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EXPLORATIVE EFFICIENCY OF TEACHERS IN DEVELOPING MULTI – MODAL STRATEGIES IN TEACHING SCIENCE

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ABSTRACT: Educators are in constant search for more efficient and effective ways to advance student learning. As exemplified in the Cone of Learning that we remember 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we see and hear, 70% of what we say, and 90% of what we say and do (Edgar Dale). Indeed, a study on strategies is much needed in this times when teachers deal with different types of learners. Thus, this study focused on strategies in teaching science and how efficient are these strategies are implemented by the teachers, Specifically, it looked into the profile of science teachers and their explorative efficiency in developing multi-modal strategies. It used the descriptive method or approach as it tried to describe the profile and the extent of efficiency of the teachers in developing multi-modal strategy. The results revealed that the science teachers have described the extent of their explorative efficiency in using multi – modal strategies in teaching science as highly efficient. There is significant difference in the level of explorative efficiency of science teachers in using multi – modal strategies along analysis, design, development and evaluation phase when grouped according to sex. There is no significant difference in the level of explorative efficiency of science teachers in using multi – modal strategies along analysis, design, development and evaluation phase when grouped according to age, highest educational attainment, bachelor's degree, major field of specialization, master's degree, major, school graduated from, number of years of teaching and number of trainings/seminars attended along pedagogy. It is recommended that further study on the effects of developed multi – modal strategies in teaching Science on the academic performance and attitudes of students towards Science and parallel studies should be conducted focused on the validation of the efficiency of Science teachers in the use of multi – modal strategies.

KEYWORDS: art of teaching science, explorative strategy, multi-modal teaching science

I. INTRODUCTION

The art of teaching Science to be effective is multi – modal in approach. It is a Laboratory – based field of discipline whose instructional requirement is not just technical knowledge on set of procedures to teach it but deep – seated experiential or empirical knowledge on Science concepts which when taught will not just open students' consciousness but bring about milestone interest on the learners to explore the physical and chemical nature of their wholesome environment.

The difficulty encountered in learning science concepts is almost the major clamor of the students which has caused their performance to be poor. In the study of Oscan in 2003, he found out that the difficulties in learning biology have negatively affected the level of motivation in learning biology and students' performance. This dilemma was attributed to many contributory factors which are sometimes neglected or if not overseen by the people in authority.

The abstract nature of science and the teaching methodologies used by teachers in science are among the reasons for the difficulty in learning science (Sedan, 2010). Overloaded biology curricula, the abstract and interdisciplinary nature of biological concepts, and difficulties with the textbooks are the other factors preventing students from learning biology effectively (Tekkaya et al., 2001). Chemistry curricula on the other hand, commonly incorporate many abstract concepts, which are central to further learning in both chemistry and other sciences. The abstract nature of chemistry along with other content learning difficulties means that chemistry classes require a high-level skill set (Taber, 2002). These abstract concepts are important because further chemistry

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concepts or theories cannot be easily understood if these underpinning concepts are not sufficiently grasped by the students (Nicoll, 2001).

The present status of the international science education is highly competitive which is dictated by the First and Second World countries. The government plays an important role in designing empirical innovations to diagnose possible problems that affect the quality of science education in the Philippines to cope with the international standard. Interplay among the government: the science program provider, the teachers: the instructional service provider, and the students: the science program end user should be established to ensure success in the attainment of national goals for science instruction.

The diversity of learners in the classroom and the difference in the degree of complexity of subject content are the reasons why teachers have to apply multi – modal approach in teaching. The use of different approaches in teaching is aimed at achieving the various lesson objectives designed by the teacher in his daily lesson plan.

Teaching is a profession that entails lots of speaking and listening activities which are claimed to be expertise of female individuals. This is evident in schools where females dominate the males in the teaching profession. This is explained by some theories that the brain of men and women are wired differently causing the differences in their abilities. In the study of William McBride (2006) on Brain – based Gender Differences, it came out that male individuals have larger cortical area responsible for spatial – mechanical functioning than female individuals. On the other hand, females have larger cortical area responsible for verbal – emotive functioning than their male counterparts. This could be a basis of difference in the efficiency of the respondents in developing visual, aural, read/write and kinesthetic study strategy in teaching Chemistry.

According to Acero (2007), experience is the best teacher. The length of exposure of teachers in the different angles of the teaching – learning process gives teachers profound experience in dealing with the different issues concerning the educative process. The greater number of years rendered by teachers in teaching may also be a basis in the number of seminars, trainings, workshops attended. The more trainings, seminars and workshops along pedagogy, content and classroom management attended, the richer the experience which may also affect the efficiency level of the teachers in developing multi –modal strategies in teaching Chemistry.

The preparation gained by teachers in their undergraduate course is not enough to achieve mastery of the content of the lesson and competence in the use of the different teaching strategies. This can be enhanced by acquiring post graduate degrees that may widen their spectrum on the different issues of education which can help them improve their competence in their chosen career. This goes with the article “Finishing Your Master’s Degree and Planning Your Next Step” which defined the intended purpose of the master’s degree which is to provide students with an increased level of understanding, depth of knowledge, and applicable skills to be used within their chosen field. (www.alleducationschools.com/.../article/masters-degree-in-education)

Different subject contents in Science necessitate different strategies to make the delivery of the lesson effective and efficient. The selection and use of strategies in teaching is based on the ability of the learners, ability of the teacher, nature of the subject content, objective of the lesson, and school facilities. Students differ in their abilities which increase the diversity of learners inside the classroom. Some students may learn best using visual study strategy, others may be classified aural/auditory learners, some may be good when reading/ writing strategy is used by the teacher, others may excel if kinesthetic study strategy is used and may be combinations of the different multi – modal teaching strategies.

