



## Gender and Major Differences in Self-Estimates of Different Aspects of Gardner's Multiple Intelligences: A Study of the Undergraduate Pre-service Teachers in Taiwan

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### Abstract

This study was to examine gender and major differences in self-estimates of different aspects of Gardner's multiple intelligences within pre-service teachers. Questionnaire participants included 411 pre-service teachers at National Changhua University of Education in Taiwan. The findings indicated that there were significant gender differences in self-estimates of verbal-linguistic, musical, math-logic, visual-spatial, and body-kinesthetic intelligences; and there were significant departmental differences in self-estimates of verbal-linguistic, math-logic, visual-spatial, body-kinesthetic, and naturalistic intelligences. Except for verbal-linguistic and math-logic intelligences, there were significant relationships among other aspects of intelligences. Conclusion and implications are also included.

**Keywords:** Gender, Major, Multiple intelligences theory, Self-estimated intelligence, Undergraduate pre-service teacher

### 1. Introduction

According to Gardner (1991), recent cognitive research documents the extent to which students possess different kinds of intelligences and therefore learn, remember, perform, and understand in different ways. These differences challenge an educational system that assumes that everyone can learn the same materials in the same way and that a uniform, universal measure suffices to test student learning. Indeed, as currently constituted, our educational system is heavily biased toward linguistic modes of instruction and assessment and, to a somewhat lesser degree, toward logical-quantitative modes as well. Therefore, many people unjustifiably deemed successful, as well as many needless casualties, emerge from contemporary educational systems. Lazear (1994) illustrate that not all progress is scientifically quantifiable. Students almost always know, understand, and have learned much, much more than they can demonstrate on any tests we administer.

In Taiwan, there are similar situations. Entrance examinations for colleges or high schools and many assessments on academic achievements mainly focus on pencil and paper tests, especially at secondary school level. As a result, some teachers have developed the view that some students are unteachable, and their major focus becomes maintaining discipline. To solve this problem, we need to encourage teachers to think about how to teach through different entries and how they can evaluate students using multiple approaches to assessment, rather than using only pencil and paper tests. Teachers need to look at such things as students' thinking and learning skills; their intellectual, emotional, and social development; their capacity to transfer and apply classroom learning to life in the real world; and their creative problem-solving abilities in their evaluation of students' achievement (Lazear, 1994). However, Campbell and Campbell (1999) indicate, "During pre-service and in-service education, teachers rarely consider the nature of the human learning potential they are responsible for. This gap in our professional knowledge base is akin to doctors being trained without studying the human body or architects being licensed without understanding the physics that allow structures to remain upright" (p. 2). Therefore, it is of the utmost importance that teachers in Taiwan recognize and nurture all of varied human intelligences, and all of the combinations of intelligences.

Multiple intelligence theory was first proposed by Howard Gardner (1983) in his seminal book, *Frames of Mind: The Theory of Multiple Intelligences*. Since that time, educators have become interested in the theory as a means to improve teaching and learning in a multiplicity of ways. According to Gardner, everyone possesses eight distinct intelligences: verbal-linguistic, mathematical-logical, interpersonal, intrapersonal, visual-spatial, bodily-kinesthetic, musical-rhythmic and naturalistic intelligence. Each of the eight intelligences is present to different degrees in a person, with some intelligences being better developed than others. Although there are eight distinct intelligences, each one has many different attributes, with individuals demonstrating considerable variability. Kagan and Kagan (1998) described MI theory as a powerful “catalyst” in education. “It is revitalizing the search for more authentic, student-centered approaches to curriculum, instruction, and assessment” (p.23). From their perspective, MI theory can be used to meet three visions: “(a) to match teaching to the ways student learn, (b) to encourage students to “stretch” their abilities to develop all their intelligences as fully as possible, and (c) to honor and celebrate diversity” (p.182).

Howard Gardner’s theory gives us a starting point for discussion about human intelligence and to talk about why a student does well in one area but not in another. Multiple intelligence approach receives a lot of attention and responses in America. The educators who have been prominent in the field of MI theory (e.g. Campbell & Campbell, 1999; Kornhaber, Fierros, & Veenema, 2004) have focused their applications on elementary education. The few writers who addressed secondary education predominately have focused on either the field of English or the general restructuring of the secondary schools (Armstrong, 1998; Brooks, 1995; Evans, 1995; Gage, 1995). If Gardner’s constructs have been successful with elementary and secondary students, could they be applicable to adults in colleges and universities? Is it possible to instruct pre-service teachers so that they can successfully use MI theory in their own teaching? Which intelligences would enable teachers to be successful in their field of endeavor?

