Impact of Multiple Intelligence (MI) on Science Process Skills (SPS) among Senior High School Students

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Abstract: Intelligence is typically described as our cognitive capacities, which is innate, can be evaluated, and is tough to alter. Individuals, on the other hand, have a variety of intelligences, such as musical, interpersonal, spatial-visual, and linguistic intelligences, which are used to describe the whole range of skills and potential that people have. Thus, this research was focused on investigating common types of Multiple Intelligences (MI) and its impact on science process skills of senior high school students in Ghana. To address this problem, questionnaires were formulated to identify the different multiple intelligences various students subscribe to and whether their individual academic needs were met by their teachers. The sample consisted of 200 senior high school students from both public and private schools. The study showed that when a students’ multiple intelligence is taken into consideration during the teaching and learning process, it has a positive effect on the students and can be a remarkable medium of the multiple intelligences advancement of learners. The study's findings will have a huge impact on instructors' prospective teaching strategies, shifting from academic ability to multiple intelligences and focusing on each learner's individual capability.

Keywords: Academic achievement, multiple intelligences, science process skill, senior high school students, teaching strategies.

Introduction

Every instructor in one way or the other has applied multiple intelligences in their classrooms. Various insights have been made in the training framework for some time now. “Each classroom in a school is an intelligence garden. While plants look the same from a distance, each grows in a different way and produces a different fruit” (Temur, 2007, p.87). Each student in the classroom comes from a different background and each student has different abilities, diverse in thinking and behavior. In this 21st century, teachers are to use the diversity of students to teach and meet the needs of every student. Various insights were proposed by Howard Gardner, a formative analyst (1983) implying that typical Intelligence Quotient (IQ) assessments are excessively Restrictive. Various researches (Amponsah, 2020; Amponsah, Kotoka, Beccles, & Dlamini, 2018; Amponsah & Ochonogor, 2018) have used teaching strategies like collaboration, cooperative learning and conceptual change texts to help improve students’ understanding of material taught. This is ultimately not enough as there are other intelligences ignored in using these methods to enhance students’ conceptual understanding of topics taught.

Thus, it is critical for a teacher to create tasks that encompass all sorts of intelligences in order to encourage intellectual competency in her or his students. Gardner's MI theory, according to Yalmanci and Gozum (2013), has two significant...
educational benefits. For starters, it lays the way for educational programmers to be organized in a way that help learners to realize their full potential and achieve their goals. Also, it allows teachers to reach out to more active students because learning would be more appealing if learners were instructed using these intelligences. This happens when an educator's lesson plan includes a wide range of activities connected to several types of levels of intelligence (Carlin, Salazar, & Cortes, 2013). As a result, determining how much a teacher's own inclinations, such as their dominant form of intelligence, are impeding with their capacity to implement MI-inspired teaching is crucial.

Several researches have delved at the theory's implications for teaching and learning in a range of topics, including Language, Psychology, and Science, since Gardner's publication of the MI theory. Multiple intelligence theory should be instituted in classrooms in a range of methods, such as brain-based learning strategies, study groups, video games, and modules, according to Abdi, Laei, and Ahmadyan (2013), Chuang, Tsu and Tsao (2010), and Nurulwahida, Yaacob, and Shaik-Abdullah (2016). Correspondingly, Madkour and Mohammed (2016), Sánchez-Martín, Ivarez-Gragera, Dávila-Acedo, and Mellado (2017), Yurt and Polat (2015) found that integrating learning strategies with learners' intelligence enhanced learners' learning and emotional intelligence, which had a positive impact on learner achievement. Prior researches have tended to focus on the effect of learning practices on student achievement. Few studies have used MI theory to help learners develop their MI and Science Process Skills (SPS). In particular, Chuang, et al. (2010) investigated approaches to improve MI through video game applications and found that employing video game puzzles can assist learners build their multiple intelligences. Similarly, Winarti, Yuanita, and Nur (2019) discovered that educators' pay attention on academic achievement as the sole determining factor of successful learning inhibits educators from developing learners' capability known as Multiple Intelligences (MI), given MI's ability to make learners love learning while also developing their capacities and reasoning abilities. To tackle this problem, a science class designed a teaching methodology based on Multiple Intelligences.

