

Prognosis of Academic Performance of Students based on Gardner's Multiple Intelligences and Learning Styles

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ABSTRACT

This study sought to prognosis the academic performance of students based on Gardner's learning styles and multiple intelligences. For this purpose, a descriptive and correlational study was conducted on all students of Tabriz universities. The sample size was estimated at 384 people according to Cochran's formula. Data were collected using the Gardner Multiple Intelligences Questionnaire, the Kolb's Learning Style Questionnaire (LSI), and the GPA of all students. The normality of the distribution of variables was evaluated through the Kolmogorov-Smirnov test, and the research hypotheses were tested through the Pearson correlation test and simultaneous multiple linear regression (MLR). Data were analyzed and calculations were performed in SPSS-18 software. It was found that verbal-linguistic intelligence, logical-mathematical intelligence, reflective observation learning style, and abstract conceptualization learning style have a significant and positive effect on the academic performance of students. In addition, Gardner's learning styles and multiple intelligences were found to explain 48% of the variance of the academic performance of students in Tabriz universities.

Keywords: Behavioral bias, Investor decisions, Remorse, Conservatism.

1. Introduction

Today, education has become an integral part of life and, with no education, life steadiness is threatened substantially. The main purpose of educating students is to enhance their academic performance, concerning that education requires devoting considerable capital and funding (Vahidi and Baratali, 2017). In addition, the progress and academic performance in any society reflect a powerful educational system in terms of goal setting and attention to fulfilling individual demands. Therefore, the educational system can be viewed as powerful and thriving if the academic performance and progress of students of varying grades are at the top and acceptable levels (Rezaei et al., 2016).

Academic performance is the success of students in one or more topics, such as comprehension, reading comprehension, or numerical calculation. Progress is measured by employing tests developed to assess the academic performance of students. The academic performance further refers to the student's progress in the classroom, which is evaluated based on school tasks (Heydari, 2017).

Performance refers to a person's ideas, skills, and knowledge, and in turn, the scores demonstrate a student's academic performance. Therefore, academic performance is a variable of utmost importance, as it reveals factors that positively and/or negatively influence the academic performance of students (Kibona and Mgaya, 2015).

Numerous factors affect the academic performance of students. Accordingly, it is crucial to identify contributing factors and fix problems and barriers in the educational system. One leading factor is learning styles that can influence the whole learning process (Sobhi Gharamaleki et al., 2013).

Studies have shown that learning styles can substantially influence academic performance (see, e.g., Moshtaghi et al, 2013; Khodabandeh et al., 2014; Ghadampour et al., 2015; Bakhshayesh et al., 2014; Sobhi Gharamaleki et al., 2013; İlçin et al., 2018).

Learning styles reflect habitual and distinctive behaviors to acquire knowledge, skills, or attitudes by study or experience, and/or a way that learners prefer to understand lessons. Learning styles are not regarded as abilities, contrary to intelligence and talent, and refer to the process of learning, not to how the student is able to learn (Seyf, 2022). Psychologically, the learning style is a way in which individuals focus, acquire experience, and obtain information and knowledge (Othman and Amiruddin, 2010).

Styles are not abilities, rather a way preferred by individuals to use their abilities in doing cognitive tasks. Studies based on style theory have revealed that style plays a vital role in the learning by students. In simple terms, when the learning style of students is parallel to relevant teaching approaches, their performance and motivation to progress improve (Ghadampour et al., 2021).

According to Kolb's Learning Style theory (1981), learning is a process that involves four stages, including concrete learning, reflective observation, abstract conceptualization, and active experimentation. The combination of these learning stages results in four learning styles, each in a unit square in the coordinate system. These styles include the following (Ghadampour et al., 2021):

1. Diverging style (concrete experience/reflective observation). Individuals with diverging styles tend to assess problems from various perspectives.
2. Assimilating style (abstract conceptualization/reflective observation). Individuals with assimilating styles can perceive plentiful data and consider them precisely and logically.
3. Converging style (abstract conceptualization/active experimentation). Individuals that prefer converging styles are able to solve problems, make decisions, and apply ideas and theories.
4. Accommodating style (concrete experience/active experimentation). Individuals with this style can learn and enjoy by getting involved in new works and controversial experiences.