The purposes of this study were to investigate gender and major differences in self-estimates of different aspects of Gardner’s multiple intelligences among undergraduate pre-service teachers. Specifically, the following research questions were addressed in this study:

1. What are the gender differences in pre-service teachers’ self-estimates of Gardner’s multiple intelligences?
2. What are the major differences in pre-service teachers’ self-estimates of Gardner’s multiple intelligences?
3. What are the corrections among eight aspects of multiple intelligences?

## **2. Multiple intelligences: A brief review**

### *2.1 The origin of multiple intelligences*

H. Gardner, a cognitive psychologist at Harvard University, is not the first to recognize multiple human abilities. However, he is the first to acknowledge diverse competencies as forms of human intelligence. Gardner (1987) explores that it is of the utmost importance that we recognize and nurture all of the varied human intelligences, and all of the combinations of intelligences. Human are all so different largely because they all have different combinations of intelligences. If people recognize this, he thinks people will have at least a better chance of dealing appropriately with the many problems that they face in the world. In his book *Frames of Mind: The Theory of Multiple Intelligence* (1983), Gardner defines intelligence as the ability to find and solve problems and create products of value in one’s culture. He points out that the concept of intelligent behavior varies from the culture to culture. The eight intelligences he has identified are: Linguistic, Logical/ Mathematical, Spatial or Visual, Musical, Kinesthetic, Interpersonal, Intrapersonal, and Naturalistic intelligences (Gardner, 1991).

### *2.2 The eight intelligences described*

Gardner provided a means of mapping the broad range of abilities that human possess by grouping their capabilities into eight intelligences (1999):

**Linguistic intelligence:** The capacity to use words effectively, whether orally or in writing. This intelligence includes the ability to manipulate the syntax or structure of language, the phonology or sounds language, the semantics or meanings of language, and the pragmatic dimensions or practical use of language. Some of these uses include rhetoric, mnemonics, explanation, and meta-language.

**Logical-Mathematical intelligence:** The capacity to use numbers effectively and to reason well. This intelligence includes sensitively to logical patterns and relationships, statements and propositions, functions, and other related abstractions. The kinds of processes used in the service of logical-mathematical intelligence include: categorization, classification, inference, generalization, calculation, and hypothesis testing.

**Spatial intelligence:** The ability to perceive the visual-spatial world accurately and to perform transformations upon those perceptions. This intelligence involves sensitivity to color, line, shape, form, space, and the relationships that exist between these elements. It includes the capacity to visualize, to graphically represent visual or spatial ideas, and to orient oneself appropriately in a spatial matrix.

**Bodily-Kinesthetic intelligence:** Expertise in using one's whole body to express ideas and feelings and facility in using one's hands to produce or transform things. This intelligence includes specific physical skills such as coordination, balance, dexterity, strength, flexibility, and speed, as well as proprioceptive and tactile capacities.

**Musical intelligence:** The capacity to perceive, discriminate, transform, and express musical forms. This intelligence includes sensitivity to the rhythm, pitch or melody, and tone color of a musical piece. One can have a figural or "top-down" understanding of music, a form or "bottom-up" understanding, or both.

**Interpersonal intelligence:** The capacity to perceive and make distinctions in the moods, intentions, motivations, and feelings of other people. This can include sensitivity to facial expressions, voice, and gestures; the capacity for discriminating among many different kinds of interpersonal cues; and the ability to respond effectively to those cues in some pragmatic way.

**Intrapersonal intelligence:** Self-knowledge and the ability to act adaptively on the basis of that knowledge. This intelligence includes having an accurate picture of oneself; awareness of inner moods, intentions, motivations, temperaments, and desires; and the capacity for self-discipline, self-understanding, and self-esteem.

**Naturalistic intelligence:** The ability to recognize patterns in nature and classify objects, the mastery of taxonomy, sensitivity to other features of the natural world, and an understanding of the different species.

Beyond the descriptions of eight intelligences, certain aspects of the theory are important to remember. Armstrong (1994) suggested that four elements be considered. First, each person possesses all eight intelligences. Each person has capacities in all eight intelligences. Second, the eight intelligences function together in ways unique to each person. Third, some people appear to possess extremely high levels of functioning in all or most of the eight intelligences, yet others appear to lack all but the most basic aspects of the intelligences. Fourth, Most fall somewhere in between highly developed in some intelligences, mostly developed in others, and relatively underdeveloped in the rest.