Howard Gardner (1983) said that students have diverse methods for taking care of numerous issues they face during the learning process. He then proposed that there are eight vital intelligences, and that each learner possesses these fundamental insights in accordance with their talents. Gardner now acknowledges that teachers will instruct learners in these eight various approaches to help them achieve their learning objectives. The eight intelligences are linguistic, logical, mathematical, spiral bodily kinesthetic, interpersonal, intrapersonal, naturalistic and musical (Armstrong 2009, p.6). This study was to discover students’ reactions towards various insights in their learning processes in the field of Science in Senior Secondary School.

**Statement of problem**

Intelligence, which is a significant determinant in learning and academic success, was once thought to be a singular entity that one is born with and cannot change. The IQ (Intelligent Quotient) theory, which claims that “intelligence influences people's ability to study, achieve academically, and hence take on leadership roles in society,” reflects this stance on intelligence (Muijs & Reynolds, 2011, p. 16). Several studies have looked at the theory's implications for teaching and learning in a variety of studies. Some researches (Chuang et al., 2010; Abdi, Laei, & Ahmadyan, 2013; Nurulwahida, Yaacob, & Shaik-Abdullah, 2013), have indicated that multiple intelligence theory should be included in classrooms in a variety of methods, including brain-based learning tools, study groups, video games, and modules. Additionally, these studies (Madkour & Mohammed, 2016; Sánchez-Martín, Ivarez-Gragera, Dávila-Acedo, & Mellado, 2017; Yurt & Polat, 2015) have found that associating learning strategies with learners' intelligence enhanced learners’ motivation and emotional intelligence, which had a positive effect on learner achievement. The effectiveness of learning methods on learning outcomes has been the focus of previous study.
Only 20% of a person's achievement may be linked to IQ, according to Goleman (1995). This notion has prompted numerous academics and researchers to investigate and find additional characteristics that contribute an additional 80% to a person's success. The cognitive and remembering components of learners are given the most emphasis in educational institutions. The link between emotions and learning receives minimal emphasis. When dealing with the issue of science learning, emotional intelligence must be considered. Several studies have recently begun to look at the relationship between emotional intelligence and academic achievement among learners, although they have yielded inconsistent results, indicating the need for more research. Thus, the problem that motivated this research is that teachers' emphasis on academic ability as the sole determinant of successful learning prevents students from developing their potential, which is known as MI, which can be used to make students enjoy learning while also developing their potential and thinking skills.

**Objectives of the study**

1. Examine the multiple intelligences among students of senior high schools?
2. Investigate the type of multiple intelligences Integrated Science teachers use to promote the science process skills of their students?

**Research questions**

1. What are the most common multiple intelligences among students of senior high schools?
2. What type of multiple intelligences do Integrated Science teachers use to promote the science process skills of students?

**Significance of the study**

This research is used to build on previous work on incorporating multiple intelligence theory in science learning procedures in senior high schools. It is also expected that the study would focus on learners' diverse perspectives on the science learning process in the classroom to help learners learn and comprehend science more effectively. This study will, for all means and purposes, clarify how different forms of intelligence have a significant impact on the science learning process. It not only assists learners in achieving their learning objectives, but it also assists students in remembering the learning contents that they have mastered so that they can use them in their daily lives. Furthermore, the purpose of this research is to demonstrate the importance of providing variety in learning processes and to appreciate the many characteristics of students' learning behavior as a function of their current intelligence(s).

**Delimitation**

The study was confined to senior high schools in the Adenta Municipality of the Greater Accra Region of Ghana. The study was also restricted to the impact of multiple intelligence-based teaching strategies in enhancing the multiple intelligence and science process skills of senior high school students.