Some researchers argue that IQ alone, with its classic concept and approach, fails to entirely prognosis success, though it plays an essential role in academic performance and success, and thus other factors are also in play (Ayesha and Khurshid, 2018). Therefore, Gardner's multiple intelligences can be utilized as a model in structural strategies to predict the success of students (Rabieinejad et al., 2015). Research has shown that Gardner's multiple intelligence has a positive and significant effect on academic achievement and performance (Hashemi and Karimi, 2006; Niroo et al., 2011; Hernandez et al., 2018).

Gardner does not consider intelligence as a single, integrated structure, rather thinks that intelligence is the product of merging several different and distinct abilities. Gardner, as with other theorists, prefers multiple intelligences, each with a specified function, instead of a single intelligence. Gardner argues that each of these intelligence has distinct tasks and functions, but they may be merged into groups to produce intelligent behavior and the desired behavior. Gardner's eight intelligences include linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, intrapersonal, and inherent intelligence (Stanberg et al., 2011).

Gardner has proposed eight distinct intelligences, including the following (Abdi et al., 2011; Gardner, 1999).

1. Verbal-linguistic intelligence. This covers sensitivity to verbal and written language, the ability to learn languages, and the capability of utilizing language to achieve specific goals.
2. Mathematical-logical intelligence. This includes the ability of deductive or inductive reasoning and the power of recognizing and manipulating relevant abstract patterns and relationships.
3. Visual-spatial intelligence. This possesses the ability to create and supply spatial/visual resources from the universe and share these expressions mentally or perceptually.
4. Physical-kinesthetic intelligence. This category includes the ability to use all or part of the body, such as the hand or mouth, for solving problems or producing products.
5. Musical intelligence. This includes skills in performing, composing, and apprehending musical patterns.
6. Interpersonal intelligence. This covers the ability to understand others, including goals, motives, interests, secret goals, etc., and therefore to work effectively with others.
7. Intrapersonal intelligence. This category includes the ability to perceive one's interests, fears, and abilities.
8. Naturalistic intelligence. It includes the capability of recognizing and classifying multiple plants and animal species in an environment.

Studies reveal that several factors influence academic performance, and identifying these factors is crucial to solving the problems and fixing limitations in the educational system. One factor that enhances the academic performance and educational efficiency of students is to evaluate the differences and various levels of learning and intelligence. Therefore, reflecting individual differences and identifying their learning styles, and developing an educational program relevant to the multiple intelligences allow students to learn better and feel delighted with learning. Generally, people utilize different styles and intelligence to learn according to their personal differences (Ezequiel et al., 2014). To improve the level of learning in students and benefit from its capability, it is crucial to identify and scrutinize the factors that can predict the academic performance of students. In this context, this study aims to predict the academic performance of students in Tabriz universities based on Gardner's learning styles and multiple intelligences.

2. Methods

Research plan

Our research was an applied study conducted based on a descriptive and correlational research design.

Statistical population

The statistical population of this research was all students in Tabriz universities, which were approximately estimated at over 40,000.

Sample size

Concerning the scarce of precise statistics of the study population, which is estimated to be high, we employed Cochran's formula for an infinite population with unknown variance. Therefore, the sample size was estimated at 384 people according to Cochran's formula, with a degree of sampling error of 5% and a CI of 0.95.

$$n = \frac{Z^2 pq}{d^2} = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} = 384 \text{ (Eq. 1)}$$

Where (n) is the sample size, (N) is the statistical population size, (Z) is the area under the standard normal curve with a 95% confidence level, (p) is the portion of the population qualified for a given trait, and (d) is the sampling error.

Sampling method

Since students were scattered throughout the city and due to the COVID-19 lockdown, the questionnaires were distributed and collected virtually via the Internet by sharing the links in virtual groups.

Data collecting tools

Data were collected using the Gardner Multiple Intelligences Questionnaire, Kolb's Learning Style Questionnaire (LSI), and the GPA of all students.

Gardner Multiple Intelligences Questionnaire

The Gardner Multiple Intelligences Questionnaire was designed to measure each of the eight components of intelligence, containing 80 questions on a 5-level Likert scale. Each component has 10 items, which are scored based on the Likert scale and from 1 to 5.