Science is believed to be dynamic causing the curriculum to be dynamic also to suit the needs of end users of the curriculum. This situation of science and curriculum is the reason behind the principle that teachers should continuously develop novel strategies in teaching. The development of teaching strategies include analyze phase, the design phase, the development phase, the implementation phase and the evaluation phase.

In the present curriculum, the Department of Education has undergone series of trainings for its Science teachers to get adjusted on the different competencies that are included in the different grade levels. Science teachers are guided with prototype lessons which are composed of subject content, lesson objectives, strategies and assessment tools. Teachers may modify the strategies indicated for specific subject content in the prototype lesson based on the need of the students. It is on this part of the proto type lesson where Science teachers should think of varied learning activities that would help them make learning efficient and permanent among students. Teachers may consider some activities that would develop the speaking, listening, reading and body kinesthetic skills of the students. The use of these multi – modal strategies in Science teaching agrees with the one of the principles in teaching stated by Acero (2007) that “Teaching Science is effective and efficient if it is multi – sensory in nature.”

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Hypothesis

There is no significant difference in the extent of explorative efficiency of respondents along the different multimodal strategies when grouped according to profile variables.

Statement of the Problem

This study ascertained on the extent of explorative efficiency of teachers in developing multi-modal strategies in teaching science. Specifically, it sought to answer the following questions:

1. What is the profile of the respondents in terms of:
1.1 sex
1.2 age
1.3 highest educational attainment
1.4 bachelor's degree and major
1.5 type of school graduated
1.6 masteral degree and major
1.7 type of school graduated
1.8 number of years teaching science
1.9 number of seminars/trainings attended along pedagogy
2. What is the extent of explorative efficiency of Science teachers in developing multi – modal strategies along:

3.1. analysis phase;

3.2. design phase;

3.3. development phase; 3.4. implementation phase; and

3.5. evaluation phase.

3. Is there a significant difference in the extent of explorative efficiency of the respondents along the different phases of developing multi – modal strategies when grouped according to profile variables?

II. METHODOGY

Research Method

The study made use of descriptive – comparative research design. The descriptive design was used since the study described the information on the profile variables of the respondents together with the extent of explorative efficiency of teachers along the different phases in developing multi – modal strategies in teaching. On the other hand, the descriptive – comparative research design was used in the study to ascertain the difference in the extent of explorative efficiency in developing multi – modal strategy along visual, aural, read/write and kinesthetic study strategy by respondents when they are grouped according to profile variables was also determined.

Locale of the Study

This study was conducted in five (5) government high schools in Tuguegarao City. These schools were selected as respondents of the study because of some reasons. First, these schools are just near the area where the researcher is employed; hence, there is easy access of data to be gathered. Second, these schools are the provider of students of the university where the researcher is employed, thus, result of this research would serve as feedback for the university Science teachers on the strategies to be used during Science instruction. Lastly, these schools have different population size and offer different curricula which add to diversity which were thought by the researcher as an advantage in terms of the quality of data to be gathered.

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Respondents and Sampling Procedure

The respondents of the study were the Science teachers from the public secondary schools of Tuguegarao City. Total enumeration of Science teachers was used and Slovin's formula was used to determine the sample size of student respondents by school.

Research Instrument

The questionnaire was the main tool in gathering the data. Part 1 of the questionnaire elicited information on the profile variables of the respondents. Part 2 of the questionnaire consisted of items that elicited information on the level of efficiency in developing multi – modal strategy which is based on the ADDIE model of Instruction which included 5 Phases namely Analysis, Design, Development, Implementation and Evaluation Phase.

Data Analysis

Descriptive statistics like percentages and mean were used to describe the profile variables, and the problems encountered by the respondents in developing multi – modal strategy. The extent of efficiency in developing multi – modal strategy was determined using computed weighted mean. The following show the ranges and the adjectival description used in describing the level of proficiency and level of efficiency respectively in developing multi – modal strategies.

Mean Range	Descriptive Value
3.25 – 4.00	Highly Efficient
2.50 – 3.24	Efficient
1.75 – 2.49	Inefficient
1.00 – 1.74	Highly Inefficient

The difference in the extent of efficiency in developing multi – modal strategies in teaching Science when grouped according to age, highest educational attainment, bachelor's degree, major, number of years of teaching and number of trainings attended along pedagogy were determined using one – way Analysis of Variance (ANOVA). In like manner, the difference in the explorative efficiency of teachers in developing multi – modal strategies when respondents are grouped according to sex and type of school graduated were determined using t – test for Independent Samples.