**Review of Related Literature**

**Theoretical Framework**

Gardner proposed the theory of multiple intelligences in the early 1980s as an alternate to conventional teaching strategies that require students to learn and comprehend in a number of ways. Gardner (1983) proposed that students had a range of intelligences rather than a single intelligence. His theory is that everyone has intelligences, but that one of these is more prominent in each individual. Based on the foregoing parameters, he identified eight separate intelligences: "logical-mathematics (number smart), verbal-linguistic (word smart), bodily-kinesthetic (body smart), musical–rhythmic (music smart), interpersonal intelligence (interpersonal intelligence) (e.g., social skills), intrapersonal (e.g., insight, metacognition, self-smart), visual / spatial intelligence, the naturalist (nature smart) and existential intelligence” (Cherry, 2021, p.1).

Verbal-linguistic intelligence; Gardner clarified this insight as affectability to the composed and communicated in language. This insight is for the most part worried about the capacity to fathom and make language effectively both orally and recorded as a hard copy. Artists, essayists, etymologist
columns, dialects instructors are barely any instances of individuals who have verbal-semantics insight.

The capability to calculate and comprehend situations or conditions competently is referred to as logical-mathematical intelligence. Learners with this kind of know how are good at looking for instances and correlations, as well as analytical thinking and reasoning (Gardner 1999a). This form of understanding is linked to deductive reasoning. This is something that people who work in logical and numerical domains should have.

Visual / spatial intelligence is defined as the capacity to perceive, alter, and create images. This intellect is commonly found in sculptors, architects, designers, and artists. Learners with his kind of intelligence are frequently excellent in visual arts classes. Visually intelligent learners learn by watching videos on specific topics.

Musical intelligence refers to the capacity to understand or discern pitch, rhythm, and the emotions of sound. It is displayed by musicians, singers, composers, and music enthusiasts in general.

The term "bodily kinesthetic intelligence" relates to how the body is mostly used to make statements. It's also known as the ability to use the body and its parts to solve issues or create goods. This group includes athletes, professional dancers, physical education instructors, and mechanics.

Intrapersonal intelligence is defined as the ability to have self-awareness and recognize similarities and differences between persons. Gardner (1999b) defines self-awareness as the ability to understand and respect one's sentiments, emotions, desires, strengths, and motives.

Interpersonal intelligence; persons, according to Teele (2000), are pleasant and engage in social activities. These individuals appreciate student engagement, information exchange, and group study.

Naturalistic knowledge is the ability to discern and organize the regular reality in which people live. According to Teele (2000), these people live in harmony with the natural world. Astronomers, zoologists, and microbiologists, among others, require a highly advanced type of this intelligence. Following the publication of the model, Gardner incorporated this type of intelligence as the eighth.

Existential intelligence involves the capability to ponder the existence of humanity, death, the meaning of life, and the purpose of one's existence. Individuals with this intellect question their existence and show a keen curiosity in the origins of life. Gardner (1999b) included it to the list in a thorough examination of the units. There is still some contention regarding this ninth multiple intelligence.

There are a few reservations and issues about Howard Gardner's multiple intelligences; however, the most vexing issue is whether the principles on which Gardner rests his assumptions are adequate. Does his knowledge representation make sense? Is there enough precise proof to support Howard Gardner's conceptualization? In order to test the depths of these concerns, Trumper (2006) examines the application of metrics and specifics covering the understanding, such as image frames, which rules must be followed, and why they are important. According to Gardner, there is a degree of prejudice in the insights.

