Active learning through Predict- Observe- Explain- Explore (POEE) Strategy: Implications for the Countryside Grade Seven Chemistry

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Abstract: *Using student- centered approach in teaching chemistry to let students learn actively in order to promote lifelong learning remains a daunting task for science teachers. With this, this research determined effectivity of active learning using POEE strategy in learning chemistry among grade seven students. Active learning is defined as students' engagement in class discussions. This was measured by students' inputs and level of participation through the use of validated survey tool, instructional plans, interview guide and POEE activity sheets. Mixed method research design was employed having 120 student participants. Results revealed that students' predictions did not coincide to projected outcomes due to lack of prior knowledge and learning experiences from their previous years in school. Students qualitatively and quantitatively stated their observations and used deductive model, probabilistic and functional explanation in explaining why and how things happen. Students explored the concepts by applying it to real life situations through solving everyday problems, addressing societal issues, and satisfying one's curiosity. Moreover, students' level of participation was very high. Generally, students were actively engaged in class discussions through POEE strategy. By this, it is recommended that science educators should use student-centered approach through POEE strategy with hands-on activities to actively engage students in learning chemistry.*

I. INTRODUCTION

Active learning is promoted and highly recommended to be used in the classrooms, in order to let the learners, take responsibility in learning and exploring new things and to help teachers to effectively use guided instruction to make learning relevant and highly contextualized (Carr et al., 2015). However, teacher-centered approach in traditional teaching is still widely used (Karamustafaoglu, 2009 and Robinson, 2017) wherein teachers lecture to class and give students limited time to participate and be involved in class discussions (UNESCO, 2016). This method lessens students' personal interest in learning (Harper, 2017) which results to low level of students' performance in National Achievement Tests (Mustacisa, 2016 & Magno, 2011).

One of the teaching strategies that this study will emphasize is White and Gunstone's Predict- Observe- Explain- Explore (POEE) strategy (1992), POE strategy which aimed at allowing students to explore and develop meaningful predictions, and their explanations for the predictions made about a certain phenomenon. Studies show that this strategy has been found effective in improving students' achievement since it uses inductive reasoning of the students which push them to expand their imaginations and ideas to come-up with meaningful applications (Hilario, 2015). Similar finding is also noted in the study of Ayvaci (2013) which states that POE strategy was effective and able to attract students' interest and attention in learning science concepts in the classroom. Chemistry is one of the difficult subjects to learn since it is comprised of abstract concepts and phenomena for the students to grasp and learn (Trauffer, 2017), specialized language, perceived as disparate to the environment in which they live (De Vos, Bulte & Pilot, 2002). Added to this, the teaching strategy and educational tools employed by teachers greatly determines whether students will find the subject appealing or otherwise (Salta and Koulougliotis, 2011). The findings of Amesbury (2006) purported that lecture method was used by teachers in delivering chemistry lessons which contributed to poor academic performance of the students. It is therefore the intention of this study to create a positive mind shift among students in learning Chemistry using active learning. Hence in this study, POEE (predict- observe- explain-explore) will be applied on Chemistry lessons in Grade seven. Specifically, this study aimed to answer the following questions: (1) what are the Grade 7 Junior High School students' inputs as to prediction, observation, explanation, and exploration? (2) what is the level of participation of Grade 7 Junior High School students? and (3) what are the learning experiences of Grade 7 Junior High School students?

II. METHODOLOGY

Research Design

This study utilized a mixed method research design through component design triangulation method (Green and Caracelli, 1997) in which components are conducted separately but are combined during data analysis to provide a comprehensive data interpretation (Maxwell and Loomis, 2003). Qualitative data were focused on students' inputs and level of participation while qualitative method analyzed the level of student's participation, the data collected is supported by qualitative findings in terms of student's inputs and learning experiences to determine students active learning using of POEE strategy.

Research Samples

This study was conducted in one of the largely populated public school in Cebu City. Three out of 13 sections in grade seven were randomly chosen, with 120 students as the research participants.

Table 1

Total number of participants in three sections

Groups		Male	Female	Total
1.	Section A	18	21	39
2.	Section B	22	18	40
3.	Section C	10	31	41
	Total	50	70	120

Data Collection Method

The researcher-made and expert-validated lesson exemplars were implemented for one week among the grade seven classes, accordingly, abiding by the academic calendar schedule. Researcher- made lesson plans was based on the government prescribed grade seven learning teacher's guide and were contextualized based on POEE strategy, nature of the topics and kinds of learner. The topics focused on solutions, acids, bases, and mixtures wherein each lesson part has the POEE embedded eliciting students' inputs as to prediction, observation, explanation, and exploration. The level of participation and learning experiences was measured using an interview guide and a researcher-made validated survey questionnaire. It contained seven questions about the efficacy and efficiency of with Cronbach's Alpha reliability test =0.828.

