

On the relationship between multiple intelligences and achievement among engineering students

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Abstract

The idea of multiple intelligences (MI) is primarily associated with Gardner (1983). It is mainly concerned with the fact that intelligence is multidimensional. It is a shift away from the notion that intelligence is only related to mathematical thinking and ability. Students studying in technological universities are believed to possess this kind of intelligence. This is the case, otherwise admission processes in Iran are quite rigid and only students endowed with this type of intelligence can survive in the academic environments, especially when it comes to engineering fields. The notion of MI was tested among students of Sharif university students. An inventory of MI was administered to 50 students. The classes were intact classes taught by the researcher. It can be said that the students were almost representative of the total population of Sharif University because the classes consisted of students coming from various fields of studies. The results ran counter to the expectations of the researcher. It was true that most students possessed logical-mathematical intelligence. But there were also students who enjoyed other types of intelligences, for example musical and linguistic intelligences. A multiple regression analysis showed that logical-mathematical intelligence was not necessarily the best predictor for their end of term achievements. While it is true that these students can survive in the academic environments relying solely on their logical-mathematical intelligences, attempts should be made to foster other types of intelligences as well. This can be achieved by nominating topics in the English language classes which cut across social skills, introspection, and other types of intelligence types.

Key Words: Multiple Intelligences, Multiple Regression, Predictors, Predicted, Achievement Scores

Introduction:

Tests of general intelligence have been around for a long time (Spearman, 1927). What these tests tend to assume is that intelligence is only a matter of logical-mathematical ability. Students may excel in other non-academic issues. But this is often lost sight of in intelligence tests. An IQ test is a perfect example of an intelligence test that presumes that intelligence essentially boils down to a question of who has more analytical ability than others. Interest in other types of intelligence gained momentum with Gardner's (1983) book on intelligence. This was a radical departure from the previous notion of intelligence. Gardner compartmentalized intelligence into seven layers or types. These were: linguistic, logical-mathematical, spatial, musical, interpersonal, intrapersonal, and bodily-kinesthetic. Later he added other components such as existential and spiritual. Gardner's ideas were well-received primarily on the grounds that they meshed well with parents and researchers (Visser, Ashton and Vernon, 2006). Gardner (1999) objected to the use of IQ tests because they assumed that mathematical ability was the driving force behind any type of success.

Sharif University of Technology is a state run university that attracts the best students in different fields of engineering fields. It goes without saying that these students possess enough of mathematical-logical intelligence to ensure their entrance into the university via a nation-wide exam. The purpose of the current study is to see which intelligence type is the most dominant among all intelligence types and which intelligence type is the best predictor of success in language learning.

Review of the related literature

Given the fact that distinction of multiple intelligences lies in its multi-dimensionality, it is of utmost importance to elaborate on these layers of intelligences.

Logical-mathematical:

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This intelligence is associated with analytical and mathematical thinking. Students who have this intelligence type excel at problem-solving activities. The anticipation is that this type of intelligence is a good predictor of success on the part of students.

Metacognition seems to be logically related to this type of intelligence.

Linguistic intelligence:

Students who are good at this type of intelligence excel in activities that are related to word manipulation and word games. Poets fall into this category.

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Bodily-kinesthetic:

This type of intelligence is associated with body movements. Athletes and dancers fall into this category. Paralinguistic features of communication are related to this type of intelligence. Adolf Hitler was quite adept deploying this type of intelligence to stimulate people into action. He could easily mesmerize crowds and appeal to their emotions. Successful teachers are also likely to utilize this strategy to build effective communication with their students. A sitting or stationary teacher runs the risk of putting students to sleep as opposed to a teacher who makes the right body movements in the right time.

Intrapersonal intelligence:

This intelligence type pertains to the idea of knowing oneself. The fact that a person can discover his or her own talent is a piece of evidence for this type of intelligence. There are people who go through life not being able to discover their talents and what they are good at. Also, it seems reasonable to suggest that this type of intelligence and metacognition are related. Both have higher order, executive functioning.

Interpersonal intelligence:

This type of intelligence encapsulates the idea of establishing a rapport with people around oneself. If one is able to sympathize or empathize with people around them, s/he is said to possess this type of intelligence. The author believes that the enhancement of this

intelligence can give rise to better communication which will eventually culminate in job satisfaction and reaping good scores in schools. This is not to say that people can circumvent laws and regulations just by the virtue of having this type of intelligence. What is meant is that there are people who are capable of doing things but lack of effective communication skills stands in the way of pitching their ideas.

