Republic of the Philippines
Department of Education
Region III
Schools Division of City of Balanga
CITY OF BALANGA NATIONAL HIGH SCHOOL
City of Balanga

S.Y. 2014-2015

STRENGTHENING THE INQUIRY-BASED LEARNING TO DEVELOP THE STUDENTS' INQUIRY SKILLS THROUGH PROBLEM-BASED ACTIVITIES"
(AN ACTION RESEARCH)

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I. Situation

Science as a learning area is accountablefor developing the necessary processing skills needed by the learners to come up with thedesired outputs. Understanding how and why things happen is much more important than knowing only what and when. Science can and must be made exciting for students and cannot be isolated by content as explained by Linda Goodin Williams of Crestwood, Kentucky.

To identify the possible cause of thelow performance of the students, a survey was conducted last grading period.InFigure 1, the survey with reference to the students' perception of their Science classis categorized into learner-centered pedagogy, Science-inquiry activities, positive affects and beliefs, grades as feedback and support for self-learning and effort. The results attest that the students seldom observe the Science-inquiry activities that are supposed to be used by the Science teachers as part of their instruction.Science-inquiryor problem-based activities are included in theInquiry- based learning philosophy. This will be the key concern of the current study as a response to the perceived problem.

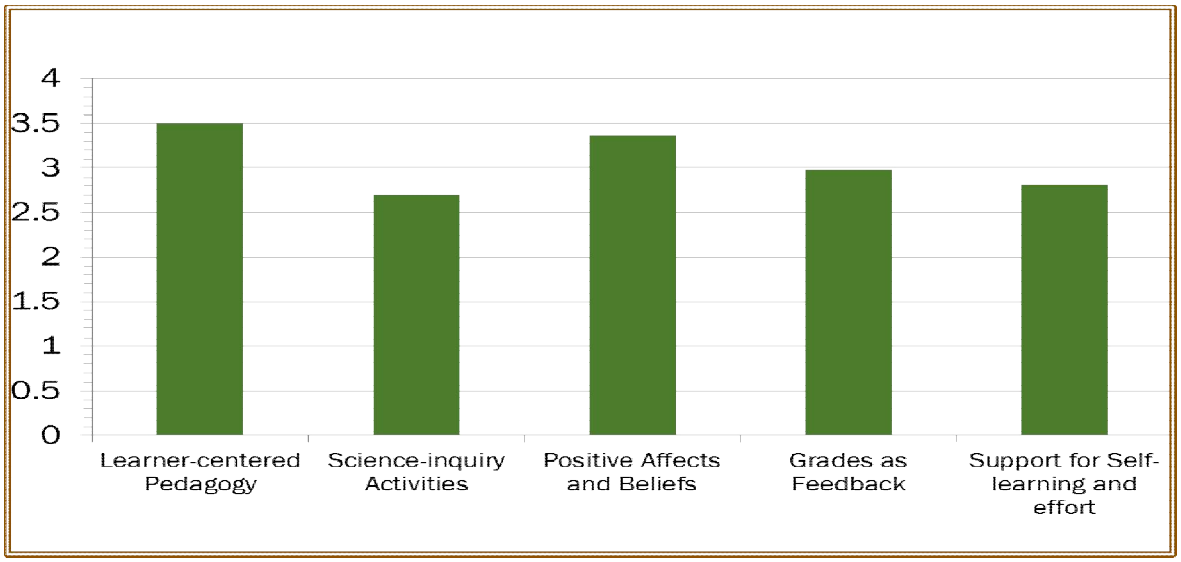

Figure 1. The Results of the Students' Perception of Science Class Survey

II. Statement of the Problem

This study aimedtodevelop the inquiry skills of students by conducting problem-based activities and research project to be facilitated by the teacher-participant of Grade 8 Papaya.