III. DISCUSSION

Profile of Respondents

Table 1. Frequency and percentage distribution of respondents according to profile

Category	Frequency	Percentage
Sex		
Male	11	20.4
Female	43	79.6
Age		
25 & below	3	5.6
26 – 30	9	16.7
30 – 35	9	16.7
36 – 40	10	18.5

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41 – 45	10	18.5
46 – 50	6	11.1
51 & above	7	13.0
Mean = 39.15 SD = 9.78		
Highest Educational Attainment		
AB/BS/AB-BSE/BSE	20	37.0
MA/MS/MST	31	57.4
Ph.D.	3	5.6
BS Degree		
BS	8	14.8
AB - BSE	4	7.4
BSE	42	77.8
Major/Area of Specialization		
General Science	18	33.3
Biology	14	25.9
Chemistry	8	14.8
Physics	9	16.7
Physical Therapy	3	5.6
Math	2	3.7
School Graduated for BS degree		
Public	25	46.3
Private	28	51.9
No response	1	1.9
MA Degree		
MA	8	14.8
MS	8	14.8
MST	18	33.3
Not Applicable	20	37.0
MA Specialization		
General Science	5	9.3
Biology	7	13.0
Chemistry	10	18.5
Physics	4	7.4
Science	1	1.9
Educational Management	7	13.0

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Not applicable	20	37.0
School Graduated with MA		
Public	23	42.59
Private	11	20.37
Not applicable	20	37.04
Number of years in teaching		
1 – 10	20	37.0
11 – 20	15	27.8
21 – 30	13	24.1
31 – 40	6	11.1
Mean = 16.50 SD = 10.39		
Number of trainings attended		
1 – 5	17	31.5
6 – 10	14	25.9
11 – 15	5	9.3
16 – 20	8	14.8
None	10	18.5
Mean = 9.00 SD = 6.31		

The frequency and percentage distribution of the teacher-respondents as to their sex, age, highest educational attainment, BS degree, area of specialization, school graduate from for BS degree , master's degree and the area of specialization, school graduated from for MA degree, number of years in teaching, and the number of trainings attended are shown on Table 1.

As seen on the table, out of 54 teacher respondents, 79.6 percent of the science teachers in the public secondary schools in Tuguegarao City are female. This finding implies that teaching is a female dominated profession and is found to be fitted with the characteristics of female individuals which are essential requirements in the teaching profession.

In terms of the age of the teacher respondents, ages within the ranges 36-40 years and 41 – 45 years have the highest percentage over the other age groups while age group 25 and below have the least number of teachers teaching Science. The obtained mean age of 39.15 is an indication that most of the Science teachers belong to the middle age group of Professional Teachers.

On the other hand, in terms of Highest Educational Attainment, 31 or 57.4 percent of Science teachers have finished their Master's Degree, while 20 or 37 percent are not holders of Master's Degree but records obtained by the researcher from the Science Coordinators of their school show that these teachers have finished some units in their Master's degree. Meanwhile, 3 or 5.6 percent of the Science teachers have finished Ph. D. in their field of specialization. In terms of the Bachelor's degree of the respondents, 42 or 77.8 percent of the teachers have finished Bachelor of Secondary Education, 8 or 14.8 have graduated BS course and 4 or 7.4 percent have finished AB – BSE course.

As regards the field of specialization of the respondents, almost all of the Science teachers have undertaken specialized area in sciences which include General Science, Biology, Chemistry and Physics with a percentage of

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33.3, 25.9, 14.8 and 16.7 respectively. This is advantageous on the part of the teachers because they are teaching their field of specialization.

As to the type of school where the teacher respondents finished their BS degree course, it came out that 28 or 51.9 percent of the Science teachers finished their undergraduate course in the private school 25 or 46.3 percent have graduated in the public school.

As regards the Master's degree earned by the Science teachers, 18 out of 34 Science Teachers have obtained MST (Master of Science in Teaching), while 8 of them took MA (Master of Arts) and 8 of them gained MS (Master of Science) in their Master's Degree.

As regards the field of specialization they took in their Master's degree, most of the teachers (10 out of 34) took Chemistry Education as their field of specialization, followed by Biology Education (7 out of 34) and General Science (5 out 34). Meanwhile, 7 of the Science teachers took Educational Management in their Master's Degree which is not related to what they have finished in their Undergraduate Course and to what they are teaching.

In terms of the school where these Science teachers obtained their Master's Degree, 23 out of 34 graduated in the public school in their Master's Degree while 11 out of 34 finished their Master's Degree in the private school.

As to the length of years of teaching Science, 20 or 37 percent of the Science teachers fall within the range 1-10 years of teaching experience while 15 or 27.8 percent fall within the range 11 – 20 years of experience teaching Science, 13 or 24.1 percent of the teacher respondents have rendered teaching services falling within the range 21 – 30 years and there are also 6 or 11.1 percent of teachers who have taught science falling within the range 31 – 40 years. The mean of 16.50 obtained on the number of years teaching Science implies that Science teachers are already classified professional teachers in the teaching profession.

Furthermore, 17 or 31.5 percent of the Science teachers have attended trainings within the range 1 -5, 14 of the teachers have attended 6 – 10 trainings, 5 teachers have attended 11 – 15 trainings and 8 teachers have attended 16 to 20 trainings in the duration of their teaching career. Meanwhile, 10 of the Science teachers haven't attended any training along pedagogy despite their number of years teaching in the Public School.

Extent of Explorative Efficiency of Science Teachers in Developing Multi – Modal Strategies

Table 2. Explorative efficiency in developing multi – modal strategies along analysis phase

Statements	Weighted Mean	Description
1. STUDENT'S FACTOR		
A. I prepare inventory of my student's socio – demographics such as age, gender and family background.	3.19	Efficient
B. I plan testing for the Multi – intelligence and Learning Style of my students.	3.13	Efficient
C. I plan an attitudinaire that determines my students' attitudes, interest and study habits.	3.04	Efficient
D. I conduct consultation activities among my students to diagnose their areas of difficulties.	3.22	Efficient
Mean	3.15	Efficient
2. CONTENT		
A. I prepare syllabus that contains the course content and the appropriate strategies.	3.20	Efficient
B. I plan checklists of learning activities appropriate for each subject content.	3.48	Highly Efficient