Data Analysis

Simple percentage and mean were the statistical tools used in this study to determine students' inputs and level of participation. Moreover, thematic analysis was employed through systematic method of coding data using specific statements of respondents characterized into themes (Creswell, 2014).

Ethical Consideration

The implementation of the following ethical directives is considered: (1) the dignity and wellbeing of research participants were protected all throughout the study and (2) the research data remained confidential throughout the analysis and the researcher was granted permission by the research respondents to use the data for presentation.

III. RESULTS AND DISCUSSION

Prediction Inputs

Table 2 presented the summary of students' inputs as to their predictions. Before the actual experimentation, the students were given the task of predicting what would happen in a teacher-given scenario. There are three kinds of prediction as mentioned by Mingers (2012) inductive, deductive, and abductive.

It can be gleaned from table 2 that majority of the predictions made were deductive in nature. Making predictions are both skill and strategy based from learners' past experiences in order to articulate results of a phenomena. It can be deduced that most of students' predictions do not coincide to the projected outcome probably

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Table 2

Predictions of grade seven students on selected chemistry topics

Topic/ Concepts	Predictions	No. of Participant who predicted	%
ACIDS AND BASES Change of Color	When immersed in bleach, the blue litmus paper will change its color	66	55%
	When soaked in vinegar, red litmus paper will change color	63	53%
	When dipped in dishwashing liquid, blue litmus paper still be blue	57	48%
	When dipped in vinegar, red litmus paper will remain red	55	46%
	When dipped in bleach, blue litmus paper will not change its color	54	45%
	The red litmus paper will remain red when dipped in dishwashing liquid	52	43%
	The red litmus paper will change color when dipped in dishwashing liquid	48	40%
	The blue litmus paper will change its color when dipped in vinegar	46	38%
	The blue litmus paper will change its color when dipped in dishwashing liquid	31	26%
	The red litmus paper will change color when dipped in bleach	23	19%
	The blue litmus paper will not change its color when dipped in vinegar	16	13%
	The red litmus paper will not change its color when dipped in bleach	6	5%
	The red and blue litmus papers will melt	2	2%
SOLUTION Saturated Solution Unsaturated Solution Supersaturated Solution	The water will be sweetened	59	49%
	The water will become not so clear	36	30%
	In set-up d, the sugar will melt.	28	23%
	In set-up d, the sugar will settle at the bottom	20	17%
	The water level will rise every after sugar is added	8	7%
	The water will become sticky	5	4%
	There will be no water left, only sugar	4	3%
	In set-up d, the color of the solution will still be the same/ will not change	4	3%
	The sugar will absorb the water	4	3%
	In set-up b, the sugar will not melt anymore	4	3%
	The sugar will float	3	3%
	The sugar will be above the glass rim	2	2%
MIXTURE Heterogeneous Mixture Homogeneous Mixture	The vinegar will stay at the bottom and the oil will be at the top	56	47%
	The sugar and sand will be mixed but each substance is still recognizable	49	41%
	The sugar will not dissolve in the sand	26	22%
	The vinegar and oil will mix, and the vinegar can't be identified anymore	12	10%
	When you mix vinegar and oil, it will explode	8	7%
	The sugar will be dissolved by the sand	4	3%
	The color of the oil will change	1	1%

because students tend to have difficulties in estimating the expected results about the scenarios given by the teacher since they only constructed partial assumptions which indicates that students overlooked other factors which may affect their actual experimentation.

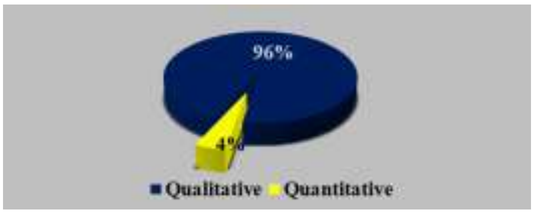
According to Hossenfelder (2009), scientific predictions are initial statements of students about the projected outcomes which are based and made from their past experiences Noted from Table 2, most of students' predictions do not coincide to the projected outcome probably because students tend to have difficulties in estimating the expected results about the scenarios given by the teacher since they only constructed partial assumptions which indicates that students overlooked other factors which may affect in the actual experimentation. An example is how the blue litmus paper turned to red when dipped in a bleach. This prediction entails that student did not know whether the substance (bleach) is an acid or a base, and how an acid or base can change the litmus paper colors. This is due to lack of students' learning experiences and prior knowledge in the previous years. This reveals that students have difficulties in predicting the expected outcome of the experiments given by the teacher because students tend to overlook some factors resulting to incomplete assumptions, which only means that they lack learning exposure and experiences (Velentzas and Halkia, 2012). With this, science educators should furnish students with hands-on activities so that they can explore and participate actively in learning chemistry concepts which can add and enhance their learning skills.

