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Senior High School Students' Multiple Intelligences and their Relationship with Academic Achievement in Science

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ABSTRAK

Purpose of the study: This study aims to investigate senior high school students' multiple intelligences and their academic achievement in science.

Methodology: This study employs a descriptive correlational research design. The respondents of this study were 300 in the 11th Grade of senior high school students. The Multiple Intelligences Inventory is used to assess students' intelligence, while their final grade in science measures academic achievement.

Main Findings: The results of this study showed that senior high school students possess all intelligence to a great extent. Existential intelligence obtained the highest mean score of 3.96, as possessed by the respondents. On the other hand, musical intelligence got the lowest mean score of 3.60. It also showed that all multiple intelligences correlate with academic performance achievement. The correlation analysis showed that all multiple intelligences were statistically significant and could positively predict academic achievement in science.

Novelty/Originality of this study: This present study may give insights to teachers about integrating multiple intelligences in the classroom.

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1. INTRODUCTION

Every individual is born with a unique intelligence. Intelligence is a mental ability that involves reasoning, planning, problem-solving, language comprehension, learning new concepts, and abstract thinking. In the past, psychometrists have determined that only one result in a standardized assessment accurately measures intelligence quotient and predicts potential intellectual achievements. According to Gardner [1], only linguistic and logical-mathematical intelligence were assessed and evaluated. Linguistic and logical-mathematical intelligence are not the only forms of intelligence.

Gardner [2] Developed a theory of multiple intelligences which includes seven distinct intelligences: logical-mathematical, linguistic, spatial, bodily-kinesthetic, interpersonal, intrapersonal, and musical, which each individual possesses to varying degrees. In the mid-1990s, naturalistic intelligence was proposed as the eighth intelligence [1], and existential intelligence as the ninth intelligence [3]. This theory explains how we analyze, understand, and recall information, in contrast to the prevailing conceptions of intelligence testing, which assume a general intelligence [4].

Students may use their linguistic intelligence to utilize words, either verbally and in writing; their logical-mathematical intelligence to analyze a problem; their spatial intelligence to visualize and interpret the visual-spatial world accurately; their bodily-kinesthetic intelligence to express thoughts and emotions through

movement; their musical intelligence to recognize, distinguish, and articulate different genres of music; their interpersonal intelligence to understand and interact with other people; their intrapersonal intelligence to understand oneself and self-awareness; their naturalist intelligence to recognize and classify among living organisms and sensitivity to other features of the natural environment; and existential intelligence to address profound questions about human existence.

Academic achievement is a key indicator of educational success. Furthermore, Steinmayr et al. [5], represents performance outcomes demonstrating how well a student achieves learning objectives. [6] emphasizes the relevance of academic achievement from several perspectives. It comprises a variety of educational outcomes. Therefore, its definition depends on the measures used to assess it. Academic achievement should be considered multidimensional, containing diverse learning domains. The best way to evaluate students' academic achievement is through examinations and continuous assessments [7].

The results of Programme for International Student Assessment (PISA) 2018, administered by the Organisation for Economic Co-operation and Development (OECD), revealed that the Philippines scored 357 points in Science Literacy, which is below the benchmark OECD ranking of 489 points [8]. The students can identify the correct explanation of familiar scientific phenomena and use that knowledge to determine if a finding is valid based on the data in simple cases. The results of PISA 2018 show the importance of strengthening the basic education quality within the Philippines. The Department of Education leads this national initiative through *"Sulong EduKalidad 2018,"* which introduces comprehensive reforms in four main areas: upskilling and reskilling of teachers; assessing and improving curriculum; improving learning environment; and supporting and collaborating with stakeholders.

Science is one of the challenging subjects for some students [9]. Students frequently find it difficult to learn science because their conceptions about how the universe works - their techniques for understanding situations - conflict with the scientific concepts they expected to understand [10]. Science teachers provide hands-on activities to help the students to understand the essential idea in a meaningful way. Additionally, teachers discuss the most critical aspects of the action so that students can better understand the concept that needs to be developed. Science education has difficulty determining whether "one-size-fits-all" activities have resulted in learning. As a result, teachers are implementing the theory of multiple intelligence, which focuses on student-centered learning and the necessity of various teaching methods [11, 2].