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C. I plan for the different mental operations required in achieving the objectives of every subject content.	3.46	Highly Efficient
D. I identify the learning outcomes that can be achieved in the different subject content.	3.44	Highly Efficient
Mean	3.40	Highly Efficient
3. ENVIRONMENT		
A. I plan for scheme of grouping students appropriate with the size of the classroom to ensure ease of movement of students.	3.52	Highly Efficient
B. I check on the availability of equipment needed in the conduct of the strategy.	3.63	Highly Efficient
C. I conduct inspection of the area where teaching will be conducted to ensure the safeness of the students.	3.56	Highly Efficient
D. I consider the structure of the school building to avoid disruption of other classes.	3.54	Highly Efficient
Mean	3.56	Highly Efficient
4. DELIVERY		
A. I know the process of using the strategy in carrying out the plan for instruction.	3.74	Highly Efficient
B. I identify the sequence of learning activities to be achieved in the delivery of instruction.	3.78	Highly Efficient
C. I select strategies appropriate for specific subject content.	3.80	Highly Efficient
D. I identify appropriate instructional materials to be used in achieving lesson objectives.	3.72	Highly Efficient
Mean	3.76	Highly Efficient
Category Weighted Mean	3.47	Highly Efficient

Developing a strategy to teach science concept lucidly is one of the functions of teachers in their chosen career. Developing a strategy takes several steps and starts always in the analysis phase. As regards the efficiency of science teachers in analyzing the different parameters considered in developing a multi – modal strategy, Table 2 shows that teachers rated themselves highly proficient in all items of the different factors considered in the analysis phase except on student factor which was rated "efficient". The mean obtained for the category "student factor" is 3.15 which is interpreted as "efficient" implies that teachers should take extra effort in exploring attributes of the students which are necessary in planning for the appropriate strategy to be used during science instruction. Meanwhile, the item "I prepare syllabus that contains the course content and the appropriate strategies" was rated proficient only with a mean of 3.20. This implies that teachers are not fully competent in preparing syllabus of the subject they are teaching because it is a practice in the Public Schools that prototype syllabi prepared by experts from the Department of Education are distributed for use by all Science teachers nationwide. Nonetheless, the mean obtained for this category is 3.40 which is interpreted as "Highly Efficient" implies that Science teachers are highly competent in planning the content of the subject that they are teaching.

All items included under the category "Environment" and "Delivery" together with their mean were rated "Highly Efficient" by the respondents. This implies that teachers manifest competence in planning for the conditions and location of instruction which are factors that affect the learning of the students. Likewise, Science teachers manifest competence in planning the approaches, strategies and methods that are appropriate for every subject content to effect instruction.

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The obtained weighted mean of 3.47 in the analysis phase with an adjectival description of "Highly Efficient" is an indication that teachers manifest a higher level of competence in analyzing the different factors necessary in developing multi – modal strategy in teaching Science.

Table 3. Extent of explorative efficiency of Science teachers in developing multi – modal strategies design phase.

Statements	Weighted Mean	Description
1. STUDENT'S FACTOR		
A. I construct questionnaire that determines my student's socio – demographic information.	3.19	Efficient
B. I modify items found in the Multi- intelligences and Learning Style Inventory Questionnaire to fit – in to the nature and characteristics of my students.	3.19	Efficient
C. I construct attitudinaire to determine attitudes, interests and study habits of my students.	3.20	Efficient
D. I construct schedule for consultation activities to determine problems encountered during instruction.	3.19	Efficient
Mean	3.19	Efficient
2. CONTENT		
A. I organize the content of the syllabus in tabular form.	3.30	Highly Efficient
B. I sequence subject content based on standards which are stipulated in the Basic Education Curriculum.	3.65	Highly Efficient
C. I prepare checklists of learning activities appropriate for each subject content.	3.44	Highly Efficient
D. I select instructional activities that bring students in focus, retain and transfer science concepts.	3.67	Highly Efficient
Mean	3.52	Highly Efficient
3. ENVIRONMENT		
A. I devise a procedure in the strategy that makes students feel that they belong to the class.	3.61	Highly Efficient
B. I design learning activities that develop cooperation and collaboration among students.	3.57	Highly Efficient
C. I arrange the furniture in the classroom to permit free movement of the students.	3.61	Highly Efficient
D. I obtain updated inventory of equipment, apparatuses and chemical supplies from the supply office.	3.09	Efficient

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Mean	3.47	Highly Efficient
4. DELIVERY		
A. I prepare outline of the procedures of a strategy to be used to carry out the plan for instruction.	3.56	Highly Efficient
B. I identify the sequence of the different learning activities to achieve lesson objectives.	3.69	Highly Efficient
C. I match strategies with subject content based on appropriateness and feasibility of use.	3.67	Highly Efficient
D. I match instructional materials with the strategies and subject content.	3.69	Highly Efficient
E. I categorize subject content into different modes of delivery such as mass, group and individualize instruction.	3.54	Highly Efficient
Mean	3.63	Highly Efficient
Category Weighted Mean	3.46	Highly Efficient

Designing is the second level in developing a multi – modal strategy. In Table 3, it shows the explorative efficiency of science teachers in designing multi – modal strategies of teaching Science. As presented on the table, teachers rated all items under student factor as "Efficient" only. The mean obtained for this category is 3.19 which is described as "Efficient" which implies that teachers are not fully equipped with the ability in designing ways of collecting information as regards the attributes of the learners which are necessary input in designing the environment, the content, and the delivery of instruction.