Observation Inputs

Observation is a skill of accurately describing observed phenomena (McClelland, 2003), in this study it was classified into two types: quantitative observations and qualitative observations (Lee, 2018). Quantitative observations are observations which are recorded numerically by the students while qualitative observations made use of senses to describe perceived phenomena.

Figure 1

Qualitative and quantitative observations



Results revealed that majority of the respondents preferred qualitative observations when expressing what they have observed during the actual experimentation. Examples of these observations are as follows:

> *"I saw that the sugar dissolved in water, then it becomes unclear." (P32-qualitative)*
>
> *"I noticed that the red litmus paper turned blue in the bleach." (P63-qualitative)*
>
> *"There are more water and less sugar used in mixing." (P7 and P36-quantitative)*

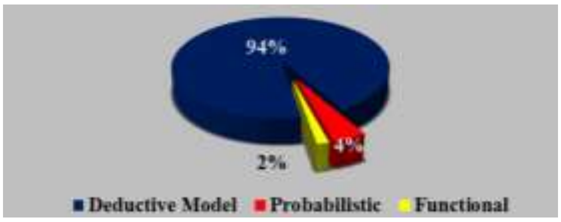
Qualitative are preferred over quantitative observations primarily because these are variable, subjective and does not require accuracy and measurement. Qualitative observation fine-tunes the preconceived ideas in order to measure and evaluate the scenario from a personal view. It can be inferred from the results that most of the students generally use qualitative observation for the following reasons: the students generally use their senses to describe what happens in the experiment and relate to what they have observed which aids them to assimilate it to their daily life situations. This finding is also supported by Campbell (2017) confirms that qualitative observation is commonly used by the students in higher education because they use their senses in order to construct detailed description of what they have witnessed than quantifying their observation and state it as values. Considering this, teachers should provide hands-on activities where students can be involved in the actual observation since it boosts their engagement in class discussions.

Explanation Inputs

Another set of inputs collected from the students is the explanation, in this study it is categorized into deductive, probabilistic, and functional model explanation (Kabita, 2012). Sample vignettes on explanation are indicated below.

Figure 2

Deductive model, probabilistic and functional explanation



> *"If the red litmus paper turns to blue, the substance inside the beaker is a base. If*

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the color of the blue litmus paper turns red, the substance in the beaker is an acid." (Deductive, P2)

"The sugar is not completely dissolved because the water is not hot." (Deductive P48)

"In set-up d, there are more sugar than water, which means that some sugar will not dissolve in water." (Probabilistic, P33)

"The sugar dissolved so that the water will be sweetened" (Functional P30, P35, P41, P47 and P51)

It is notable that majority (94%) of the responses preferred deductive explanations, this may be attributed to its possibility to explain causal relationship, quantitative measurement and generalize findings to some extent. Students were able to use previous experiences to relate to the results of the experimentation. Scientific explanation is the understanding on how and why specific events occurred. Deductive explanation using pieces of evidence to generate a logical conclusion helps students to connect the hypothesis in mind and the result of the actual event. Logical thinking is a crucial part of humanity who seeks practical explanation for observed phenomenon (Gulati, 2009). Considering this, educators should provide active learning experiences to enhance students' skills in generating logical conclusions, and sufficient amount of time in doing it in order to give them time to think and construct comprehensive explanation.

Exploration Inputs

After the discussion, grade seven students were tasked to explore the concepts taught as to how they can use observably there were three forms of exploration they perceived namely – addressing societal issues, solving everyday problem, and satisfying curiosity (Kom, 2015).

Data revealed use of chemistry is to solve everyday problem. Sample vignettes are listed below:

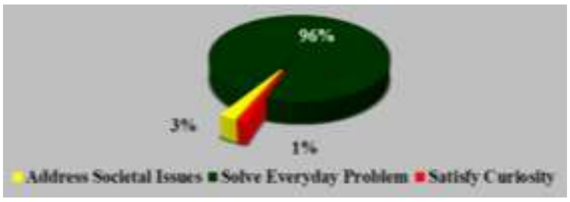
"I drink coffee before going to school, so that I will not be sleepy in the classroom". (P21)

"If I have cough, I drink water with lemon juice and a little amount of sugar." (P83)

"Every day, before I take a bath, I mix baking soda and lemon and put it in my underarm so that it will not be smelly in school." (P44)

Figure 3

Three types of explorations made by grade seven students



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Moreover, only three per cent (3%) of the students apply chemistry concepts by addressing societal issues.

