. , & Manning , J.T.(2006). Hand preference for writing and associations with selected demographic and behavioral variable sin 255,100 subjects: the BBC internet study . Brain and cognition, 62, 177-189.
Pore , A. M . (1997). Mixed handedness and schizotypal personality in a non- clinical sample: The role of task demand .Physiol Behav, 87 , 112–119 .
Raviv , S., & Nabel , N.(1988).Dependence – Independence and concentration as psychological characteristics of basketball players . Perceptual and motor skills ,66,831-836.
Reio , T.G., Czarnolewski , M. , & Eliot , J.(2004).Handedness and spatial ability: Differential patterns of relation ships.Laterality , 9, 339-58 .
Resnik , S.M., Berenbaums , S.A. , Gottesman , I., & Bouchard , T.J.(1986). Early hormonal influences on cognitive functioning in congenital adrenal hyperplasia. Develop Psychol , 22, 191-8.
Safaripour, F. (2001). Examining the interaction of gender and cognitive styles on academic achievement in mathematics and social studies of junior high school students in Shiraz in 2001 (Unpublished master's thesis). Shiraz University, Iran.
Shapleske , S . L . (1999). The planum temporal: a systematic, quantitative review of its structural, functional and clinical significance Brain Res.Rev, 29 , 26–49 .
Shimoda , N., Takeda , K., Imai , I., Kaneko , J. , & Kato , H.(2008).Cerebral Laterality differences in handedness : A mental rotation study with NIRS.Neurosci Lett , 430, 43-7.
Springer , D.(1998). Left Brain , Right Brain. 5th Edition. W. H. Freeman & Company publishment ,U. S. A.
Thomas, J.(2005). Facilation of critical thinking and Deep cognitive processing by structured discussion Board Activities . Jornal of Science Education and Technology, 8 ,2 32544-334 .
Vakili, N., & Amini, A. (2010). Investigating educational barriers to fostering students' creativity from primary school

teachers' perspective in Helilan district of Ilam province. Research in Educational Administration, 4(3).

Witkin , H.A. , & Goodenough,D.R.(1977).Field dependence and interpersonal behavior.

Witkin , H.A. , & Goodenough , D.R.(1981).The essence and origin of cognitive style field dependence and field independence. psychological Issue , Monograph No 51 , NewYork International university Press.

Woolfolk, A.E.(1995).Educational psychology .(6th ed).Boston :Allyn and Bacon.

Witkin , H.A., Morre , C., Goodenough , D.R. , & Cox ,P.(1977). Field dependent and field independent cognitive style and Their Educational Implications.Review of Educational Research.