Gardner (1983) and Ramos-Ford and Gardner (1991) suggested that these intelligences are autonomous but they are also interactive. In general, students have relative strengths and weaknesses across the intelligences, which has implications for the gifted and talented students. That is, students will differ as to the areas they are considered to be gifted or talented. However, Gardner (2004) points out that it may be timely to reconsider the relationship between IQ (general intelligence) and multiple intelligences theory. Having established the legitimacy of a multiple intelligences approach, Gardner suggests to understand better the differences between individuals who have the standard high IQ (for scholastic intelligence) and those who stand out in order respects, perhaps by having a notably scattered profile of intelligences. Gardner thinks now of high IQ individuals as having a mental searchlight, which allows them to scan wide spaces in an efficient way, while those with a more jagged profile employ a mental laser, which allow them to focus intensely on a more specific area. Politicians, business-persons, leaders of various sorts are more likely to stand out for their high IQs; those who go into the arts, the sciences, or some kind of craft or trade are more likely to display a laser-form of intelligence. The smooth running of society may be depended on having individuals with reliable searchlights; the advances of society may reflect individuals with highly beamed lasers.

In addition, MI makes its contribution to education by suggesting that teachers expand their repertoire of techniques, tools, and strategies beyond the typical linguistic and logical ones predominantly used in U.S. classrooms (Campbell, 1997). MI theory provides an avenue for accomplishing what good teachers have always done: Research beyond the text to provide varied opportunities for students to learn and show evidence of learning. MI theory provides a framework for teachers to reflect on their best teaching methods and to understand why these methods work or why they work well for some students but not for others. It also helps teachers expand their teaching repertoire to include a broader range of methods, materials, and technique for reaching an ever-wider and more diverse range of learners (Standford, 2003).

### **3. Method**

#### *3.1 Participants and settings*

Participants for this study were pre-service teachers (N=411) at the National Changhua University of Education (NCUE). Participants from each department was as follows: (a) Industrial education, 13.62%; Information management, 1.46%; Business Administration, 2.43%; Business Education, 3.65%; Mathematics, 8.52%; Chemistry, 6.81%; Physics, 5.35% ; Biology, 3.41%; Physical Education, 5.11%; Special Education, 6.33%; Guidance and Counseling, 12.41%; English, 8.27% ; Chinese, 8.76%; Art, 5.84%; Geography, 8.03%. Of the total participants, 57.18% were female and 42.82% were male. NCUE is responsible for secondary teacher education as well as in-service training. Most of the NCUE students can take the teacher education program. All of the students indicated an interest in becoming secondary teachers. Student permission to participate was obtained for all participants. Participants took approximately 30 minutes to complete this questionnaire.

### 3.2 Instrument

Participants were given a questionnaire, *How Smart I Am—Knowing Yourself Multiple Intelligences*, which, in a brief introduction, explained the idea of a visual analogue scale. The items of the questionnaire consisted of eight aspects of intelligence proposed by Gardner (1983): verbal-linguistic, mathematical-logical, interpersonal, intrapersonal, visual-spatial, bodily-kinesthetic, musical-rhythmic and naturalistic intelligence. The questionnaire items were modified from Shore (2001) questionnaire items and translated into Chinese version. Initially, a large number of items ( $n=104$ ) was generated as self-reported and describes a person's intellectual disposition in eight general areas, e.g., "Are you good at mental arithmetic?", "Are you good at writing?" Each item used 5-point Likert-type scale ranging from 1 (Statement does not describe you at all) to 5 (Statement describes you exactly).

### 3.3 Analysis Procedure

Confirmatory factor analysis was utilized to confirm the construct of multiple intelligences. CFA allows us to test whether our observed variables define a valid construct and assess the reliabilities of the variables (Byrne, 2001; Shumacker & Lomax, 2004). In order to investigate the conceptual framework of multiple intelligence, utilizing Analysis of Moment Structure (AMOS) software package 5.0 (Arbuckle, 2003), the present study used CFA approach to confirm the eight underlying aspects of multiple intelligence Gardner (1983) developed and apply them to the data of the college students in Taiwan.

For the CFA, the criteria used were as follows: conceptual/theoretical considerations; the factor loadings must exceed .30 or, in most cases, .40 (Stevens, 1996; Tabachnick & Fidell, 1989). In addition, the indices used to test the fit of the models are the  $\chi^2$  statistic, AGFI, CFI, TLI, SRMR, RMSEA, critical N, and Normed  $\chi^2$  (NC). It should be noted that the  $\chi^2$  statistic is sensitive to sample size; therefore, alternative goodness-of-fit indices have been used for the present study. A value of .90 and above for AGFI, CFI, and TLI indicates a reasonable fit (Byrne, 2001). Hu and Bentler (1999) suggested that a value of .08 and less for SRMR indicated a decent fit. Browne and Cudeck (1993) suggested that a value of .08 and less indicated reasonable fit. Researchers have recommended using ratios as low as 2 or as high as 5 to indicate a reasonable fit of Normed Chi-Square (Marsh & Hocevar, 1985). Hoelter (1983) argues that a critical N of 200 or better indicates a satisfactory fit.