III. Proposed Solution

To address the unsatisfactory performance of the students, the following notions wereanticipated:

1. Learner's Modules in Science (Grade 7-9)were reviewed to identify the skills to be developed among the students, specifically in the Chemistry strand.
2. Prepared problem-based activities(practical works) were performed by the students.
3. Students were given simple problem for their experimental research output.

IV. Actions Undertaken

The following plan of actions was accomplished to test the research problems:

Objectives	Activities/ Interventions	Resources Needed	Time Frame
1. To review the learning competencies of the Learner's Module	Check the content matrix/strand of Chemistry.	Grade 7-9 Learning Modules	3rd quarter (October-December,2014)
2. To develop the inquiry learning skills of students	Employ different problem-based activities: laboratory activities, formulation of hypothesis, testing of theories and conducting a simple scientific write-up.	Students of Grade 8-Papaya taking Chemistry in 3rd quarter Worksheets Materials needed for activities	3rd quarter (January, 2015)

V. Evaluation Criteria

The prepared problem-based activities and research project of the students were assessed using standards. The criteria are the following:

Activity

Criteria	Percentage
Content/Concept	40%
Investigative Processes/skills	40%
Individual Cooperation	20%
TOTAL	**100%**

Research Project

Criteria	Percentage
Content/Concept	40%
Investigative Processes/skills	40%
Validity of Paper	20%
TOTAL	**100%**

The students were divided into five groups. The total average of the students' outputs measured their total performance. The scale below interpreted the students' inquiry learning.

Weighted Average	Descriptive Equivalent
95-100	Outstanding
85-94	High
75-84	Low
65-74	Poor

VI. Data Presentation, Analysis, and Interpretation

Problem-based activities were given as enrichment and the experimental research output as project of the class. The activities and research were characterized as Structured and Guided levels of inquiry*(Heather Banchi and Randy Bell, 2008*).In the given activities, the materials and procedures were posted by the teacher then the

students asked to make their own explanations based on their findings while in their research work, theyasked to design their own procedures, test their hypothesis through experimentation, interpret the results and come up withcomplete scientific write up.

Theaverage scores of the students of 8-Papaya in response to the criteria were presented in Figure 2 below.

Respondent	**Inquiry-based Activities**	**Criteria**			
		Content/Concept (40%)	*Investigative Processes/Skills (40%)*	*Individual Participation (20%)*	**AVERAGE**
8-Papaya	Activity	30	30	20	**80**
	Research Project	*Content/Concept (40%)*	*Investigative Processes/Skills (40%)*	*Validity of Paper (20%)*	**AVERAGE**
		29	32	17	**78**
TOTAL					**79**

Figure 2: Summary of the Average Scores of 8-Papaya in the Inquiry-based Activities

To assess the class performance in the activity, its criteria composed of the content/concept (40%), investigative processes/skills (40%) and individual participation (20%) were applied. Figure 2 showed thatin content, 30% of the class got the expected answers while 10% did not. For the investigative processes and skills, 30% of them utilized the necessary skillsduring the conduct of activity while 10% of them had shown limitedprocessing skills but trying. In terms of participation, each member of the group had contributed their efforts and shared the ideas for the assigned task.

In the class research project, the criteria were the following:the content or concept (40%), investigative processes and skills (40%) and validity of paper (20%). Based on Figure 2 also, considering the content, 29% of the expected hypotheses had beenformulated and concludedscientifically by the class while 11% did not exactly meet the information needed. For investigative skills, out of 40%, 32% showed a positive response in using scientific skills while 8 % failed to do so. In checking their scientific write-up for its validity, 17% had their original copy while the 3% only duplicated the paper of other groups.

To sum up the over-all class performance, the study showed 79% which described those students are still performing *low* in their Science class.