Empirical Framework

Dean (2002) reviewed Dunns (2002) book: Multiple Education in the Instructing of Literacy Abilities. The book simply demonstrates that the intention is to urge educators to use whatever scholarly procedures that can benefit from outside assistance writers to arrange, process, conceptualize and amend their thoughts and writing. The book is both guard and a guide for, utilizing what Dunn calls multiple literacy, however what different essayists have called Multiple Intelligences or Multimodal approaches. In spite of the fact that the target group is school educators, Dunn depicts techniques that can be utilized in or adjusted high school classrooms. The books completely give a justification to utilizing the methodology recorded to teach how to write, reacts to messages, manage creating and sorting out writings, modifying and manages proficient issues identified with this extended view on literacy skills.
Prior studies have been done on the research topic in the past years and many benefits have been identified in connection with multiple intelligence. Many articles have been written as a result of further study. However, this article does not depute but rather build on the foundational knowledge of Gardner. In an article written under the National Ministry of education, Turkey. The relationship between learning styles and various discoveries, as well as the role of second and unknown dialect learning, was investigated by analysts. Teikner (2005) investigated the relationship between different intelligences and perceptive and social learning styles among Turkish college students. It was observed that there were certain connections between logical-mathematical intelligence and individual learning styles; intrapersonal intelligences and individual learning styles; interpersonal and group learning styles; linguistic intelligence and individual learning styles; interpersonal and kinesthetic learning styles; and linguistic intelligence and individual learning styles. The study's goal was to look at the association between a learner's learning styles, numerous intelligence kinds, and gender in attempt to optimize the learner's language in a foreign language setting.

Lee (2005) looked into the impact of learners' attitudes toward Science. This research examined the attitudes of learners in two separate classes, fifth grade and eighth grade, toward science in connection to teaching science, scientific advancements, and educator qualities. Learners in fifth grade had a considerably more positive attitude toward science than learners in eighth grade, according to the findings.

Trumper (2006) investigated the elements that influence middle school learners' interest in physics. The examination was held to mark the end of the learners' mandatory study in Israel, which was carried out as part of the ROSE Project. Their feelings about scientific classes, their outside-of-school contacts with material science, and their attitudes toward Science and Technology were all factors evaluated. Students' excitement for Physics was mostly neutral, with males showing more excitement than females.

Through control groups and multiple intelligences, Owolabi and Okebukola (2009) led an investigation of the untapped potential of science learners. This study looked into the effects of good pedagogical skills on learners, as well as the effectiveness of comprehending literary skills. The research engaged the participation of 90 science learners from three different classes. The implementation of study groups and multiple intelligence techniques differed dramatically, according to investigation. Because science is a hands-on subject, it's critical to get learners more involved in doing through student-to-student engagement.

Chuang et al. (2010) investigated the efforts to increase multiple intelligence through video game applications and discovered that learners' many intelligences can be strengthened through the usage of video game puzzles. Multiple intelligence theory, according to Yaacob and Shaik-Abdullah (2014), should be implemented in classrooms in a variety of methods, including implementing a mind-based instructional strategies, study group technique, video games, and modules.

According to Dávila-Acedo and Mellado (2017), aligning learning tactics with learners' intelligence boosted learning motivation and emotional intelligence, resulting in improved student accomplishment. However, earlier research has tended to be based on the Effect of Learning Practices on Learning Outcomes. Only a few researches have used multiple intelligences theory to Improve Learners' Multiple Intelligences and Science Process Skills (SPS).

Another contradictory belief that many people hold is that they consider musical and bodily kinesthetic intelligence to be abilities rather than intelligences. Given the observable evidence supporting conceptualization, the most frequently accepted interpretation is that most of Gardner's work isn't just based on grounded research, but rather on his own technique of reasoning and observation. Many people are frequently dissatisfied with the fact that there are no tests to identify or assess different intelligences. Gardner's hypothesis supports the notion that most tests result in stigmatization and labeling. Gardner began to consider the concept of
disseminated insight as a greater means of advancing into the zone than focusing on what goes on in the mind of a single person in the mid-1990s (Gardner and Bring forth, 1989). Frequently, schools and foundations become preoccupied, self-assured, intimidated, or financially depleted to the point that they exhibit no interest for new ideas or practices.