Kolb's Learning Style Questionnaire (LSI)

This LSI questionnaire assesses individuals' learning styles in terms of concrete experience, abstract conceptualization, reflective experience, and active experimentation. The combination of these components produces four learning styles, including diverging, converging, assimilating, and accommodating learning styles. The LSI questionnaire consists of 12 sentences. Each sentence has four items, each of which is answered and scored by the respondents from 1 to 4 according to the respondent's learning experience. Each item is scored 4 if it best matches the subject's learning style, followed by scores of 3 (for average matching), 2 (for poor matching), and 1 (for no matching). To determine the respondent's learning style, the first items of each of the 12 questions are first summed. The same process is repeated for the 2nd, 3rd, and 4th options. In this system of scoring, four general scores are obtained, in which the first total score (i.e., the sum of 1st options) represents the score of concrete experience. Similarly, the 2nd score (i.e., the sum of 2nd options) represents the score of reflective experience, followed by the 3rd score for abstract conceptualization and the 4th score for active experimentation. Accordingly, the higher score, than the three other scores, indicates the respondent's dominant learning style. Kolb (1985) studied 1,466 male and female sophomores and reported a good content validity of the questionnaire, which qualifies it as a reliable tool for identifying learners' learning styles. Kolb further reported a reliability coefficient of 0.80 for this questionnaire. Izadi and Mohammadzadeh (2007) investigated students' personality traits and academic performance and utilized Cronbach's alpha, Spearman-Brown prediction formula, and bisection methods to assess the reliability of the LSI questionnaire, with the corresponding reliability coefficients values of 0.74, 0.66, and 0.63, respectively.

Research method

This research was conducted based on field and library methods. In the library method, data are collected from reliable scientific sources such as books, articles, research journals, and related theses, and, or through field distribution of questionnaires among students.

The questionnaires were first selected using the theoretical foundations and the research variables. Questionnaires have been previously standardized and their validity and reliability were confirmed in Iran. Furthermore, the reliability of each questionnaire was estimated in this study. The questionnaires were eventually compiled after confirming their validity and reliability and distributed among the respondents. The questionnaires were collected in virtual groups via the Internet. To do so, they were designed into Google Docs and their link was sent to respondents. The respondents were asked to complete and submit the questionnaire. Samples were collected randomly, and the data were analyzed in SPSS-18 software.

Data analysis method

The normality of the distribution of variables was evaluated through the Kolmogorov-Smirnov test, and the research hypotheses were tested through the Pearson correlation test and simultaneous multiple linear regression (MLR).

3. Findings

Out of all the participants, 44% were male and 56% were female. A total of 70.8% of participants were single and the remaining 29.2% were married. In addition, 10.4% of participants had an associate degree, 45.1% had a bachelor's degree, 35.2% had an MSC degree, and 9.4% were Ph.D. graduates.

Variable	Items	Frequency	Percentage
Gender	Male	169	44
	Female	215	56
Marital status	Single	272	70.8
	Married	112	29.2
Education	Associated degree	40	10.4
	Bachelor	173	45.1
	M.Sc.	135	35.2
	Ph.D.	36	9.4

Descriptive statistics for age and other main research variables are given in Table 2.

Variable	Mean	SD	Skewness	Kurtosis	Min	Max
Age	27.40	6.67	1.02	0.85	18	49
Academic performance	15.10	1.93	0.31	-0.91	11.79	19.50
Verbal-linguistic intelligence	32.46	5.03	-0.15	0.21	20	48
Logical/mathematical intelligence	34.23	5.76	-0.28	0.10	16	49
Visual-spatial intelligence	31.16	4.04	0.01	-0.30	22	43
Bodily-kinesthetic intelligence	29.41	4.40	-0.012	0.45	15	43
Interpersonal intelligence	33.31	4.59	0.01	0.26	20	47
Intrapersonal intelligence	32.95	4.37	-0.14	-0.15	21	46
Musical intelligence	34.25	5.89	-0.15	-0.60	19	50
Naturalist intelligence	28.94	4.10	-0.14	0.35	15	41
Concrete experience style	2.57	2.84	0.42	0.97	0	11
Reflective experience style	2.91	2.62	0.24	0.64	0	10
Abstract conceptualization style	3.10	2.35	0.40	0.91	0	10
Active experimentation style	3.14	2.20	0.79	0.22	0	9

The normality of the distribution of variables was investigated using the Kolmogorov-Smirnov test. The Kolmogorov-Smirnov test results given in Table 3 indicate the normal distribution of all the study variables ($p < 0.05$).