In addition to this, teachers rated the item "I obtain updated inventory of equipment, apparatuses and chemical supplies from the supply office" 3.09 which is described as efficient. This implies that science teachers do not follow religiously standard operating procedure in the use of laboratory. Somehow, some public schools in the country are not provided with laboratory rooms equipped with laboratory equipment, apparatuses and reagents to undertake experimental procedures during science instruction.

Nonetheless, all items under content, environment, delivery and the category weighted mean were rated highly efficient by the science teachers which mean that they manifested a higher level of competence in designing multi – modal strategy considering the content, environment and delivery factors.

Table 4. Extent of explorative efficiency of Science teachers in developing multi – modal strategies along development phase.

Statements	Weighted Mean	Description
1. STUDENT'S FACTOR		
A. I construct the different parts of the strategy based on socio – demographics of my students.	3.24	Efficient
B. I construct the different procedures of the strategy based on the age and maturity level of my students.	3.30	Highly Efficient
C. I create technique of a strategy that is suitable to my students' individual differences, interests and needs .	3.59	Highly Efficient

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D. I create guidelines of the strategy considering students' multiple – intelligences and learning style.	3.54	Highly Efficient
Mean	3.42	Highly Efficient
2. CONTENT		
A. I generate lesson plan that covers subject content that is responsive of the needs and interests of the students.	3.67	Highly Efficient
B. I construct strategy that covers the essentials of the subject content.	3.57	Highly Efficient
C. I construct strategy that provides balance of subject content.	3.65	Highly Efficient
D. I generate strategy that covers the subject content as prescribed in the Basic Education Curriculum.	3.61	Highly Efficient
Mean	3.63	Highly Efficient
3. ENVIRONMENT		
A. I construct strategy that does not disrupt the learning process of the neighboring classes.	3.57	Highly Efficient
B. I create strategy that does not harm the students, the teacher and the surroundings.	3.63	Highly Efficient
C. I generate strategy that allows students to work comfortably with one another.	3.63	Highly Efficient
D. I construct strategy that requires instructional material that are readily available in the surroundings.	3.63	Highly Efficient
Mean	3.62	Highly Efficient
4. DELIVERY		
A. I create strategy that is simple, enjoyable and relevant.	3.70	Highly Efficient
B. I generate strategy that is economical.	3.63	Highly Efficient
C. I prepare appropriate instructional materials to achieve lesson objectives.	3.72	Highly Efficient
D. I create variation in the delivery of instruction such as mass, group and individualize instruction.	3.69	Highly Efficient
Mean	3.69	Highly Efficient
Category Weighted Mean	3.59	Highly Efficient

Table 4 presents the assessment of teachers on the extent of explorative efficiency of science teachers in developing multi-modal strategies along development phase. As to the development of the multi – modal strategy, only the item "I construct the different parts of the strategy based on socio – demographics of my students" was rated efficient by the teacher respondents. This implies that teachers do not consider to the fullest the socio demographics of the students in developing multi – modal strategy in teaching science.

As shown on Table 4, the mean obtained on the category "Student Factor" is "Highly Efficient". This means that Science teachers are skillful in developing multi – modal strategies considering the different needs, interest, maturity level, and other attributes of the their students. Moreover, Table 8 revealed that teachers are also skillful in developing the multi – modal strategy considering the content of the subject they are teaching as manifested by the mean obtained for the category "Content" which is 3.63 which is described as "Highly

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Efficient". This suggests that teachers manifest expertise in developing multi – modal strategies in teaching Science considering the content of the subject that they are teaching because they are aware of the different qualities of subject content which include validity, feasibility, significance, balance, utility and self-sufficiency (Salandanan, 2007).

Similarly, Science teachers are highly skillful in developing multi – modal strategies considering the conditions of the learning environment of their students and the availability of materials necessary in executing the strategy which is manifested by the obtained mean of 3.62 which is described as "Highly Efficient".

Furthermore, Science teachers demonstrate a higher level of adeptness in considering their abilities as teachers in delivering the content of their subject matter when they develop multi – modal strategies in teaching Science which is reflected by the obtained mean of 3.69 which is described as "Highly Efficient."

Table 5. Extent of explorative efficiency of Science teachers in developing multi – modal strategies along implementation phase.

Statements	Weighted Mean	Description
E. IMPLEMENTATION PHASE		
1. STUDENT'S FACTOR		
A. I execute the strategy that involves maximum participation of the students.	3.70	Highly Efficient
B. I implement the strategy that develops the skill and mental abilities of the students.	3.69	Highly Efficient
C. I perform the strategy to make learning among students efficient.	3.70	Highly Efficient
D. I utilize the strategy to provide confidence and security among the students.	3.69	Highly Efficient
Mean	3.70	Highly Efficient
2. CONTENT		
A. I perform the strategy to make learning of the subject content feasible among the students.	3.65	Highly Efficient
B. I implement the strategy for the students to determine the application of the science concepts in their daily living.	3.65	Highly Efficient
C. I execute the strategy to accomplish the different learning objectives as reflected in the daily lesson plans.	3.67	Highly Efficient
D. I create the strategy to increase self – sufficiency of the subject content.	3.65	Highly Efficient
Mean	3.66	Highly Efficient
3. DELIVERY		
A. Implement the strategy to make learning more efficient among the students.	3.69	Highly Efficient
B. I use the strategy to facilitate the transition from one learning activity to another.	3.70	Highly Efficient
C. I perform the strategy to avoid unnecessary delays and time wastages.	3.69	Highly Efficient

D. I use the strategy to sustain the interest of the students.	3.70	Highly Efficient
Mean	3.70	Highly Efficient
Category Weighted Mean	3.68	Highly Efficient

Implementation phase is the stage in the development of a strategy whereby teachers actually execute the developed strategies. The data presented on Table 9 shows that teachers rated themselves highly efficient in all items considered in the different factors in the implementation phase of developing multi – modal strategies in teaching Science. As to the student's factor, the data reveals that the obtained mean on this category was 3.70 which was interpreted as "Highly Efficient." This means that Science teachers demonstrate a high level of competence in executing the multi – modal strategies that they have developed based on the attributes of the learners.