The K to 12 Basic Education Program is regulated by Republic Act No. 10533. The curriculum should incorporate differentiated pedagogy. Differentiated considers students' learning styles and multiple intelligences, which are significant features of their differences as students and individuals. According to Guignon [12], two of the best ways to use multiple intelligences in the classroom are to make lessons that let students use more than one intelligence and to make tests where students can show they know the material in different ways that fit their intelligence. Moreover, Tolentino [13] enrichment creates more opportunities for students' multiple intelligences to develop with their content-based and skill-based competencies prescribed by the K to 12 curricula.

In related studies, different aspects of this topic have a significant impact, such as the effects of multiple intelligence theory on students' achievements [14]-[19]. Moreover, the multiple intelligence theory poses a template for improving students' academic achievement [20, 21]. However, According to Denig. [22], the multiple intelligence theory has not been subjected to strong experimental tests. It is considered too broad to be helpful in planning curriculum, and the multiple intelligence theory presents a static view of student competence [23].

A review of the literature on multiple intelligences and academic achievement in science revealed that many schools began integrating multiple-intelligence teaching strategies into their classrooms and even the entire curriculum. Many researchers conducted studies to investigate the effect of this strategy on science. The results of several studies conducted on teaching multiple intelligence have shown a wide range of impacts of its application in the classroom. As a result, it is necessary to investigate if there is a significant relationship between senior high school students' multiple intelligences and their academic achievement in science.

2. RESEARCH METHOD

This study is a descriptive correlational research design. The researcher used the multiple intelligences inventory and academic achievement in science to answer the question about the relationship between senior high school students' multiple intelligences and their academic achievement in science. The respondents of this study were 300 in the 11th Grade of senior high school students.

This study utilized a standard questionnaire on the Multiple Intelligences Inventory, which Walter McKenzie developed. The instrument consisted of 90 statements related to nine multiple intelligences proposed by Gardner [3]. Each item describes one of the multiple intelligences manifested in their behaviors, feelings, and attitudes [24]. Each category consisted of 10 items using the five-point Likert scale from "mostly agree" to "mostly disagree." It is reliable, as evidenced by the Cronbach's alpha of .92. The Cronbach's alpha scores indicated that the scales used for the present study were highly reliable.

The multiple intelligences inventory is a standardized test used to assess an individual's strengths in multiple intelligences. Through this test, the researcher found out the profile of students' multiple intelligences. It is a psychological theory about people and their different types of intelligence that will test the students in discovering their most vital types and how they help them learn [25]. On the other hand, their final grade in science measures academic achievement. To assess it, the researcher categorized the qualities of the students into outstanding (90-100), very satisfactory (85-89), satisfactory (80-84), and fairly satisfactory (75-79).

The researcher used Pearson's correlation coefficient to determine the variables' relationship. Pearson's correlation coefficient exemplifies the relationship between two variables [26]. The survey results on senior high school students' multiple intelligences inventory and the academic achievement in science of the respondents were processed using the Statistical Package for Social Sciences (SPSS). The following statistical measures were used for the analysis and interpretation of the collected data:

Table 1. Students' Multiple Intelligences Inventory

Rating Scale	Range	Descriptive Evaluation
5	4.50 – 5.00	Mostly Agree/Very Great Extent
4	3.50 – 4.49	Agree/Great Extent
3	2.50 – 3.49	Slightly Agree/Moderate Extent
2	1.50 – 2.49	Slightly Disagree/Least Extent
1	1.00 – 1.49	Mostly Disagree/None at all

Table 2. Pearson's r Correlation Coefficient Analysis

Pearson's r Correlation Coefficient	Descriptive Evaluation
$\|r\| = 1.0$	Perfect Correlation
$0.8 \leq \|r\| < 1.0$	Very Strong Correlation
$0.6 \leq \|r\| < 0.8$	Strong Correlation
$0.4 \leq \|r\| < 0.6$	Moderately Strong Correlation
$0.2 \leq \|r\| < 0.4$	Weak Correlation
$0.0 \leq \|r\| < 0.2$	Very Weak Correlation
$0.0 \leq \|r\|$	No Correlation