Variable	Z-value	p-value
Academic performance	1.238	0.093
Verbal-linguistic intelligence	1.27	0.079
Logical/mathematical intelligence	1.164	0.133
Visual-spatial intelligence	1.257	0.085
Bodily-kinesthetic intelligence	1.256	0.085
Interpersonal intelligence	1.11	0.17
Intrapersonal intelligence	1.265	0.081
Musical intelligence	1.296	0.073
Naturalist intelligence	1.336	0.056
Concrete experience style	1.32	0.059
Reflective experience style	1.308	0.061
Abstract conceptualization style	1.29	0.071
Active experimentation style	1.311	0.06

The relationship between variables was investigated using Pearson's Correlation Coefficient (Table 4). It was found that there is a significant and positive association between verbal-linguistic intelligence (p

<0.05, $r = 0.37$), logical-mathematical intelligence ($p < 0.05$, $r = 0.39$), visual-spatial intelligence ($05 P < 0.05$, $r = 0.18$), interpersonal intelligence ($p < 0.05$, $r = 0.23$), intrapersonal intelligence ($p < 0.05$, $r = 0.12$), musical intelligence ($05 P < 0.05$, $r = 0.17$), naturalistic intelligence ($p < 0.05$, $r = 0.14$), reflective observation style ($p < 0.05$, $r = 0.46$), and abstract conceptualization style ($P < 0.05$, $r = 0.45$) with the academic performance of students.

Table 4. Pearson's Correlation Coefficient results for the relationship between variables (n = 384)

		1	2	3	4	5	6	7	8	9	10	11	12	13
Academic performance	r	1												
	p													
Verbal-linguistic intelligence	r	0.365	1											
	p	0.001												
Logical/mathematical intelligence	r	0.389	0.388	1										
	p	0.001	0.001											
Visual-spatial intelligence	r	0.176	0.296	0.388	1									
	p	0.001	0.001	0.001										
Bodily-kinesthetic intelligence	r	-0.001	-0.016	0.065	0.017	1								
	p	0.987	0.755	0.205	0.739									
Interpersonal intelligence	r	0.226	0.406	0.473	0.494	-0.016	1							
	p	0.001	0.001	0.001	0.001	0.749								
Intrapersonal intelligence	r	0.116	0.448	0.408	0.39	0.081	0.474	1						
	p	0.023	0.001	0.001	0.001	0.115	0.001							
Musical intelligence	r	0.166	0.444	0.542	0.391	0.172	0.436	0.635	1					
	p	0.001	0.001	0.001	0.001	0.001	0.001	0.001						
Naturalist intelligence	r	0.136	0.44	0.174	0.293	0.06	0.31	0.262	0.304	1				
	p	0.008	0.001	0.001	0.001	0.244	0.001	0.001	0.001					
Concrete experience style	r	-0.046	-0.098	-0.119	-0.013	-0.081	-0.068	-0.05	-0.078	-0.048	1			
	p	0.368	0.056	0.02	0.793	0.114	0.185	0.326	0.126	0.349				
Reflective experience style	r	0.462	0.12	0.28	0.135	0.073	0.155	0.03	0.114	0.009	-0.135	1		
	p	0.001	0.019	0.001	0.008	0.153	0.002	0.563	0.026	0.865	0.008			
Abstract conceptualization style	r	0.447	0.107	0.078	0.097	-0.004	0.05	0.008	0.015	0.041	0.62	0.155	1	
	p	0.001	0.037	0.129	0.059	0.938	0.327	0.87	0.764	0.427	0.223	0.002		
Active experimentation style	r	0.027	0.098	0.058	0.006	-0.115	-0.015	0.11	0.02	0.052	0.059	-0.091	-0.086	1
	p	0.592	0.056	0.253	0.914	0.025	0.77	0.031	0.696	0.313	0.247	0.076	0.092	

In this study, simultaneous multiple linear regression was employed to assess Gardner's learning styles and multiple intelligences for their role in predicting the academic performance of students. The multiple correlation coefficient (R) and the coefficient of determination were 0.69 and 0.48, respectively, implying that 48% of the variance in the academic performance of students is explained by Gardner's variables of learning styles and multiple intelligences. The Durbin-Watson (DW) value was 1.92, which is a value between 1.5 and 2.5, suggesting that the criterion variable is not self-correlated and the errors are independent. In addition, the p-value for the F-test was 0.001, which is less than 0.05, implying that there is a significant linear association between the criterion and predictor variables (Table 5).