After confirming the eight aspects of multiple intelligence, descriptive statistics was then conducted for each gender and department as well as for the eight aspects of multiple intelligence. A *t*-test and analysis of variance (ANOVA) were used to examine multiple intelligence scores as the dependent variables with gender and department as the independent variables. A significant AVOVA was followed by *Scheffé* test to determine differences between means.

## 4. Results

### 4.1 Instrument validation

Eight aspects of multiple intelligence were determined and were named as *verbal-linguistic, mathematical-logical, visual-spatial, bodily-kinesthetic, musical-rhythmic, interpersonal, intrapersonal, and naturalistic*. 102 items within the eight aspects were retained after the confirmatory factor analysis. Utilizing Cronbach's alpha, the reliability coefficient for the measures are .84, .90, .82, .80, .91, .88, .80 and .86, respectively. Table 1 shows parameter estimations of eight aspects of multiple intelligence. Note that the corresponding factor loadings of these indicators were significant at  $\alpha$ -level of .05.

220 pre-service teachers were selected as the respondents of the validation studies. These results indicated that the study already had basic framework validly. In the internal consistency inspection (Table 1), Cronbach's  $\alpha$  for each factor ranged from 0.80 to 0.91. Cronbach's  $\alpha$  for entire questionnaire was 0.94

#### Insert Table 1 about here

Table 2 presents the goodness-of-fit indices of the model of multiple intelligence. The statistical results included the  $\chi^2$  statistic, AGFI, CFI, TLI, SRMR, RMSEA, CN and NC. As shown in Table 2, although the value of the  $\chi^2$  statistic indicated poor fit of the model, it was sensitive to sample size and needed to examine alternative indices. The results of these alternative indices indicated a reasonable fit.

#### Insert Table 2 about here

### 4.2 Gender effects

Means and standard deviations of different types of self-estimates intelligence for male and female were reported in Table 3. In addition to the scores of the eight aspects of multiple intelligence assessed, overall mean self-rated intelligence for both groups was computed. As shown in Table 3, *t*-tests revealed that males' self-estimates of mathematical, visual-spatial, and bodily-kinesthetic intelligences were significant higher as compared to the female sample. In contrast, self-estimates of verbal-linguistic and musical-rhythmic intelligences were significantly higher for the female than for the male sample.

**Insert Table 3 about here***4.3 Major effects*

Overall means and standard deviations of different department pre-service teachers' self-estimated intelligences were reported in Table 4. Table 5 presented the mean scores of pre-service teachers from a variety of academic department areas. There were significant differences among different departments in verbal-linguistic, mathematical-logical, visual-spatial, bodily-kinesthetic, and naturalistic intelligences.

**Insert Table 4 about here****Insert Table 5 about here**

The means, standard deviations, *F* value and *Scheffé* tests of different department pre-service teachers' self-estimated in the above intelligences were shown from Table 6 to Table 10. As shown in Table 6, *F* value and *Scheffé* tests revealed that Chinese literature department participants' self-estimated of verbal-linguistic intelligence ( $F=3.04$ ,  $p<.001$ ), were higher as compared to participants from industrial education, mathematics, physics departments.

**Insert Table 6 about here**

As shown in Table 7, *F* value and *Scheffé* tests revealed that industrial education, mathematics, chemistry, physics department participants' self-estimates of mathematical-logical intelligence ( $F=13.66$ ,  $p<.001$ ), were higher as compared to participants from physical education, special education, guidance and counseling, English literature, Chinese literature departments. In addition to this, mathematics department participants' self-estimates of mathematical-logical intelligence were higher as compared to participants from art and geography department.

**Insert Table 7 about here**

As shown in Table 8, *F* value and *Scheffé* tests revealed that art department participants' self-estimated of visual-spatial intelligence ( $F=6.55$ ,  $p<.001$ ), were significantly higher as compared to participants from physical education, guidance and counseling, English literature, Chinese literature departments.

**Insert Table 8 about here**

As shown in Table 9, *F* value and *Scheffé* tests revealed that physical education department participants' self-estimates of bodily-kinesthetic intelligence ( $F=3.43$ ,  $p<.001$ ), were higher as compared to participants from Chinese literature department.