On the other hand, table 9 shows a computed mean of 3.66 which is described as "Highly Efficient" for the category "Content." This computed mean suggests that Science teachers manifest competence in the application of the developed multi – modal strategies considering the content of the subject that they are teaching. This competence shown by Science teachers along the category "Content" is attributed to the the degree they finished in both undergraduate and post graduate course which is reflected in their profile that almost all of them are Science majors. Likewise, the data presented on table 5 shows that the obtained mean for the category "Delivery" is 3.68 which is described as "Highly Efficient." This suggests that Science teachers are highly skillful in carrying out the developed multi – modal strategy in teaching their subject matter. The skill manifested by Science teachers during the delivery of their subject matter is explained by the course they finished during their undergraduate and post graduate course. The profile of the Science teachers revealed that almost all of them are Bachelor of Secondary Education graduates and Master of Arts and Master of Science graduates in their post graduate course where they were equipped with the different principles and methods of teaching as part of their curriculum.

Furthermore, result presented on table 5 shows that the category weighted mean for the "Implementation Phase" in developing multi – modal strategies in teaching Science is 3.68 which is described as "Highly Efficient." The obtained weighted mean on this phase is an indication that Science teachers are highly skillful in implementing their developed multi – modal strategies in teaching Science. The skill manifested by the Science teachers in implementing the developed multi – modal strategies is explained by the confidence gained by the Science teachers because of their length exposure in teaching their field of specialization. As reflected on the profile of the Science teachers, most of them have taught 1 – 10 years and some have taught for more than 10 years already. This exposure in teaching is necessity for them to be trained well to achieve mastery and expertise of the different facets of teaching. This goes with the Law of Exercise by Edward Thorndike (Acero, 2007).

Table 6. Extent of explorative efficiency of Science teachers in developing multi – modal strategies along evaluation phase.

Statements	Weighted Mean	Description
E. EVALUATION PHASE		
1. STUDENT'S FACTOR		
A. I conduct written exams to determine the understanding of concept by students during and after using the experiment.	3.67	Highly Efficient
B. I administer a practical exam to assess the understanding of the concept by students when the strategy was used.	3.69	Highly Efficient
C. I conduct recitation to check whether students can follow the discussion of the lesson using the strategy.	3.65	Highly Efficient
D. I give board works and seat works to assess mastery of the lesson during and after the use of the strategy.	3.72	Highly Efficient

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E. I give project to determine whether students can translate science concept into concrete form after using the strategy.	3.69	Highly Efficient
Mean	3.68	Highly Efficient
2. CONTENT		
A. I assess whether lesson objectives were met after the prescribed duration of time.	3.70	Highly Efficient
B. I conduct item analysis to determine the concepts that need reinforcement activities.	3.61	Highly Efficient
C. I conduct consultation activities to determine the concepts that need remediation activities.	3.52	Highly Efficient
D. I conduct authentic assessment showing the connection of concepts to real life situations.	3.65	Highly Efficient
Mean	3.62	Highly Efficient
3. DELIVERY		
A. I conduct re – teaching activities to be performed by the students to determine mastery of the subject content.	3.50	Highly Efficient
B. I conduct re – demonstration activities to check whether skills were developed among the students.	3.46	Highly Efficient
C. I conduct peer – tutoring to assess whether students can teach the concept to their classmates.	3.33	Highly Efficient
D. I reflect on the difficulty encountered in executing the teaching strategy.	3.50	Highly Efficient
Mean	3.45	Highly Efficient
Category Weighted Mean	3.59	Highly Efficient

The data presented on table 6 shows the efficiency of Science teachers in evaluating the developed multi – modal strategies in teaching Science. The table shows that every conditions considered under the student's factor obtained a weighted mean described as "Highly Efficient" and the mean obtained for this category is 3.68 which is described as "Highly Efficient". This suggests that Science teachers manifest expertise in evaluating the effect of using the developed multi – modal strategies in teaching their subject matter using different techniques of evaluation. The expertise of Science teachers in evaluating the performance of their students is explained by their exposure to their daily teaching which require them to conduct evaluation of the performance of their students as an integral part of their responsibilities as a teacher which is reflected on their daily lesson plan (Salandanan, 2000).

In terms of the efficiency of teachers in evaluating the effect of using the developed multi – modal strategies in teaching Science along the category "Content", table 6 shows that all items under this category obtained a mean value described as "Highly Efficient" together with the category mean of 3.62 which is described as Highly Efficient". This suggests that Science teachers are highly skillful in determining whether the objectives set forth for specific subject matter were achieved using the developed multi – modal strategies.

As regards the category "Delivery", the data on Table 6 reveals that all conditions considered being evaluated by Science teachers in executing the developed multi – modal strategy obtained a mean described as "Highly efficient together with its category mean of 3.45 which is described as "Highly Efficient". This suggests that teachers demonstrate a certain level of efficiency in evaluating the impacts of executing the developed multi – modal strategy. The efficiency manifested by the Science teachers is attributed to their experiences in giving assessment for every instructional activity conducted which is done by teachers on a daily basis as part of their responsibilities.