VII. Conclusion

After a period of gathering and testing of the research design, the following inferences are drawn:

1. The learning competencies of Grade 7 to 9 in Chemistry strand are a combination of low and high order thinking skills. In the strand of Grade 8, most of the competencies are LOTS. Inquiry-based learning requires HOTS.
2. In the learner's module, the lessons are activity-based. The teacher could only give instructions in doing the experiments by following the procedures and answering the guide questions. The inquiry learning lets the students formulate hypothesis and work on their findings.
3. The students respond positively to the given problem-based activities. During the experimentation, the collaboration among the groupisevident because they worked as a team. However, difficulty in doing investigation is observed.Inquiry needs a high level of creativity in doing it.

VIII. Reflection

This research is not intended to attest the validity or reliability of our curriculum. The suggested activities in the learner's modules are made based on Constructivism Approach and are ready for execution. The teacher must check if the activity is really suited to the students' capability and needs. Revision or little modification in the activity could be done.However, the competencies must be intact. Development of different learning skills is theonly concern of all educational researches. Inquiry skills, for instance, should be developed if we aim to increase the performance of the students.

The following concerns were observed and hoped to be addressed:

1. The source of the problem may be the result that many teachers appeared to have difficulty creating classroom environment that is inquiry-based *(Chiapetta and Adams, 2000; Minstrell and Van Zee, 2000).*

2. In the process, the possible causes of difficulty that led to students' low performance are poor comprehension in terms of scientific vocabulary, poor mathematical skills, low critical thinking skills and having no experience in writing simple research work; thus, oral communication is also affected.

Inquiry-based learning is fundamental for the development of higher order thinking skills.According to Bloom's Taxonomy, the ability to analyze, synthesize, and evaluate information or new understandings indicates a high level of thinking.Teachers must be prepared to ask students questions to probe their thinking processes in order to assess accurately. Inquiry-science requires a lot of time, effort, and expertise; however, the benefits outweigh the cost when true authentic learning can take place. *(Source: Wikipedia)*

CONTENT AND LEARNING COMPETENCY OF CHEMISTRY STRAND IN GRADE 7 TO 9LEVELS*(Source: K to 12 Curriculum Guide-SCIENCE)*

Grade Level	Content	Learning Competency	Type of Skills
Grade 7	Matter (1st Quarter) Doing Scientific Investigations 1. Ways of acquiring knowledge and solving problems	The learners should be able to: 1. Describe the components of a scientific investigation;	**LOTS**
	2. Diversity of Materials in the Environment 2.1. Solutions	2. Investigate the properties of unsaturated and saturated solutions; 3. Express concentrations of solutions quantitatively by preparing different concentrations of mixtures according to uses and availability of materials;	**HOTS**
	2.2. Substances and Mixture	4. Distinguish mixtures from substances based on a set of properties;	**LOTS**
	2.3. Elements and Compounds	5. Recognize that substances are classified into elements and compounds;	**LOTS**
	2.4. Acids and Bases	6. Investigate properties of acidic and basic mixtures using natural indicators; and	**HOTS**
	2.5. Metals and Nonmetals	7. Describe some properties of metals and nonmetals such as luster, malleability, ductility, and conductivity.	**LOTS/HOTS**

Grade 8	Matter (3rd Quarter) 1. The Particle Nature of Matter 1.1. Elements, Compounds, and Mixtures 1.2. Atoms and Molecules	1. Explain the properties of solids, liquids, and gases based on the particle nature of matter; 2. Explain physical changes in terms of the arrangement and motion of atoms and molecules;	**HOTS**
	2. Atomic Structure 2.1. Protons 2.2. Neutrons 2.3. Electrons	3. Determine the number of protons, neutrons, and electrons in a particular atom;	**LOTS**
	3. Periodic Table (PT) of Elements 3.1. Development of the PT 3.2. Arrangements of Elements 3.3. Reactive and nonreactive metals	4. Trace the development of the PT from observations based on similarities in properties of elements; and 5. Use the PT to predict the chemical behavior of an element.	**LOTS**
Grade 9	Matter (2nd Quarter) 1. Electronic Structure of Matter 1.1.	1. Describe how the Bohr model of the atom improved Rutherford's atomic model; 2. Explain how the Quantum Mechanical Model of the atom describes the energies and positions of the electrons	**HOTS**