**Insert Table 9 about here**

As shown in Table 10, *F* value and *Scheffé* tests revealed that biology, geography department participants' self-estimates of naturalistic intelligence ( $F=2.79$ ,  $p<.001$ ), were higher as compared to participants from mathematics department.

**Insert Table 10 about here***4.4 The correlations among MI*

Other than the above intelligences, there were no significant differences in musical-rhythmic, interpersonal, and intrapersonal intelligences among different departments. The Correlations among participants' different types of self-estimated intelligence is presented in Table 11.

**Insert Table 11 about here****5. Discussion***5.1 Gender*

The present study revealed that males do not generally estimate their intelligence higher as compared to females. Significantly higher self-estimates of male were shown for mathematical, visual-spatial, and bodily-kinesthetic intelligences while females rated their verbal-linguistic and musical-rhythmic intelligences significantly higher. Results are partly consistent with the outcome of studies by Furnham et al. (1999), Rammstedt and Rammsayer (2000), and Ksiciński (2000). Furnham et al. indicated significantly higher self-estimates by males were shown for mathematical intelligence, visual-spatial intelligence, and bodily-kinesthetic intelligence while there was no other type of intelligence that showed significantly higher self-ratings for females than for males. Rammstedt and Rammsayer reported that male sample had significantly higher self-estimates of mathematical, visual-spatial intelligences and reasoning as compared to the female sample while females rated their musical-rhythmic intelligence significantly higher than males. Ksiciński's data was compiled from responses from 81 students in remedial classes at College of the Redwoods in California. Results indicated that women rated themselves higher in seven out of the eight MI domains; men rated themselves higher only in the kinesthetic domain.

However, there was no gender difference in interpersonal and intrapersonal intelligences. It was not consistent with the results of studies by Cranford (2005) and Shi and Wang (2007). Cranford examined the difference in emotional

intelligence (EI) between different groups of undergraduates in Singapore. One of the results indicated male undergraduates achieved higher EI scores than female undergraduates. Her finding is consistent with the outcome of the study by Shi and Wang.

Gardner (1993) states that multiple intelligences have a cultural component. Participants of the present study were Taiwanese undergraduate pre-service teachers, while Rammstedt and Rammsayer (2000) tested German undergraduate psychology students, and Furnham et al. tested students from various faculties, more importantly, from different cultures (Britain, Hawaii, and Singapore). From this perspective, various findings of studies may be accounted for by possible cross-cultural differences.

### 5.2 Major

As to the mean scores of pre-service teachers from a variety of academic department areas, respondents from Chinese literature department had significantly higher self-estimates of verbal-linguistic intelligence than respondents from industrial education, math, and physics departments. This finding is consistent with the outcome of a study by Shearer (2004). Shearer selected American high school teachers as participants and found that the high mean score of verbal-linguistic intelligence is the English department. In Taiwan, the Chinese department is regarded as English in the U. S. A. There are significant differences among some various majors in self-estimates of verbal-linguistic intelligence.

Moreover, the high mean scores of mathematical-logical intelligence are math, physics and chemistry departments while the low mean score is the Chinese literature department. This finding is also consistent with the outcome of a study by Shearer (2004). Shearer's study revealed that high mean scores of mathematical-logical were math and science departments while the low mean score is the English literature department. In addition, the present study revealed respondents from math, physics, chemistry, and industrial education departments had significantly higher self-estimates of mathematical-logical intelligence than respondents from the physical education, special education, Guidance and Counseling, English, and Chinese departments. There is a significant difference among some various majors in self-estimates of mathematical-logical intelligence.

Third, the low mean score of visual-spatial intelligence is from the Chinese literature department. This finding is also consistent with the outcome of the study by Shearer (2004). Shearer's study revealed that the low mean score is from the English department. Additionally, the present study revealed respondents from the Arts departments had significantly higher self-estimates of visual-spatial intelligence than respondents from the Physical Education, Guidance and Counseling, English, Chinese departments. There is a significant difference among some various majors in self-estimates of visual-spatial intelligence.

Fourth, the high mean score of bodily-kinesthetic intelligence is from the Physical Education department. This finding is also consistent with the outcome of the study by Shearer (2004). Moreover, the present study revealed respondents from physical education departments had significantly higher self-estimates of bodily-kinesthetic intelligence than respondents from the Chinese department. There is a significant difference among some various majors in self-estimates of bodily-kinesthetic intelligence.

Fifth, the high mean score of naturalistic intelligence is from the Biology department. This finding is partly consistent with the outcome of the study by Shearer (2004). Shearer's study revealed that the high mean score is the Science department. Moreover, the present study revealed respondents from the Biology and geography departments had significantly higher self-estimates of naturalistic intelligence than respondents from the Math department. There is a significant difference among some various majors in self-estimates of naturalistic intelligence.