Furthermore, the computed category weighted mean for the evaluation phase is 3.59 which is described as

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"Highly Efficient" which means that Science teachers are highly skillful in conducting evaluation of the impact of using the developed multi – modal strategy in teaching Science. The adeptness of these teachers is attributed to their responsibility which is expressed in the line "Every teacher is an evaluator and a researcher (Acero, 2007).

Test of Difference on the Explorative Efficiency of Science Teachers in Developing Multi – Modal Strategies When Grouped According to Profile Variables

Table 7. Test of Difference on the extent of explorative efficiency of Science teachers in developing multi – modal strategies when respondents are grouped according to profile variables.

Variables		Analysis	Design	Development	Implementation	Evaluation
Age	f – ratio	0.539882	0.594819	0.785663	1.196639	0.516723
	p - value (2tailed)	0.77515	0.732843	0.58555	0.324687	0.792656
Sex	Critical value	2.055529	2.093024	2.059539	2.04523	2.024394
	p - value (2tailed)	0.008383*	0.010678*	0.005355*	0.076492	0.020362*
Highest Educational Attainment	f – ratio	0.615336	0.402509	0.062685	0.08539	0.493403
	p - value (2tailed)	0.544423	0.670746	0.939312	0.918285	0.613429
BS degree	f – ratio	0.244849	0.096455	0.095905	0.01524	0.278851
	p - value (2tailed)	0.783738	0.908216	0.908714	0.98488	0.757799
Major	f – ratio	1.230381	1.968908	1.033453	1.002181	1.442376
	p - value (2tailed)	0.309604	0.100346	0.40886	0.42669	0.226358
School Graduated	Critical value	2.007584	2.01174	2.008559	2.008559	2.007584
	p - value (2tailed)	0.089537	0.320029	0.3426	0.910248	0.915298
Master's degree	f – ratio	0.786787	0.821947	0.892341	1.003607	0.409847
	p - value (2tailed)	0.464186	0.448927	0.419958	0.378154	0.667295
Major	f - ratio	2.013377	1.886256	1.519216	1.233189	1.054523

	p - value (2tailed)	0.107489	0.128658	0.215734	0.320042	0.406099
School Grad	Critical value	2.05183	2.042272	2.079614	2.079614	2.073873
	p - value (2tailed)	0.733566	0.656444	0.658663	0.765635	0.63585
Number of Years Teaching Science	f - ratio	0.770448	0.446291	1.195192	1.381033	1.638886
	p - value (2tailed)	0.51601	0.720996	0.321153	0.259357	0.192195
Number of trainings attended	f - ratio	0.823794	0.229895	1.033461	1.263774	0.391238
	p - value (2tailed)	0.516383	0.9203	0.399504	0.296932	0.813901
Type of School where MA was Obtained	Pearson Correlation	-.055	-.068	-.079	.053	-.083
	Sig. (2-tailed)	.760	.706	.663	.768	.647

*significant at p<0.05

On the test of difference on the explorative efficiency of Science Teachers when grouped according to their profile variables, table 7 shows that only one variable showed significant result measured at 0.05 level of significance and that is sex. The gender of the Science teachers showed significant difference in the explorative efficiency of Science teachers along analysis phase, design phase, development phase and evaluation phase. Comparing the means obtained from the male and the female respondents, revealed that male obtained higher mean along analysis phase, design phase, development phase and evaluation phase. This implies that male science teachers are more efficient than female teachers during the analysis, design, development and evaluation of strategy.

The difference in the explorative efficiency of male and female teachers is explained by the difference in the brain size and structure of the male and female brains. Men's brain was found to have approximately 6.5 times more gray matter than in the brain of women. The gray matter in the brain is responsible for logical thinking and is sometimes called the "thinking matter" in the human brain. (http://www.webmd.com/balance/features/howmale-female-brains-differ?page=3)

Furthermore, the research of Madhura Ingalhalikar, et. al. (2013) on the diffusion tensor imaging of the human brain revealed that in all supra-tentorial regions, males had greater within-hemispheric connectivity, as well as enhanced modularity and transitivity. This finding has led the group to conclude that male brains are structured to facilitate connectivity between perception and coordinated action which are essential elements for planning, an activity that is conducted during analysis phase of developing a strategy.

The difference in the design phase between the male and female teachers is based on the creativity of male and female teachers. The higher mean obtained from the male teacher respondents over the mean obtained from female teacher respondents is an indication that males are more creative than female teachers. This is supported by the theory that men has larger parietal cortex, which is involved in space perception, which give men superior spatial abilities over female counterparts. (http://science.howstuffworks.com/life/men-women-differentbrains1.htm) Furthermore, the German philosopher Arthur Shopenhauer has once said that "only males can achieve genius – the highest level of creativity" because he defined it as "the pinnacle of objective, abstract thought." On the other hand, the feminist art historian Linda Nochlin wrote a very influential article in the 1970's called "Why Have There Been No Great Women Artists?" in which she said "there have **NOT** been any great women artists of the caliber of Michelangelo, Shakespeare etc." Likewise, Simonton (2000) has recently indicated that "Psychologists still have a long way to go before they come anywhere close to understanding creativity in women and minorities." In addition to this, it has been noted that male professors produce more creative work in research publications work than female professors (Ajzenberg-Selove, 1994), and men earn more degrees, produce more works of art,

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and make more contributions in professional fields (Piirto, 1998). The preceding works mention are just few of the basis supporting the finding that males farely predominated female in developing multi – modal strategies along design phase.