3. RESULTS AND DISCUSSION

Profile of Senior High School Students Multiple Intelligences

Student profiling helps as a guide for understanding more about their capabilities. Teachers must be aware of the student's characteristics to serve as the basis for the method and strategy to be used in the delivery of instruction in classrooms. Multiple intelligences profiling is a practical approach to personal awareness of the potential of students to achieve through tertiary education in the area of career they are studying. Thus, assessing the multiple intelligence profiles of the students should improve teachers' awareness of their cognitive abilities and eventually help them develop skills [27].

All students enter the classroom with various sets of intelligence developed. It implies that each learner should have a range of limitations and intellectual abilities. These sets assess how easy or difficult it is when explicitly addressed for a student to learn the depth of understanding. Therefore, it is difficult and impractical for a teacher to adapt every lesson to all the learning styles used in the classroom. However, the teacher should show students how to use their more developed intelligence to help them understand a subject that usually uses their weaker intelligence [28].

The theory of multiple intelligences is helpful as a technique to improve classroom diversity [29]. Teachers can use the multiple intelligences profiles of the students to plan suit-made activities to enhance learning opportunities inside and outside the classroom.

Table 3. Summary of the Average Mean Scores of Students Multiple Intelligences

Multiple Intelligences	Mean	Verbal Interpretation	Rank
Naturalistic Intelligence	3.65	Great Extent	6th
Musical Intelligence	3.60	Great Extent	9th
Logical-Mathematical Intelligence	3.61	Great Extent	8th
Existential Intelligence	3.96	Great Extent	1st
Interpersonal Intelligence	3.76	Great Extent	5th
Bodily-Kinesthetic Intelligence	3.91	Great Extent	3rd
Linguistic Intelligence	3.62	Great Extent	7th
Intrapersonal Intelligence	3.94	Great Extent	2nd

Spatial Intelligence	3.85	Great Extent	4th
Composite Multiple Intelligence	3.77	Great Extent	

Based on the survey result, Table 3 summarizes the respondents' average mean scores of the multiple intelligences inventory profile. The respondents rated themselves as possessing the composite multiple intelligences to a "great extent" with an average mean score of 3.77. The highest mean score is existential intelligence (M = 3.96); this type of intelligence can be regarded as the dominant intelligence among the 11th Grade senior high school students participating in this study. According to [3], they are curious at their age; they can contemplate life and death's purpose and meaning. They can deal with many questions about being, God, supernatural beings, mysteries on earth, and unfathomable mysteries and miracles. They tend not to be easily satisfied with insufficient facts or data from religion or science. Next to it is intrapersonal intelligence (M = 3.94); they are powerful will and independence. The best performs when they are alone. They can focus on their thing and heavily concentrate on what is presently done and is needed to be done [1].

Third in rank is bodily-kinesthetic intelligence (M = 3.91); these individuals focus their talents or skills on bodily movements that stimulate their muscles and joints. They are usually noticed tapping their fingers or swaying their feet rhythmically, back and forth. They also use body movements and hand gestures when talking to people. They show physical sensations while thinking or working. They do not just enjoy but involve in sports-related activities such as swimming, running, dancing, and the like [1].

Fourth in the rank is spatial intelligence (M = 3.85), which characterizes individuals with talents and skills in drawing and sketching. They possess a natural ability to read maps, charts, or diagrams more quickly than textual meanings. They are geographically oriented and can easily find their way around a new place without being lost [1].

Fifth in the rank is interpersonal intelligence (M = 3.76); they have a natural charm to please, attract and lead people. They manifest a feature or quality that is pleasing or attractive to people. It is why they can easily mingle and associate with other fellow students. They help, entertain, counsel, approach, and empathize with others with ease and charm [1].

Sixth in the rank is naturalistic intelligence (M = 3.65); students possess ability and knowledge about nature. They keenly understand global environmental concerns, trends, and issues [1].