Highly significant positive correlations ( $p < .01$ ) were found among the other six intelligences except for verbal-linguistic intelligence and mathematical-logical intelligence. This finding is partly consistent with the outcome of a study by Rammstedt and Rammsayer (2000). In Rammstedt and Rammsayer's study, the inter-relationships among the various self-estimated aspects of intelligence in the male and the female samples indicated there is at least one highly significant positive correlation for each intelligence. For example, there are highly significant positive correlations among math, spatial, reasoning, memory, and perceptual speed intelligences. The present study supports Rammstedt and Rammsayer's (2000) findings that self-reports of intelligence are correlated with at least one correlation for each intelligence.

## 6. Conclusion

The aim of the study was to examine gender and major differences in self-estimates of different aspects of Gardner's multiple intelligences within pre-service teachers. The findings indicated that there were significant gender differences in self-estimates of verbal-linguistic, musical, math-logic, visual-spatial, and body-kinesthetic intelligences; and there were significant departmental differences in self-estimates of verbal-linguistic, math-logic, visual-spatial, body-kinesthetic, and naturalistic intelligences. Except for verbal-linguistic and math-logic intelligences, there were significant relationships among other aspects of intelligences.

As literature review mentioned, students possess different kinds of intelligences that warrant attention from teachers, teacher educators, and researchers. In order to let pre-service teachers understood multiple intelligence, this study introduced MI theory by MI methods in a teacher preparation course in Taiwan and understood how the eight intelligences are distributed within samples of pre-service teachers. Traditional teaching methods rely mostly on logical and verbal abilities, but neglect the development of students' potentials. The theory viewpoints of multiple intelligences, on the other hand, remind teachers of valuing students' balanced development in various intelligences, even to assist the development of students' weak intelligences with their strong ones. Undoubtedly, the theory of MI has paved a broad way for the possibilities and thinking that we teach students in accordance with their aptitudes. At the same time, it points out the bias that, from the traditional assessments to the whole culture, logical and verbal education prevails over art education and emotion (personality) education.

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Table 1. Standardized (and unstandardized) solution, and S. E. for eight aspects of multiple intelligence

Parameters	Factor loading	S.E.
MI → verbal-linguistic	.32(1.00) <sup>a</sup>	—
MI → mathematical-logical	.50*(1.87)	.34
MI → visual-spatial	.78*(2.49)	.41
MI → bodily-kinesthetic	.62*(1.94)	.31
MI → musical-rhythmic	.48*(1.93)	.31
MI → interpersonal	.74*(2.21)	.39
MI → intrapersonal	.44*(1.19)	.18
MI → naturalistic	.42*(1.34)	.26

\*  $p < .05$ .

<sup>a</sup> indicates parameters fixed for identification purpose, not estimated.

Note: Parameter estimates are standardized values. Unstandardized values are given in parentheses.

Table 2. Goodness-of-Fit Indices for confirmatory factor analysis

Fit index	Index value
$\chi^2$ (df), $p$ -value	42.39(15), $p < .05$
AGFI; CFI; TLI	.94; .96; .92
SRMR	.039
RMSEA(90% CI)	.066(.043-.090)
Critical N	246
Normed $\chi^2$ (NC)	2.83

Table 3. Means, SD and *t*-test of MI for gender

	Males		Females		<i>t</i> value
	<i>M</i>	S.D.	<i>M</i>	S.D.	
verbal-linguistic	36.72	7.64	39.12	7.68	-3.14**
mathematical-logical	39.65	7.83	32.96	7.72	8.64***
visual-spatial	39.12	6.90	37.61	7.54	2.08*
bodily-kinesthetic	42.51	7.42	39.50	7.79	3.58***
musical-rhythmic	38.90	10.24	41.65	9.69	-2.77
interpersonal	44.04	7.00	44.83	7.77	-1.06
intrapersonal	46.66	8.36	46.66	6.66	.01
naturalistic	34.15	8.82	32.63	7.15	1.92

p<.05.    p<.01.    p<.001.