"Strong acid should be put to all drainages which are blocked by plastics and any other material, so that the water can flow freely." (P3, P29, P89 and P90)

On the other hand, only one per cent (1%) of the students apply the concepts learned by satisfying one's curiosity.

"It's nice to know the topics so that it will enhance my knowledge about the concepts of acid and bases." (P93)

Learning must be related to real-life scenario and all lessons must be connected to where students are. Chemistry becomes meaningful when students learn to associate it with everyday scenario. Chemistry concepts are more ingrained in student's mind when it is applied to solve everyday problems. Exploration - learning must be related to real-life scenario and all lessons must be connected to where students are. Applied concepts lead students to appreciate the subject as to its practical usage. This realization was supported by ACEL (2016) which

Table 3

Level of participation of the students measured by three teacher – observers

Activities	Solution	Mixture	Acid and base	Average
Asked questions during class or contributed to class discussions	3.56 (Very participative)	2.78 (Participative)	2.78 (Participative)	3.04 (Participative)
Worked with other classmates to collaborate and share some ideas during class time	3.44 (Very participative)	3.78 (Very participative)	3.78 (Very participative)	3.67 (Very participative)
Worked with classmates to perform and complete tasks assigned by the teacher	3.56 (Very participative)	3.67 (Very participative)	4.00 (Very participative)	3.74 (Very participative)
Volunteered in stating their predictions to the class	3.56 (Very participative)	3.78 (Very participative)	3.33 (Very participative)	3.56 (Very participative)
Volunteered in stating their observation to the class	3.56 (Very participative)	3.67 (Very participative)	3.56 (Very participative)	3.59 (Very participative)
Volunteered in explaining their observation to the class	3.44 (Very participative)	3.44 (Very participative)	3.67 (Very participative)	3.52 (Very participative)
Volunteered in doing tasks requested by the teacher	3.56 (Very participative)	3.89 (Very participative)	3.78 (Very participative)	3.74 (Very participative)
Answered the questions raised by the teacher	4.00 (Very participative)	3.78 (Very participative)	4.00 (Very participative)	3.93 (Very participative)
Showed enthusiasm in presenting their works tasked by the teacher	3.67 (Very participative)	3.67 (Very participative)	3.44 (Very participative)	3.59 (Very participative)
Were actively participated in presenting the group performance	3.67 (Very participative)	3.67 (Very participative)	3.89 (Very participative)	3.74 (Very participative)
Average	3.60 (Very participative)	3.61 (Very participative)	3.62 (Very participative)	3.61 (Very participative)

states that education must prepare and equip students to become pro-active and productive citizens by training them to become creative thinkers who can utilize skills and knowledge to create solutions. With this, teachers should not only teach the students the science concepts but also give hands-on activities where the concepts learned can be applied and concretized by the students. Moreover, student-centered approach should be practiced to let the students understand holistically the science concepts and let them learn at their own pace.

Level of Participation

Table 3 shows that the grade seven students were very participative during the chemistry class discussions. Data collected from the three teacher-observers affirms that students' level of participation is indicative of active engagement using the POEE strategy. Teaching Chemistry using POEE enabled the students to better understand the concepts of chemistry i.e. condensation as it gives students the opportunity to learn at their own pace and apply the concepts to real life situations that help them achieve lifelong learning. POEE is a student-centered strategy which promotes active participation and enhancement of mental processes and scientific skills. Student-centered approach through POEE strategy will encourage active participation thus enhance their mental processes and scientific skills (Costu, Ayas and Niaz, 2012)

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IV. CONCLUSION

Conclusion drawn from empirical data supports the effectivity of delivering chemistry lessons through POEE. Active learning in chemistry gives students an opportunity to express their predictions, observations, explanations, and explorations. A student-centered approach enhances of mental processes, scientific skills and improves participation in class. Abstract science concepts may be appreciated if it is applied to solve real life situations. This research confirms that lack of learning exposure and experiences may be dealt with by incorporating hands-on activities in lessons. The research findings showed that during experimentation the use of the senses and the association of previous experiences leads to learning new concepts. Lessons must be related to real-life scenario; activities must encourage students to be creative thinkers to generate pro-active solutions.

Based on the findings and conclusions of the study, the following recommendations are being suggested:

1. Student-centered approach through Predict-Observe-Explain-Explore (POEE) strategy should be practiced letting the students learn actively during class discussions.

2. The use of hands-on activities to provide students opportunities to explore and experience the real-life applications of the concepts taught.

3. Further studies may be conducted in the countryside schools having a control group exposed to teacher-centered approach like lecture method and compare it to the student-centered approach utilizing the Predict-Observe-Explain- Explore (POEE) strategy to determine which strategy is more effective in delivering Chemistry lessons. Furthermore, the study may be conducted with a higher number of populations, longer timespan and in other field of science.

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