Musical intelligence:

This is the ability or talent to appreciate music. People who are musically intelligent can use music to their advantage. Musicians fall into this category. The question is that whether this type of intelligence lends itself to training. In other words, if a person is not gifted musically, is it possible to nurture this ability in her or him? That is an open question and research studies need to be carried out to substantiate the claims made.

Figure 1 recaps different intelligence types. A brief explanation of each intelligence type is provided.



Figure 1: multiple intelligences

Some research studies

There are numerous research studies in terms of MI and achievement. Bu two have been singled out here. One study that is pertinent to the topic of the current research is that of McMahon, Rose, Dale, and Parks (2004). The study set out to investigate the statistical property of a multiple intelligence measure. Studies of this nature are reminiscent of Klein's (1997) statement that measures of multiple intelligences lag behind the theory itself. It turned out that some subscales of this multiple intelligence measure had poor internal reliability indices. So the writers shied away from conducting any further reliability analyses not the least of which was test retest reliability. But the writers express great satisfaction with the achievement test they used. It has satisfactory reliability indices and as evidence of validity, it demonstrated good correlations with similar tests tapping the

same constructs. In terms of intercorrelations among different intelligence types, the highest correlations were between linguistic and logical-mathematical intelligence types. This, the writers say, should not come as a surprise due to the fact that the two intelligence types are capitalized on in academic environments. But what is interesting about the findings of the research study is the fact that none of the intelligence type had any significant correlation with achievement scores. The highest, albeit non-significant, correlation belonged to logical-mathematical. The writers caution us that the results should be treated with circumspection due to unsatisfactory statistical values obtained.

The other study is that of Snyder (2000) who investigated the relationship between multiple intelligences, learning styles and achievement. Achievement in this study was operationally defined in terms of students' Grade Point Average (GPA). A multiple intelligences inventory was developed and it was validated with Armstrong (1994). A correlational analysis was conducted to see the correlations between various intelligence types and GPA of students. Some positive, if not strong, correlations were obtained. For example the correlations between spatial intelligence and GPA of students was .29. The author concludes that " In general, the students with stronger GPA's considered themselves to be more self-motivated, persistent, and more likely to study alone" (p. 15).

Research questions

The following research questions were raised in the current study:

- 1-Is there any significant correlation among intelligence types on the one hand and intelligence types and achievement scores in the other?
- 2-Which variable or combination of variables is the best predictor of students' success in foreign language learning?

Methodology

1-Subjects:

The participants of the current study consisted of 50 Sharif University students. They came from the following fields of studies: electrical engineering, mechanical engineering, aerospace engineering, and computer engineering. All the data came from three classes which the author was handling. The majority of students were males. This is the general make-up of Sharif university classes.

2-Instruments

Two instruments were employed in the current study. The first one was that of an achievement test. This test is devised and administered to students by the Languages and Linguistics Center at Sharif University of Technology. It is noteworthy that the author has a key role in designing and administering the test. There are four sections to the test. These sections are as follows: grammar, vocabulary, reading comprehension, and idioms. The tests are based on a textbook taught in this university. The Cronbach alpha for the test was .80. In terms of validity the test proved valid as its concurrent validity index with a similar criterion measure was .70.

The second instrument was a multiple intelligence inventory (Armstrong, 2010). This instrument was administered to students in class and students were given 50 minutes to respond to the questionnaire. The teacher was ubiquitous in all the administrations because there were some vague points that needed to be elucidated by him. The reliability of the all 70 items of this inventory was .87 which is quite satisfactory considering Davies's (1990) criterion. Reliability could have been obtained from the developer of the inventory. But Bachman (1990) reminds us that reliability is a function of test takers who take the test.

Table 1 shows the seven layers of intelligences and their Cronbach alphas:

Table 1: Reliability statistics for intelligence types

Intelligence type	L	Ma	S	Ie	K	Mu	Ia
Reliability	.50	.54	.60	.71	.78	.82	.47

L=Linguistic

Ma=Logical-mathematical

S=Spatial

Ie=interpersonal

K=bodily-kinesesthetic

Mu-Musical

Ia=Intrapersonal

As it can be observed, low reliability indices were observed for some intelligence types.