Research Methodology

Research Design

A quantitative research design was used in this study. Quantitative research is a scientific method that is heavily reliant on numerical data and statistics (Creswell & Plano Clark, 2011; Dörnyei, 2007). Quantitatively, cross-sectional descriptive survey design was utilised to investigate the impact of multiple intelligence (MI) on science process skills (SPS) among senior high school students in Ghana.

Population

The target population is made up of public and private senior high schools in the Greater Accra region of Ghana. The accessible population is the public and private schools in the La Nkwanzanang and Adenta municipalities.

Sample and Sampling Techniques

The actual sample of 200 students used for the study was drawn from various public and private schools in the La Nkwananang and Adenta municipalities of the Greater Accra region of Ghana. A total number of 200 respondents were used in this study. This includes 81.5% of students from government schools and 18.5% of students from private schools. A total number of 120 boys and 80 girls participated in the survey, representing 60% and 40% respectively. In order to achieve the aim of the study random sampling was used.

Instrumentation

Due to the global pandemic (COVID-19), online questionnaires in Google forms were used as a means of collecting data as a result of the close down of schools and the critical need of social distancing. There were 36 questions in the questionnaires. The items in the questionnaires were generally grouped under:

- Section 1: Demography of the respondent
- Section 2: Multiple Intelligences
- Section 3: Teaching Strategy

A self-created questionnaire was utilized to gather information. The use of the questionnaire was appropriate for the study because it is an instrument used to gather information from a large group of people and also to collect data about knowledge, beliefs, attitudes and behaviors. An enormous number of information can be gathered from countless individuals in a brief timeframe, and in a cost effective way of gathering data (Ackroyd & Hughes, 1981). Just like other tools of data collection questionnaires ensure anonymity. Questionnaires often allow respondents time to think before responding and also impose uniformity on the information obtained by asking all the respondents the same question.

Data collection Procedure

Due to the global pandemic (COVID-19), the researchers could not send letters to the various schools for data collection. However, online questionnaires in Google forms were sent via WhatsApp to students in Senior High Schools for them to fill. The questionnaires were designed in a way that the identity of students and confidentiality were protected. Prior to administering the questionnaire for the main study, they were pilot tested using a sample of control respondents to ensure the validity of items. Response to questions proved positive and this gave way for the research to take off. Consent from the respondents was obtained prior to administering the questionnaires. All researchers participated in the collection of data.

The data were collected from the students in both private and government schools in the second semester of 2019-2020 academic year. The participants included 200 senior high school students of Form 1, Form 2, and Form 3. They were 80 females and 120 males, between the ages of 13 and 24 with the average being 18. All of the students read Integrated Science which comprises Biology, Chemistry and Physics and Agriculture Science.
Data Analysis

Data collected were analyzed using quantitative data analysis in summarizing data and organizing in such way as to enable the researchers answer the research questions. For the quantitative part, descriptive statistics was used to analyse the demographic section. Percentages, mean, and standard deviation were used to answer the research questions.

Table 1: Demographic representation of respondents

<table>
<thead>
<tr>
<th>Variables</th>
<th>Categories</th>
<th>Number (N)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>120</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Age</td>
<td>13-15</td>
<td>21</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td>16-18</td>
<td>138</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>19-21</td>
<td>33</td>
<td>16.5</td>
</tr>
<tr>
<td></td>
<td>22-24</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Nationality</td>
<td>Ghanaians</td>
<td>186</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>Non-Ghanaians</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Form</td>
<td>SHS1</td>
<td>39</td>
<td>19.5</td>
</tr>
<tr>
<td></td>
<td>SHS2</td>
<td>104</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>SHS3</td>
<td>57</td>
<td>28.5</td>
</tr>
<tr>
<td>Programme</td>
<td>General Science</td>
<td>111</td>
<td>55.5</td>
</tr>
<tr>
<td></td>
<td>Home Economics</td>
<td>13</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>Visual Arts</td>
<td>15</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>General Arts</td>
<td>41</td>
<td>20.5</td>
</tr>
<tr>
<td></td>
<td>Business</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Type of School</td>
<td>Private</td>
<td>37</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td>Public</td>
<td>163</td>
<td>81.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Field data 2020

Results and Discussions

Research Question 1: What are the most common multiple intelligences among students?