	2. Chemical Bonding 2.1. Ionic and Covalent Bonding 2.2. Metallic bonding	3. Explain the formation of ionic and covalent bonds; 4. Recognize different types of compounds (ionic or covalent) based on their properties such as melting point, hardness, polarity, and electrical and thermal conductivity; 5. Explain properties of metals in terms of their structure; 6. Explain how ions are formed;	**HOTS/LOTS**
	3. The Variety of Carbon Compounds 3.1. Carbon Atoms 3.2. Organic Compounds	7. Explain how the structure of the carbon atom affects the type of bonds it forms; 8. Recognize the general classes and uses of organic compounds;	**HOTS/ LOTS**
	4. Mole Concept 4.1. Mass 4.2. Moles 4.3. Percentage Composition of Compounds	9. Use the mole concept to express mass of substances; and 10. Determine the percentage composition of a compound given its chemical formula and vice versa.	**HOTS/ LOTS**

SCIENCE-INQUIRY ACTIVITIES*(Source: Chemistry for the New Millennium, copyright 2000)*

Activity 1: ***Concept of Atom***

Spray, using atomizers, different scents in front of the class. The scents could be of a flower, lemon, strawberry, vanilla and banana. Ask the students to identify each scent after spraying them. Ask them to explain in their own words how they were able to identify scents. Prepare the write up for this activity.

Activity 2: ***Rutherford's Alpha Scattering Experiment***

As an analogy of Rutherford's alphascattering experiment, bring the class outside to play bowling. Borrow or bring some tennis balls to simulate the alpha particles. Find a post such as the supports of volleyball nets that you could use to simulate the nucleus of a gold atom. Instruct the students to fall in line, holding a tennis ball. Then one by one, they would roll the ball at the post as fast as they could.

Guide questions:

1. What percentage of the balls hit the post?
2. What percentage of the balls missed the post?
3. How many of those that hit the post rebounded completely?
4. If the post were somehow invisible, what would you conclude based on the behavior of the balls?

Research Project

Submit a research paper investigating the characteristics of lead (Pb). Problem and materials are provided. Develop your own methods or procedures, form a hypothesis and test it through experimentation then draw your conclusion. Be ready for defense.

Problem: *Why lead (Pb) is not used to carry drinking water, either as storage or vessels or in pipes?*

Materials: *distilled water, a piece of lead, beaker (glass)*

Proposed Format

Problem:
Materials:
Procedures:
Data Analysis and Interpretation:
Conclusion:

Group #:_____ Section:_____ Score:_____

Activity 1: ***Concept of Atom***

What to do: Spray, using atomizers, the scent assigned to your group.

Problem:

_____
_____
_____

Hypothesis:

_____
_____
_____

Presentation of Data and Analysis:

Type of Scent	Explain in your own words how you were able to identify scents

Conclusion:

_____
_____
_____
_____
_____

Group #:_____ Section:_____ Score:_____

Activity 2: ***Rutherford's Alpha Scattering Experiment***

What to do: As an analogy of *Rutherford's alpha scattering experiment*, go outside to play bowling. Borrow or bring some tennis balls to simulate the alpha particles. Find a post such as the supports of volleyball nets that you could use to simulate the nucleus of a gold atom. The students will fall in line, holding a tennis ball. Then one by one, roll the ball at the post as fast as you could.

Problem:

_____
_____
_____

Hypothesis:

_____
_____
_____

Presentation of Data and Analysis:

% of the balls hit the post	% of the balls missed the post	# of the balls hit the post rebounded completely	If the post were somehow invisible, what would you conclude based on the behavior of the balls?

Conclusion:

_____
_____
_____
_____