Along the development phase of developing a multi – modal strategy, the male teacher respondents gained higher mean compared with their counterpart. The male brain is highly specialized, using specific parts of one hemisphere or the other to accomplish specific tasks. Men can focus their brains on particular tasks or activities and are able to focus on narrow issues and block out unrelated information and distractions. These are essential elements in the development of a planned and designed activity. (http://www.steadyhealth.com/articles/Female_vs__Male_Brain___Is_There_A_Difference__a1460.html)

Lastly, along the evaluation phase, the male teachers have obtained a higher mean compared with their female counterparts. Analysis of the structure of the brain tells that "men are able to separate information, stimulus, emotions, relationships, etc. into separate compartments in their brains, while women tend to link everything together". These characteristics are essential in achieving an objective evaluation. (http://www.steadyhealth.com/articles/Female_vs__Male_Brain___Is_There_A_Difference__a1460.html)

Nevertheless, both male and female teachers haven't shown difference in their explorative efficiency in developing multi – modal strategies along implementation phase. This implies that both groups of teachers execute the developed multi – modal teaching strategies because execution of strategies follows standard procedures and achieve standard lesson objectives.

As to the other profile variables included in the study, age, course, school type, highest educational attainment, number of years of teaching and number of trainings along pedagogy have not shown significant difference in the explorative efficiency of science teachers in developing multi – modal strategies. This negative correlation is explained by the similarity in the policies and guidelines set by the Department of Education to all public Schools in the country. All schools are using prototype syllabus in Science designed by the DepEd. All teachers regardless of age, degree earned, school graduated, number of years of teaching and number of years of training along pedagogy are required to undertake training along their fields of specialization sponsored by DepEd.

IV. CONCLUSIONS

In the light of the discussions and findings of the study, the following conclusions can be drawn:

The teaching of Science is female dominated. The Science teachers belong to the middle age group of professional teachers and continue to acquire professional competence by finishing appropriate post graduate course and by teaching their chosen field of specialization. Science teachers follow the scheme verticalization in their post graduate course. Science teachers are professional teachers based on the number of years rendered. Not all science teachers have undergone seminars and trainings along pedagogy.

The science teachers have described the extent of their explorative efficiency in using multi – modal strategies in teaching science as highly efficient. There is significant difference in the extent of explorative efficiency of science teachers in using multi – modal strategies along analysis, design, development and evaluation phase when grouped according to sex. There is no significant difference in the extent of explorative efficiency of science teachers in using multi – modal strategies along analysis, design, development and evaluation phase when grouped according to age, highest educational attainment, bachelor's degree, major field of specialization, master's degree, major, school graduated from, number of years of teaching and number of trainings/seminars attended along pedagogy.

V. RECOMMENDATIONS

In the light of the findings obtained from the study, the following recommendations are proposed:

1. The school heads should provide equal opportunities for teachers to attend seminars/training along pedagogy either in the local, national or international level to enhance the acquired skills of teachers in teaching their field of specialization.

2. The school heads should grant scholarship among their teachers to encourage them to pursue post graduate course along their fields of specialization to strengthen the faculty profile of their school.

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3. The principal or Science coordinators should conduct regular classroom visitation to maintain quality instruction and to validate the perceived level of proficiency in developing multi – modal strategies of Science teachers which they described as highly proficient.

4. The Department of Education (DepEd) should take effort in providing opportunities to all public school teachers to undertake trainings focused on the development of the skills of science teachers in developing strategies which are found to be suitable on the nature, interest and mental abilities of the students

5. The Department of Education (DepEd) should augment the allotted operational budget of all public schools for them to allot funds for teachers who are undertaking creative works like developing novel strategies which are found to facilitate the teaching and learning process.

6. Further study on the effects of developed multi – modal strategies in teaching Science on the academic performance and attitudes of students towards Science.

7. Parallel study should be conducted focused on the validation of efficiency of Science teachers in the use of multi – modal strategies.

VI. REFERENCES

[1] Acero, Victorina et.al. 2007. Principles of Teaching 1. Rex Book Store Inc.

[2] Nicoll, G., (2001). A Report Of Undergraduates' Bonding Alternative Conceptions, *International Journal of Science Education,* 23(7), 707–730.

[3] Salandana, Gloria G. 2000. Teaching Approaches and Strategies. Quezon City: Katha Publishing Co., Inc.

[4] Salandana, Gloria G. 2000. Teaching Approaches and Strategies. Quezon City: Katha Publishing Co., Inc.

[5] http://gcscienceteachers.wordpress.com/about/

[6] http://science.howstuffworks.com/life/men-women-different-brains1.htm

[7] http://www.ehow.com/list_7634819_effective-teaching-learnin strategies.html#ixzz2pYKM7RZL

[8] http://www.nwlink.com/~donclark/hrd/strategy.html

[9] http://www.project2061.org/publications/sfaa/online/chap1.htm

[10] http://www.sei.dost.gov.ph/timss/mfind_c.html

[11] http://www.steadyhealth.com/articles/Female_vs__Male_Brain___Is_There_A_Difference__a1460.html

[12] http://www.webmd.com/balance/features/how-male-female-brains-differ?page=3

[13] www.alleducationschools.com/.../article/masters-degree-in-education [14] www.criced.tsukuba.ac.jp/pdf/09_Philippines_Antonio.pdf