The first research question tackled issues related to the most common multiple intelligences among students. This research question sought to find out the most common multiple intelligence amongst students. Therefore, students were asked to indicate their awareness or otherwise of the content areas.

Table 2: Multiple intelligence of students

<table>
<thead>
<tr>
<th>Multiple intelligence</th>
<th>Number (N)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Deviation (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual / spatial</td>
<td>200</td>
<td>1.00</td>
<td>4.00</td>
<td>2.20</td>
<td>0.88</td>
</tr>
<tr>
<td>Musical / Rhythmic</td>
<td>200</td>
<td>1.00</td>
<td>4.00</td>
<td>1.69</td>
<td>0.32</td>
</tr>
<tr>
<td>Logical / Mathematical</td>
<td>200</td>
<td>1.00</td>
<td>4.00</td>
<td>1.74</td>
<td>0.75</td>
</tr>
<tr>
<td>Verbal / Linguistic</td>
<td>200</td>
<td>1.00</td>
<td>4.00</td>
<td>2.00</td>
<td>0.81</td>
</tr>
<tr>
<td>Kinesthetic / Bodily</td>
<td>200</td>
<td>1.00</td>
<td>4.00</td>
<td>1.60</td>
<td>0.68</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>200</td>
<td>1.00</td>
<td>4.00</td>
<td>2.79</td>
<td>1.78</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>200</td>
<td>1.00</td>
<td>4.00</td>
<td>1.56</td>
<td>0.79</td>
</tr>
<tr>
<td>Naturalistic</td>
<td>200</td>
<td>1.00</td>
<td>4.00</td>
<td>1.96</td>
<td>0.99</td>
</tr>
</tbody>
</table>
From Table 2, it is observed that the most common types of multiple intelligences that the students are more inclined to are Interpersonal (M=2.79; SD=1.78), visual intelligence (M=2.20, SD = 0.88), and verbal / linguistic (M=2.00;SD=0.81). This is not surprising as the lecture method dominates the lecture theatres and these three are prevalent in such situations.

### Table 3: Multiple intelligences that are common to students

<table>
<thead>
<tr>
<th>Questions</th>
<th>Always N (%)</th>
<th>Sometimes N (%)</th>
<th>Rarely N (%)</th>
<th>Never N (%)</th>
<th>mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I prefer to draw pictures than to calculate</td>
<td>69 (34.5)</td>
<td>51(25.5)</td>
<td>46 (23)</td>
<td>34 (17)</td>
<td>2.19</td>
<td>1.07</td>
</tr>
<tr>
<td>2. Musicals are more interesting than dramatic plays</td>
<td>61 (30.5)</td>
<td>119 (59.5)</td>
<td>19 (9.5)</td>
<td>1(0.5)</td>
<td>1.78</td>
<td>0.61</td>
</tr>
<tr>
<td>3. I ask a lot of questions about how things work</td>
<td>78 (39)</td>
<td>97 (48.5)</td>
<td>21 (10.5)</td>
<td>4 (2)</td>
<td>1.74</td>
<td>0.74</td>
</tr>
<tr>
<td>4. I like to read science journals to increase my knowledge</td>
<td>60 (30)</td>
<td>79 (39.5)</td>
<td>50 (25)</td>
<td>11(5.5)</td>
<td>2.06</td>
<td>0.84</td>
</tr>
<tr>
<td>5. I enjoy Ludo checkers and other strategy games</td>
<td>81 (40.5)</td>
<td>81 (40.5)</td>
<td>31 (15.5)</td>
<td>7 (3.5)</td>
<td>1.87</td>
<td>0.85</td>
</tr>
<tr>
<td>6. I like to work in groups with other students</td>
<td>96 (48)</td>
<td>80 (40)</td>
<td>15 (7.5)</td>
<td>9 (4.5)</td>
<td>1.72</td>
<td>0.80</td>
</tr>
<tr>
<td>7. I display a sense of independence or strong will</td>
<td>139 (69.5)</td>
<td>47 (23.5)</td>
<td>14 (7.5)</td>
<td>0 (0)</td>
<td>1.57</td>
<td>0.86</td>
</tr>
<tr>
<td>8. I hope to become a geologist, biologist or some other type of scientist</td>
<td>75 (37.5)</td>
<td>61 (30.5)</td>
<td>21 (10.5)</td>
<td>43 (21.5)</td>
<td>2.20</td>
<td>1.17</td>
</tr>
</tbody>
</table>