Table 4. Overall means and SD for different majors of MI

VI	ML	VS	BK	MR	InterP	IntraP	Natural
<b>Industrial Education</b>							
36.09(6.47)	40.61(8.35)	40.(6.40)	42.91(8.42)	39.58(10.88)	45.98(7.27)	48.76(10.04)	33.87(8.68)
<b>Information Management</b>							
36.09(6.47)	40.61(8.35)	40.(6.40)	42.91(8.42)	39.58(10.88)	45.98(7.27)	48.76(10.04)	33.87(8.68)
<b>Business Administration</b>							
32.17(5.53)	39.17(5.56)	39.33(4.93)	42.67(5.43)	41.83(9.15)	42.33(4.41)	45.33(9.14)	26.67(7.58)
<b>Business Education</b>							
37.20(5.94)	36.30(8.50)	35.40(7.23)	39.60(4.86)	41.40(7.44)	45.80(8.04)	47.20(4.92)	32.50(8.70)
<b>Mathematics</b>							
36.93(5.90)	39.46(7.19)	39.53(6.14)	42.33(7.14)	41.13(8.85)	46.80(6.84)	46.93(7.12)	33.53(7.94)
<b>Chemistry</b>							
35.80(8.73)	42.71(6.01)	38.91(6.84)	40.94(7.42)	38.11(11.12)	44.29(7.10)	44.83(6.86)	30.46(7.22)
<b>Physics</b>							
39.57(7.08)	41.93(6.81)	38.96(6.05)	41.61(5.80)	39.93(10.24)	42.50(5.97)	46.43(8.18)	35.82(7.98)
<b>Biology</b>							
33.95(6.54)	42.50(6.07)	39.82(5.84)	40.82(5.81)	39.59(9.86)	43.50(7.84)	46.41(7.69)	34.82(9.43)
<b>Physical Education</b>							
38.07(9.72)	37.57(6.78)	38.86(8.59)	41.43(7.94)	42.21(7.23)	42.64(5.73)	48.14(6.32)	38.93(11.02)
<b>Special Education</b>							
36.67(7.32)	31.29(5.63)	36.29(4.86)	47.57(5.64)	39.48(6.42)	47.29(6.29)	48.57(7.40)	34.19(7.43)
<b>Guidance and Counseling</b>							
38.62(6.64)	32.12(6.84)	38.31(7.67)	39.12(6.88)	41.96(12.32)	43.73(8.21)	46.81(5.89)	30.92(8.22)
<b>English</b>							
38.75(8.68)	32.45(8.45)	34.78(6.90)	39.29(8.51)	42.71(10.14)	46.65(7.59)	47.69(7.36)	31.62(6.79)
<b>Chinese</b>							
40.50(6.64)	31.32(7.20)	34.35(6.13)	40.32(6.96)	40.68(9.78)	41.65(6.90)	45.62(4.94)	31.76(5.93)
<b>Art</b>							
43.33(8.02)	29.08(5.51)	34.50(7.45)	35.11(7.69)	39.08(9.23)	43.83(8.95)	45.81(8.23)	34.25(6.63)
<b>Geography</b>							
39.29(6.89)	32.33(8.07)	46.71(4.28)	41.25(6.59)	43.63(10.03)	43.17(6.52)	45.92(6.21)	30.79(7.45)
<b>Total</b>							
38.10(7.74)	35.82(8.43)	38.26(7.30)	40.79(7.76)	40.48(10.01)	44.49(7.45)	46.66(7.42)	33.28(7.93)

Table 5. Mean percentage scores by high/low pre-service teacher department groups

	Groups	
	High M (Department)	Low M (Department)
verbal-linguistic	43.33(Chinese)	32.17(Information management)
mathematical-logical	42.71(Math) 42.50(Physics) 41.93(Chemistry)	29.08(Chinese)
visual-spatial	46.71(Arts)	34.78(Guidance & Counseling) 34.50(English) 34.35(Chinese)
bodily-kinesthetic	47.57(Physical education)	35.11(Chinese)
musical-rhythmic	43.63(Art)	38.11(Math)
interpersonal	47.29(Physical education)	41.65(English)
intrapersonal	48.76(Industrial education) 48.57(Physical education)	44.42(Geography)
naturalistic	38.93(Biology)	26.67(Information management)

Table 6. Means, SD, *F* value and *Scheffé* tests of verbal-linguistic intelligence for different major

Verbal-linguistic intelligence					
group	Department	<i>M</i>	S. D.	<i>F</i> value	<i>Scheffé</i> test
1	Industrial Education	36.09	6.48	3.04 <sup>***</sup>	
2	Information Management	32.17	5.53		
3	Business Administration	37.20	5.94		
4	Business Education	36.93	5.90		
5	Mathematics	35.80	8.73		13>1, 5, 7
6	Chemistry	39.57	7.08		
7	Physics	33.95	6.53		
8	Biology	38.07	9.72		
9	Physical Education	36.66	7.32		
10	Special Education	38.61	6.63		
11	Guidance and Counseling	38.74	8.68		
12	English	40.50	6.64		
13	Chinese	43.33	8.02		
14	Art	39.29	6.88		
15	Geography	37.78	8.12		

\*\*\*  
p<.001.