3-Data analysis

Three types of data analysis were used in the current study. First and foremost, correlational analyses were used to examine the relationship between levels of multiple intelligences on the one hand and also achievement scores on the other. Low correlations were to be expected among different types of intelligences because low correlations are pieces of evidence for the separateness of traits (Kline, 1994).

Multiple regression is a technique by which it is possible to investigate which independent variable or combinations of these variables is the best predictor of a dependent variable (Hatch and Lazaraton, 1991; Ary, Jacobs, and Razavieh, 2002). It was employed to find which of the six variables or intelligences was the best predictor for the achievement scores.

Design:

The design of the study is that of ex-post facto (Ary et al, 2002). In this design, a researcher has no control over the variables. He cannot control or manipulate them. He can only investigate their relationships and/or effects. There are no control or experimental

groups. It is after the fact as the latinistic term implies. In the present study, the dependent variable is the achievement scores of students. The independent variable has seven variables corresponding to the number of intelligence types.

Results:

Descriptive statistics

Table 2 summarizes the descriptive statistics of these 50 students who were the participants of the current study.

Table 2: Descriptive statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
L	50	2	18	8.30	3.059
Ma	50	9	20	14.50	2.845
S	50	3	17	10.92	3.148
Ie	50	3	19	11.66	4.079
K	50	3	19	11.48	4.151
Mu	50	2	19	10.52	4.883
Ia	50	5	17	10.66	2.730
Fscore	46	21	49	37.63	6.104
Valid N (listwise)	46				

Ma=Logical-mathematical

S=Spatial

Ie=interpersonal

K=bodily-kinesthetic

Mu-Musical

Ia=Intrapersonal

As it can be observed in Table 2, the highest mean belongs to logical-mathematical intelligence. This is perfectly understandable on the grounds that most any student is here by the virtue of their logical-mathematical intelligence. It remains to be seen whether this intelligence is the best predictor of success in foreign language learning as well. It is the

case that this intelligence type is the most dominant of all types. As a matter of fact, not only does this intelligence type bring them here to Sharif University, but also this type is the guarantee of their survival in Sharif University environment. However, as elicited via anecdotal observations, the students do agree that intelligence alone is not sufficient and it should be accompanied by hard work. They always quote Einstein saying “Success is 99 percent perspiration and only one percent inspiration.” The lowest mean goes to linguistic intelligence. This makes sense on the grounds that students lack linguistic skills in the sense of manipulation of words and word games. This is evidenced by the fact that they do not appreciate the jokes that revolve around manipulation of words. As a matter of fact, they have their own types of jokes that may fall flat. Part of this may stem from the fact that there is not a correspondence between their pragmatic competence and that of grammatical competence (Jianda, 2007). Pragmatic competence explains the inability of these students to fathom out clues in listening comprehension passages that are based on extralinguistic clues.

The results of the current study run counter to the findings reported in Visser et al (2006) in which the mean of bodily-kinesthetic was largest in the domain of mark making.

Furthermore, to see whether these seven intelligence types are significantly different among students, a repeated measures analysis of variance was performed. As it can be observed in Table 3, the difference in terms of seven intelligence types is significantly different.

Table 3: Repeated measures on levels of intelligence

Source	Type III Sum of Squares	Df	Mean Square	F	sig
Intercept	43501.726	1	43501.726	1171.208	.000
	1819.989	49	37.143		

Answer to the first research question:

To answer the first research question, a correlational analysis was run. The anticipation was that low correlational indices would be arrived at. Table 4 shows the intercorrelation indices of the seven intelligence types. Furthermore, the correlation of the dependent variable, i.e., achievement scores with intelligence types are shown:

Table 4: Intercorrelations of variables

	linguistic	logical- Mathematical	Spatial	interpersonal	intrapersonal	musical	Bodily- kinesthet ic	scores
linguistic	1	.386**	.297*	.298*	.452**	.383**	.376**	-.099
logical- Mathematical	.386**	1	.285*	.187	.335*	.272	.299*	-.019
Spatial	.297*	.285*	1	.249	.248	.242	.376**	-.070
Interpersonal	.298*	.187	.249	1	.151	.335*	.638**	-.331
Intrapersonal	.452**	.335*	.248	.151	1	.170	.301*	-.194
Musical	.383**	.272	.242	.335*	.170	1	.302*	.060
Bodily- kinesthetic	.376**	.299*	.376**	.638**	.301*	.302*	1	-.173
Scores	-.099	-.019	-.070	-.331*	-.194	.060	-.173	1