The statements in Table 3 relate to the eight multiple intelligences. From Table 3, it is observed that the most common types of multiple intelligence were calculated, which the Visual intelligence had the highest mean score of 2.22. The Naturalistic intelligence then followed with the second highest mean score of 2.20, and then followed by the linguistic intelligence with the third highest mean score of 2.06. The three intelligence groups, Intrapersonal, Interpersonal, and Logical intelligence types were observed to be the least with the mean scores of 1.57, 1.72, and 1.74 respectively.

**Research Question 2: What type of multiple intelligences do Integrated Science teachers use to promote the science process skills of students?**

The results on the effectiveness of teaching strategies of teachers to promote science process skills are presented in Table 4. The most common multiple intelligences to show the effectiveness of the teaching strategies, of teachers were calculated and derived. It was observed that the Naturalistic intelligence showed to be the highest with a mean score of 2.68. This was followed by the Linguistic/Verbal intelligence with a mean score of 2.31, and then intrapersonal intelligence with a mean score of 2.19 as seen in Table 4. The three
The study revealed that multiple intelligences affect the science process skills of students (Mohd, Noor, Corrienna, Hayani, & Mhd, 2015). This shows that science process skills and multiple intelligences are linked. Teachers are supposed to obtain competence in merging the many aspects of intelligence and creating their pedagogical skills to enhance science education in the school system so as to boost learner engagement in the classroom and deliver meaningful learning as a result of this. It also creates the human capital that an ever-expanding global system requires. The analyses showed that students are very familiar with all the multiple intelligences and have applied either two or more of the intelligences in their studies. The data above showed that a larger percentage of the students were familiar with the visual intelligence because it had the largest mean of 2.22, followed by the naturalistic intelligence with a mean of 2.20 and linguistic which had a mean of 2.06. It can be interpreted that the participants are more exposed to nature and hence the deduction that their environment was a factor that contributed to their intelligence.

Also, it could be seen that teachers have been inculcating multiple intelligence in their classroom work to help improve the science process skills of the students. Science process skills were connected to multiple intelligences as a teaching technique. This study backed up Shahrokhi, Ketabi, and Dehnoo’s
(2013) advice to use various intelligences in education to satisfy the requirements of all learners. This is due to the fact that multiple intelligence theory is an excellent instrument for achieving educational goals (Hopper & Hurry, 2000). This was shown through the positive correlation between the variables. In relation to the effectiveness of teaching strategies in enhancing multiple intelligence to improve science process skills, all the intelligences had a higher mean with the exception of Logical Intelligence with the lowest mean of 1.69 and Naturalistic Intelligence with the highest mean of 2.68. It is believed that Logical Intelligence had the lowest mean because most teachers were unable to connect what they taught in class to real life experiences. Meanwhile, most students are inclined to the Naturalistic Intelligence and therefore learn from nature. This makes it difficult for students to understand the abstract nature of the teacher’s strategies.