The regression results are summarized in Table 6, suggesting that there is a significant positive correlation between verbal-linguistic intelligence ($p = 0.001$; $\beta = 0.25$), logical-mathematical intelligence ($p = 0.001$; $\beta = 0.24$), reflective observation learning style ($p = 0.001$; $\beta = 0.33$), and abstract conceptualization learning style ($p = 0.001$; $\beta = 0.36$) and the academic performance of Tabriz students. Abstract conceptualization learning style ($\beta = 0.36$) had the greatest impact on academic performance of students.

R	Coefficient of determination	DW	F	p-value
0.692	0.479	1.921	28.395	0.001

	Non-standardized coefficients		Standardized coefficients	t-value	p-value
	B	SD	Beta		
Constant value	9.456	0.904		10.456	0.001
Verbal-linguistic intelligence	0.096	0.018	0.25	5.221	0.001
Logical/mathematical intelligence	0.082	0.017	0.244	4.867	0.001
Visual-spatial intelligence	-0.021	0.022	-0.044	-0.963	0.336
Bodily-kinesthetic intelligence	-0.004	0.017	-0.009	-0.236	0.814
Interpersonal intelligence	0.01	0.021	0.023	0.464	0.643
Intrapersonal intelligence	-0.027	0.023	-0.061	-1.164	0.245
Musical intelligence	-0.024	0.018	-0.074	-1.349	0.178
Naturalist intelligence	0.004	0.02	0.009	0.204	0.893
Concrete experience style	0.012	0.026	0.018	0.467	0.641
Reflective experience style	0.242	0.03	0.329	8.185	0.001
Abstract conceptualization style	0.294	0.032	0.359	9.309	0.001
Active experimentation style	0.049	0.034	0.056	1.438	0.151

4. Discussion and conclusion

This study investigated the predictory role of Gardner's learning styles and multiple intelligences to the prognosis of the education performance of students in Tabriz. It was found that verbal-linguistic intelligence and logical-mathematical intelligence have a significant and positive impact on the academic performance of students. According to Howard Gardner (1999), in the customary academic system, teachers only focus on spotlighting verbal-linguistic intelligence and logical-mathematical intelligence and think that only students with these two proficiencies can progress in their academic journey. Concerning that the education system is customary in the majority of cases, logical-mathematical intelligence and verbal-linguistic intelligence are more accentuated. In this system, students with verbal-linguistic intelligence and logical-mathematical intelligence will show improved academic performance than other students. This finding is in agreement with the results reported by Niroom et al. (2011). In this study, reflective observation and abstract conceptualization had a significant and positive impact on the academic performance of students in Tabriz. The reason is that students with a reflective observation learning style can consider and conceptualize issues from various points of view. They appreciate intuition and sensation of ideas and concerns and reflect on their thoughts and feelings originating from personal ideas. In this learning style, the person trusts patience, objectivity, and precise appraisal, but does not take any action when it is not

necessary. To form their ideas, students consider thoughts and theories, which eventually leads to their improved academic performance (Ghadampour et al., 2020). Students with abstract learning styles rely often on their logic and thinking, instead of their feelings, to perceive problems. In these students, learning is influenced by experiencing instead of merely observing circumstances, and by influencing others and events. In this stage of learning, both logic and thought are more reflected, instead of feelings, to perceive issues and conditions. Therefore, logic and thought contribution to the learning process improves the academic performance of students. This finding is in agreement with the results documented by Rezaei et al. (2011). In this study, it was found that abstract conceptualization learning style ($\beta = 0.36$) has the greatest impact on the academic performance of students in Tabriz.

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