Table 7. Means, SD, *F* value and *Scheffé* tests of mathematical-logical intelligence for different major.

Math-logical intelligence					
group	Department	<i>M</i>	S.D.	<i>F</i> value	<i>Scheffé</i> test
1	Industrial Education	40.60	8.34	13.66 <sup>***</sup>	
2	Information Management	39.16	5.56		
3	Business Administration	36.30	8.49		
4	Business Education	39.46	7.18		
5	Mathematics	42.71	6.00		1, 6, 7 >
6	Chemistry	41.92	6.80		9,10,11,12, 13
7	Physics	42.50	6.06		5 >
8	Biology	37.57	6.77		
9	Physical Education	31.28	5.63		9,10,11,12, 13,
10	Special Education	32.11	6.84		14, 15
11	Guidance and Counseling	32.45	8.45		
12	English	31.32	7.20		
13	Chinese	29.08	5.51		
14	Art	32.33	8.06		
15	Geography	33.18	5.46		

<sup>\*\*\*</sup>  
p<.001.

Table 8. Means, SD, *F* value and *Scheffé* tests of visual-spatial intelligence for different major

visual-spatial intelligence					
group	Department	<i>M</i>	S.D.	<i>F</i> value	<i>Scheffé</i> test
1	Industrial Education	40.89	6.39	6.55 <sup>***</sup>	
2	Information Management	39.33	4.92		
3	Business Administration	35.40	7.22		
4	Business Education	39.53	6.13		
5	Mathematics	38.91	6.83		
6	Chemistry	38.96	6.05		
7	Physics	39.81	5.83		
8	Biology	38.85	8.59		
9	Physical Education	36.28	4.85		
10	Special Education	38.30	7.67		
11	Guidance and Counseling	34.78	6.89		
12	English	34.35	6.13		
13	Chinese	34.50	7.45		
14	Art	46.70	4.27		
15	Geography	39.84	8.27		

<sup>\*\*\*</sup>  
p<.001.

Table 9. Means, SD, *F* value and *Scheffé* tests of bodily-kinesthetic intelligence for different major

Bodily -kinesthetic intelligence					
group	Department	<i>M</i>	S.D.	<i>F</i> value	<i>Scheffé</i> test
1	Industrial Education	42.91	8.42	3.43 <sup>***</sup>	
2	Information Management	42.66	5.43		
3	Business Administration	39.60	4.86		
4	Business Education	42.33	7.14		
5	Mathematics	40.94	7.42		
6	Chemistry	41.60	5.80		
7	Physics	40.81	5.81		9>15
8	Biology	41.42	7.94		
9	Physical Education	47.57	5.64		
10	Special Education	39.11	6.88		
11	Guidance and Counseling	39.29	8.51		
12	English	40.32	6.96		
13	Chinese	35.11	7.68		
14	Art	41.25	9.11		
15	Geography	41.03	7.76		

\*\*\*  
p<.001.

Table 10. Means, SD, *F* value and *Scheffé* tests of self-estimated naturalistic intelligence for different major

naturalistic intelligence					
group	Department	<i>M</i>	S.D.	<i>F</i> value	<i>Scheffé</i> test
1	Industrial Education	33.87	8.67	2.79 <sup>***</sup>	
2	Information Management	26.66	7.58		
3	Business Administration	35.50	8.69		
4	Business Education	33.53	7.93		
5	Mathematics	30.45	7.21		
6	Chemistry	35.82	7.98		
7	Physics	34.81	9.43		
8	Biology	38.92	11.02		8, 15>5
9	Physical Education	34.19	7.43		
10	Special Education	30.92	8.21		
11	Guidance and Counseling	31.62	6.79		
12	English	31.76	5.93		
13	Chinese	34.25	6.63		
14	Art	30.79	7.45		
15	Geography	37.25	6.72		

\*\*\*  
p<.001.

Table 11. Correlations among different types of self-estimated intelligence

	1	2	3	4	5	6	7	8
Verbal	1							
Math	.09	1						
Visual	.18(**)	.43(**)	1					
B/K	.15(**)	.32(**)	.47(**)	1				
Musical	.32(**)	.13(**)	.41(**)	.33(**)	1			
InterP	.32(**)	.16(**)	.27(**)	.44(**)	.33(**)	1		
IntraP	.42(**)	.24(**)	.26(**)	.26(**)	.22(**)	.34(**)	1	
Natural	.17(**)	.20(**)	.38(**)	.27(**)	.17(**)	.15(**)	.24(**)	1

\*\* p<.01.