** . Correlation is significant at .01 level (2-tailed).

As it can be observed, the correlations of the seven levels of intelligences with the scores of the students are low. Interestingly enough, they are negative albeit non-significant at .01

level. In terms of intercorrelations of intelligence types, the correlational indices are relatively high; the highest belonging to that of interpersonal intelligence and bodily-kinesthetic intelligence. The lowest correlation goes to that of interpersonal and intrapersonal intelligence types. All in all, intercorrelations of intelligence types are significant. Kline (1994) claims that low intercorrelations speak to distinctness of traits or variables.

The findings of the current study are not in conformity with those of MacMahon, Rose and Parks (2004) in which there are low or even negative inter-scale correlations.

The results of the study also provide some counter evidence to the findings reported in Saricaoglu and Arikan (2009) in which some, albeit low, correlations were found between students' scores and those of some intelligence types like musical intelligence.

The results of the current do lend support to those of Snyder (2000) in whose study some positive correlations were arrived at between intelligence types and GPA's of students. For example the correlation between GPA of students and interpersonal intelligence was .27.

The answer to the second research question:

To answer the second research question which enquires about the best predictor of students' scores, a multiple regression analysis was run. Table 5 reveals which variable is the best predictor of achievement.

Table 5: Multiple regression analysis

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	44.098	5.683		7.759	.000
	L	.004	.366	.002	.010	.992
	Ma	.158	.393	.068	.401	.690
	S	.003	.312	.002	.011	.991
	le	-.686	.307	-.459	-2.236	.031
	K	.164	.347	.111	.473	.639
	Mu	.235	.201	.192	1.167	.251
	Ia	-.497	.374	-.230	-1.330	.191

a. Dependent Variable: Fscore

L=Linguistic

Ma=Logical-mathematical

S=Spatial

le=interpersonal

K=bodily-kinesthetic

Mu-Musical

Ia=Intrapersonal

As it can be observed in Table 5, the best predictor of success in language is the musical intelligence. The next predictor is kinesthetic intelligence. Considering the Beta values, all the rest of predictors are good ones or in some cases predict in the opposite direction. This holds true for interpersonal and intrapersonal intelligence types.

It is interesting that findings of the current study confirm those of Razmjoo's (2008) findings. In his study, musical study was the best predictor of success of all intelligence types.

Discussion:

To answer the first research question which asked if there were significant intercorrelations of variables, a correlational matrix as in Table 4 was formed. As it was seen, none of the intelligence types correlated in a significant way with the achievement scores of students. This is strange and shows that achievement scores in foreign language learning may be the function of a myriad of factors other than intelligence types. Furthermore, the intelligence types were intercorrelated. The highest

correlation obtained was between interpersonal and bodily-kinesthetic ($r=.63$). This is justifiable to some extent as students who are interpersonally oriented tend to be involved in extra-curricular activities outside class. Sharif University is a big university with a potential for a lot of outdoors activities. Mountaineering group of the university is just one of the examples of many activities taking place in the campus. Anecdotal observations tend to support the assumption that engineering students tend to be intrapersonally dominated. Naturally those who are interpersonal tend to engage themselves in sports-related activities.

The lowest correlation is between interpersonal and intrapersonal intelligence types. This is perfectly fathomable on the grounds that the two belong to opposite poles. In other words, those people who are interpersonal tend to be involved in activities that are not related to reflection about themselves. Consequently the amount of shared variance is negligible

($=.02$). This shows that they have almost little in common. The low correlations of logical-mathematical intelligence with interpersonal has a common sense appeal in that those students who are good at math-related concepts tend to detach themselves from their environments and find solace in solving math problems of their own.