Seventh in the rank is linguistic intelligence (M = 3.62); they love learning new words or phrases when writing essays or conversing. They are most of the time aware and conscious of how words are used. They are very much particular with their grammatical arrangement of sentences or dialogues because they are wordily oriented people; they can have a good memory of people, places, names, and dates [1].

Eighth in the rank is logical-mathematical intelligence (M = 3.61); they can solve math problems in their head and perform mind-boggling games such as chess, checkers, logic puzzles, brainteasers, etc. They can exert efforts in solving math problems [1].

Lastly, musical intelligence (M = 3.60) obtained the lowest mean score among the other intelligence. They can have a keen sense of hearing musical notes. They can identify "out of tune" notes or instruments. They can articulate these notes and make musical variations. These people have good listening skills in music, especially in how the lyrics are pronounced or uttered [1].

Student's Academic Achievement in Science

A student's academic achievement at any point in education depends on the degree to which it develops and improves its natural potential. Individual differences in student academic achievement are evident because all students may be exposed to a similar educational environment and school facilities. Every student's academic achievement can vary due to different skill levels. These differences can be attributed to several factors, both innate and environmental.

Science learning confronts the relevance of science and technology to the needs and demands of society. Science learning is crucial in reshaping students' intellectual awareness towards academic achievement and developing required skills, e.g., subject-specific skills and general and transferable science competencies [30]. The Philippines joined the Program for International Student Assessment (PISA) in 2018 as part of the Quality Basic Education Improvement Plan and as a step towards globalizing the quality of primary education in the Philippines. In PISA 2018, the Philippines scored an average Scientific Literacy score of 357 points, slightly below the OECD's average ranking of 489 points. The mean student score for Filipino is below level 1a of Proficiency.

Consequently, an average Filipino student aged 15 can use basic science knowledge to learn or recognize interpretations of scientific phenomena. They can make organized scientific inquiries with a maximum of two variables, with additional guidance. By contrast, a typical 15-year-old student at Proficiency Level 3 from OECD countries may draw on moderately complex knowledge of content to create explanations for everyday phenomena.

Table 4. Students' Level of Academic Achievement in Science

Level of Academic Achievement	Frequency	Percentage
Outstanding	131	43.67%
Very Satisfactory	67	22.33%
Satisfactory	64	21.33%
Fairly Satisfactory	38	12.67%
Total	300	100.00%

Table 5. Students' Level of Academic Achievement in Science

Level of Academic Achievement	Minimum	Maximum	Mean	Standard Deviation
Average	75.00	98.00	87.66	6.21

Tables 4 and 5 show the respondents' academic achievement level in science. The findings revealed that most 11th Grade senior high school students are very satisfactory performers in their Science subject, as evidenced by the average mean score of 87.66. Forty-three-point sixty-seven percent (43.67%) are outstanding performers, twenty-two-point thirty-three percent (22.33%) are very satisfactory, and twenty-one-point thirty-three percent (21.33%) are satisfactory performers. In comparison, the other twelve-point sixty-seven percent (12.67%) obtained fairly satisfactory. Based on these results, the current study must reinforce science process skills by helping students identify their multiple intelligences. [3] emphasized that using multiple learning strategies helped learners to create new learning experiences.

The learning process through multiple intelligences theory trains students to connect materials to the real world. Prior knowledge investigation is a method for determining to what extent the students have known the prerequisite information and organizing it in their cognitive structures. Based on the student's prior knowledge, the teacher only directs them to study the problems and to follow the teaching process seriously. Then the students can present their abilities based on the materials learned. Then this is continued by reviewing the concepts learned to solidify the concepts they constructed from the previous phase.

[31] found that learner effects related to cognition play a pivotal role in academic achievement. Intelligence is thought to be the master factor between learner-related academic achievement variables. Nowadays, researchers have brought up studies to determine the profile of students' multiple intelligences that belong to various educational grades so that they can stimulate to improve their academic achievement. The researcher also focuses a lot of time on determining if there is any connection between any specific form of learner intelligence and their academic achievement in science.