Conclusion, Implications, and Recommendations

Conclusion

The significant inspiration, while operationalizing Gardeners theory, is to give students meaningful self-reflection with respect to everyone’s capabilities. Individual quality perceptions are also linked to self-concept and identification. An individual’s attempt is most successful when they are motivated by a desire to express themselves or do something different. Intelligence is a broad phrase that refers to a mental attribute that encompasses a variety of capabilities. Each individual has one or more intelligences, and Gardner developed the multiple intelligence theory to determine which intelligence each individual holds. This study demonstrates a substantial breakthrough in the feasibility of using different intelligence-based learning procedures in science classes. In light of the outcomes, it tends to be reasoned that there is an essential impact of multiple intelligence-based teaching strategies in enhancing the multiple intelligences and science process skills of students in the senior high schools. The usage of multiple intelligence theories in this research improves multiple intelligence and science process skills of students. The questionnaires used for the research proved to be effective in finding the correlation between students’ learning and the teaching strategies which aid in enhancing the multiple intelligences of students.

The research proved to be useful in finding the effects of multiple intelligences on students learning. The analyses of data paved way to see the underutilized multiple intelligences and how to enhance them among students, and the way forward. The findings of this research will help to improve the structure of science education in the future. Learning is not only aimed at building academic competence at this time, but it is also aimed at promoting learners’ science process skills and potential. Aside from academics, there are several disciplines in which a person can flourish. Academics are an important element of life, but they are not the full answer. Every person possesses intelligence in one or more areas. Everybody should be aware of their inner capabilities and work on honing their skills in this area. The association between multiple intelligence types and teaching styles was studied in this research. Teachers were shown to be the most effective in taking most multiple intelligence types into consideration in choosing their teaching strategies. It was observed from the study that Visual, Verbal and Naturalistic Intelligences are most common among students with Logical, Interpersonal and Intrapersonal Intelligences being the least common among the students. Evidently, most teaching strategies were focused on meeting the multiple intelligence types that were most common among students. Consequentially, certain intelligences, like Logical Intelligence, were found to be underdeveloped among students. As a result, it is suggested that when teachers incorporate multiple intelligences of students while developing instructional tactics, students’ science process skills improve dramatically.

Implications

Emotional intelligence abilities are critical for teachers to operate efficiently. This is because possessing this capacity has been shown to assist students not just performing academically, but also excel in their careers after they enter their professional domains. Emotional intelligence can be
further developed and maintained through extra tuition. The importance of emotional intelligence has not been properly addressed in the senior high school education curriculum in Ghana. It is overdue for the National Council for Curriculum and Assessment (NaCCA) of Ghana to introduce parts of it into their curricula. It is hoped that this will go a long way to help students acquire these critical abilities. The approach implies that learning and teaching should be centered on each individual's specific intelligences. Individuals with great spatial or musical intelligences, for instance, should be motivated to further develop their skills. Gardner emphasized that the various intelligences reflect not just different topical domains, but also different learning mechanisms. Another implication of the theory is that ability evaluations should take into account all types of intelligences, not simply verbal and logical-mathematical intelligences.

**Recommendation**

This study offers insight into the long-term implications of tracking different intelligences when it comes to lesson planning, materials, and learning settings. Teachers can use a variety of ways to help their students increase their intelligences. They can, for example, use simpler assignments and practices to help learners be more contented with their academic achievements. They can also create and present a variety of tasks so that a huge number of learners of various cognitive levels can profit from the lessons they get. Due to the COVID-19 pandemic and the number of learners in schools at the time, this was a small-scale study. It is suggested that more investigations with a large number of learners be undertaken.

**Limitations**

The growth of cognition is a difficult variable to quantify and monitor. Questionnaires appear to be inadequate for assessing intelligence growth. Other accompanying tools are required to better accurately measure intellectual capacity.

**References**


Asia-Pacific Society for Computers in Education.


28. Temur, O. D. (2007). The effects of teaching activities prepared according to the multiple intelligence theory on mathematics achievements and permanence of information