Bodily-kinesthetic intelligence is the only type of intelligence that has significant correlations with all the rest of intelligence types except the dependent variable which is the final scores. Interestingly enough, it is the one of the best predictors of success as well. Speaking of predictors, Table 5 shows musical intelligence is the best predictor of success for language learning. This makes sense in that students who are dominant with respect to musical intelligence tend to listen to English songs via which they pick up words and phrases of the English language. The book that is taught here in this university is quite rich when it comes to lexicon. Naturally students who are adept at music tend to outperform those who don't.

The reason why the study revealed the same results as that of Snyder (2000) may be attributed to the fact that the current study did adopt Armstrong's inventory. In a similar token, Snyder validated her instrument against the same inventory. Furthermore, the reason why Razmjoo's (2008) findings are confirmed are due to the fact that both studies have been conducted within the context of Iranian universities.

Conclusions

Mathematical intelligence is not necessarily the best predictor of achievement as it might have been postulated to be. Attempts should be made to foster other types of intelligences in the university environment. It is fathomable that the university campus is subject to certain restrictions, but students' potentials can be discovered via extracurricular programs. Sharif university students are highly focused on their academic activities so much so that other intelligences may be neglected. The results of the study showed that other intelligences other than logical-mathematical are accountable for students' achievements in foreign language learning. If the right measures are taken and student's talents or abilities are discovered, then we will have students who are multi-dimensional and capable of coping with non-academic issues as well. Hypothetically, take the example of a student who excels in his academic courses, and takes a scholarship for a foreign university. If he is good at spatial intelligence, he will be able to manipulate the new environment easily. Most engineering are endowed with logical-mathematical intelligence. So, having other intelligence types at their disposals puts them at an advantage.

Pedagogical Implications:

The only intelligence type that has significant correlation with all other types is bodily-kinesthetic intelligence. It is important to use this to advantage. Sharif university campus lends itself to various sports activities not the least of which is the mountain climbing group. In so doing, students get to know themselves better and learn from the experiences of one another. Like it was discussed before, engineering students tend to be engulfed in their own worlds. Attempts should be made to involve them in as many activities as possible. This involvement has the added plus of boosting their interpersonal orientation as well which has a high correlation with bodily-kinesthetic intelligence.

Another important factor is incorporating musical activities in classes. This is culturally not possible in our country. But students can be encouraged to listen to

songs in their own free times to take advantage of their musical intelligence as this was the best predictor of success in foreign language learning.

Suggestions for further research

Future researchers may be inspired with the following suggestions for further research.

1-It is entirely possible that Gardner's multiple intelligences and Oxford's (1990) learning strategies are related. Studies can be conducted to investigate the possible relationship between the two (Akbari and Hossieni, 2008).

2-A study can be carried out to the effect whether these intelligences can be nurtured or lend themselves to training.

3-In the current study, success was operationally defined in terms of students' scores on an achievement test of General English. Other studies need to be conducted to test the predictive powers of these intelligence types with respect to general academic achievements. It goes without saying that among engineering students, the best predictor is postulated to be logical-mathematical intelligence.

4-Gender is a potential independent variable that can be investigated.

5-In the present study, data on multiple intelligences were collected via an inventory. The problem with these inventories is that students' choices are limited (Dorneye, 2007). Other data collection methods can be employed like interviews and surreptitious observations (McKay and Gass, 2005).

6-Gardner's MI can be compared with traditional views of intelligence to share if there are commonalities (Almeida, Prieto, Ferreira, Bermejo, Ferrando, and Ferrandiz, 2010).

7-Multiple intelligences can be woven into curriculum. Douglas, Burton and Reese-Durham (2008) compared the effectiveness of multiple intelligences teaching strategy in the academic achievement of students.

(De)Limitations of the study

The following points are brought to the attention of the reader which is why the results of the study should be treated with caution.

First and foremost, the achievement test used, having high validity notwithstanding, could be a suspect. It was the one to which the researcher had easy access and which students took as part of fulfillment for a general course in English. Correlational evidence is not sufficient piece of evidence for the validity of instruments (Grotjahn, 1986).

Second of all, the sample size precludes sweeping generalizations to the whole population at large. Again, the researcher collected the data from his own classes. Students in other classes would have done a perfunctory job of answering the tests and MI items. Given the fact that the study is quantitative in nature, it does not meet the benchmarks set for quantitative studies (Larsen-Freeman and Long, 1991).

Third of all, the study was conducted with engineering students. This definitely reduces the possibility of generalizability to other fields of study.

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