Table 6. Reliability

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.939	.942	9

As shown in Table 6, the value of (.94) Cronbach Alpha coefficients for the questionnaire was excellent and appropriate for this study investigating the relationship between the multiple intelligences of the students and their academic achievement in science.

Senior High School Students' Multiple Intelligences and their Relationship with Academic Achievement in Science

In the conduct of the study, the hypothesis states that there is no significant relationship between the senior high school student's multiple intelligences and their academic achievement in science. The data collected were subjected to Pearson's correlation coefficient analysis to determine the relationship between the students' multiple intelligences and their academic achievement in science. As shown in Table 15, the Pearson's correlation coefficient results indicate there is a significant correlation between the students' multiple intelligences and their academic achievement in science such as the following: there is a weak relationship between naturalistic intelligence and academic achievement ($r = .37$, $p < 0.05$), a weak relationship between musical intelligence and academic achievement ($r = .27$, $p < 0.05$), a moderately strong relationship between logical-mathematical intelligence and academic achievement ($r = .42$, $p < 0.05$), a weak relationship between existential intelligence and academic achievement ($r = .23$, $p < 0.05$), a weak relationship between interpersonal intelligence and academic achievement ($r = .32$, $p < 0.05$), a weak relationship between bodily-kinesthetic intelligence and academic achievement ($r = .26$, $p < 0.05$), a weak relationship between linguistic intelligence and academic achievement ($r = .28$, $p < 0.05$), a weak relationship between intrapersonal intelligence and academic achievement ($r = .34$, $p < 0.05$), and a weak relationship between spatial intelligence and academic achievement ($r = .34$, $p < 0.05$). The findings are also observed in the study of [32].

It can be shown that students have a wide range and distinct multiple intelligences to acquire and process information to promote the learning process by designing teaching styles and instructional strategies to these capabilities. Further, [2] claimed that different intelligences represent not only other domains of content but also modalities of learning that reflect the different ways of interacting with the world. The findings indicated the students ' potential, which could serve as the basis for the teachers' choice in the delivery of lessons as it is central in the theory of multiple intelligence to focus on the ability of the learners to bring out their potential.

Table 7. Correlation Analysis of Multiple Intelligences and Academic Achievement in Science

Multiple Intelligences	R-value	Interpretation	Significant value	Interpretation	Decision
Naturalistic Intelligences	.37	Weak Correlation	.00	Significant	Reject
Musical Intelligences	.27	Weak Correlation	.00	Significant	Reject
Logical-Mathematical Intelligences	.42	Moderately Strong Correlation	.00	Significant	Reject
Existential Intelligences	.23	Weak Correlation	.00	Significant	Reject
Interpersonal Intelligences	.32	Weak Correlation	.00	Significant	Reject
Bodily-Kinesthetic Intelligences	.26	Weak Correlation	.00	Significant	Reject
Linguistic Intelligences	.28	Weak Correlation	.00	Significant	Reject
Intrapersonal Intelligences	.34	Weak Correlation	.00	Significant	Reject
Spatial Intelligences	.34	Weak Correlation	.00	Significant	Reject
Composite Multiple Intelligences	.31	Weak Correlation	.00	Significant	Reject

Thus, the study rejected the null hypothesis, which states that there is no significant difference between the students' multiple intelligences and their academic achievement in science. The findings of the correlation analysis agree with [33]-[36], who also revealed the significant relationship between students' multiple intelligences toward academic achievement in science. It implies that implementing a multiple intelligence approach improved the student's academic achievement in learning science.

4. CONCLUSION

There are different types of students, and a corresponding instructional approach is necessary to motivate students to learn effectively. These multiple intelligence can enhance through creative strategies, appropriate instructional materials, and a stimulating and nurturing environment. The levels of academic achievement in science of the 11^{th} Grade senior high school students are very satisfactory. The null hypothesis states that there is no significant relationship between the senior high school students' multiple intelligences and their academic achievement in science has been rejected. The findings drew several implications that there is a need to conduct more studies on this issue. This present study may give insights to teachers about integrating multiple intelligences in the classroom.

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