Inquiry-Based Learning: Its Effect on Students’ Science Achievement

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Abstract

This study examined the effect of Inquiry-Based Learning (IBL) on the Science achievement of Grade IV Pupils. It sought to discover whether such kind of learning would have a significant effect on pupils’ Science achievement. The subjects of this study were Grade IV pupils of an elementary school in Silang, Cavite, Philippines during the first grading period of the school year 2015-2016. Two sections experienced two kinds of learning strategies in Science. One section experienced Inquiry-Based Learning and the other section experienced the traditional way of learning. The posttest showed that after 6 weeks of the experimental period, the Non Inquiry-Based Group remained in the low achieving level while the IBL Group moved from the low achieving level to the high achieving level. There was a significant difference between their levels in Science achievement. The result showed that the IBL group had a higher mean gain score than the Non IBL group. Considering gender and socio-economic status, the use of IBL had no significant effect on Science achievement. It is recommended that pupils, teachers, teaching practices, and future researchers establish ways to find more systematic in the effective use of IBL at school, at institutions, and in research.

Keywords: Inquiry-based learning, Science, parents’ income

Introduction

Students’ achievement in science and related subjects has continued to decline. This generally inadequate outcome from science teaching and learning in recent years are well documented in both national and international testing yardsticks (Berns & Sandler, 2009). The Program for International Student Assessment (PISA) indicates that students from Brazil, Greece, Mexico, Latvia, Portugal and Luxembourg recorded lower scores in science (OECD, 2015). Nnodi (2012) pointed out that in Uganda, students continue to perform poorly in science. The Republic of the Philippines lags behind its Asian neighbors in science, technology, and innovation (STI), states Senator Edgardo Angara who recommends an upgrade in science education in all levels (Uy, 2008). Angara pointed out that for every scientist in the Philippines, there are six in Vietnam, 25 in Thailand, and 200 in Singapore. He said that there are only 12 scientists and engineers for every one million population in the Philippines, Uy reported.

Students do not think out of box. They are at a verge of explorations. They are like plants that needed trimming to grow properly and beautifully. With these, teachers need to be well equipped with modern teaching theories and practices so that desired results could be achieved. (Nighet, Tayyab, Muhammad & Maqsd, 2015).

Today’s students need to be able to work cooperatively, communicate effectively, interrogate and synthesize ideas concisely, solve problems efficiently among many other important life skills of the 21st century (Kilbane & Milman, 2014). The challenges mentioned above prompted the researcher to conduct a study to find out the effect of inquiry-based learning on science achievement and social skills of Grade IV pupils.

The objective of this study is to determine the effect of IBL to grade four pupils’ science achievement and social skills. Specifically, this study attempted to answer the following research questions:
1. Is there a significant difference in the gain scores of science achievement of the respondents in the non-IBL and IBL groups?
2. Is there a significant difference in the gain score of science achievement of the respondents in the non-IBL and IBL groups considering gender and socio-economic status?

**Review of Literature**

**Inquiry-Based Learning**

Inquiry-based learning (IBL) refers to the activities of students where they develop knowledge and understanding of scientific ideas as well as understanding of how scientists study the natural world. IBL begins with questions based on real observations and then proceeds through discussions and explanations based on evidence. Consequently, it can be said that inquiry is the art of questioning and the art of raising questions (Oguz & Yurumezoglu, 2014). When engaging in inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and share their ideas with others (Simsek & Kabapinar, 2010).

The role of teachers in inquiry-based classroom is different from those in a conventional classroom. Teachers act as a facilitator, guide, and helper and they give students a chance to generate their own content-related questions and instruct their investigations through proper guidance (Nighat et al., 2015). Traditional instruction has centered on having students read textbooks, listen to lectures with an occasional video, and complete worksheets focused on memorization of facts rather than using the scientific method and research procedures (Peterson & Hittie, 2010).

**Gender**

With respect to gender, there have been no consistent differences in science achievement. Studies show that, on average, girls do better in school than boys. In the study of Blume and Zembral (2011), boys begin to perform better than girls on science tests in the fourth grade. In the study made in Kedah, Malaysia by Veloo, Perumal, and Vikneswary (2013), the results indicated that female students performed better in science than male students which is opposite to the TIMSS in its third report at the eighth-grade in which males had significantly higher average science achievement than females in the countries.

**Socio-Economic Status**

It has been put forward that parents of high economic status have more positive attitudes towards their children’s schooling and have high expectations for the children since they have the economic empowerment and advantages that money can provide (Klebanor, 2002). Thus, parents’ annual income that defines Science-economic environment is a factor that determines Science academic achievement of students (Secreto, 2015).

**Theoretical Framework**

This study was anchored on two important theories, namely 5-E learning cycle (Abdi, 2014) and constructivism theory (Orstein et al., 2014).

**5-E learning cycle.** The 5 E-Learning is an instructional model based on the constructivist approach to learning with five components: Engage, Explore, Explain, Elaborate, and Evaluate. The 5-E learning cycle allows students and teachers to experience common activities, to use and build on prior knowledge and experience, to construct meaning, and to continually assess their understanding of a concept. The teacher as the researcher used the 5-E’s in teaching the IBL group.

In the engagement stage, the teacher creates interest, generates curiosity, raises
questions, and elicits responses that uncover what the pupils know or think about the concept or topic. The pupils ask questions, such as “Why did this happen?” “What do I already know about this?” “What can I find out about this?”

In the exploration stage, the teacher encourages the students to work together by groups. The teacher asks probing questions to redirect the pupils’ investigation when necessary. The teacher provides time for the students to puzzle through problems and acts as the consultant for the pupils. Under the guidance of the teacher, pupils clarify their own understanding of major concepts and skills. In the explanation stage, the teacher encourages the pupils to explain the concepts and definitions in their own words. The teacher asks for justification or evidences and clarification from the pupils while in the elaboration stage, students are challenged to apply what they have learned. The teacher asks them to use formal labels, definitions, and explanations provided previously. The teacher asks questions like: What do you already know? Why do you think that was the answer?

In the evaluation stage, the teacher observes the pupils as they apply new concepts and skills. The teacher accesses students’ knowledge and skills by looking at the evidences that the pupils have changed their thinking or behavior. The pupils answer open-ended questions that would encourage future investigations.

Constructivism Theory

Ornstein, Levine, Gutek, & Vocke, (2014) emphasized that as the children interact with the environment, they build knowledge of their world through creative process known as constructivism. As the children discover gaps between their existing concepts and the new situations they encounter when exploring their environment, children reconceptualize their existing knowledge with their new information to construct more complete higher-order concepts.

Methodology

Research Design

This study used quasi-experimental pre-test – post-test control group design. Two groups were included in the study, namely IBL group and non-IBL group. Pretest was administered to both groups. Non-IBL group was taught in a traditional way of teaching while the IBL group was taught using the Inquiry-Based Learning approach.

Sampling Technique

Convenience sampling, also known as availability sampling, was used in this study. The two sections of the Grade IV pupils of an elementary school in Barangay Tartaria, Silang, Cavite with a total of 66 pupils who were enrolled in the school year 2015-2016 were the respondents of this study.

Results and Discussion

Difference in the Science Achievement Gain Scores of the Respondents Between the Non-IBL and the IBL Groups

Table 1 shows the difference in the mean gain scores in science achievement between the Non-IBL and IBL groups. It shows that the mean gain score of the Non-IBL group was 1.51 (SD = 2.89). The mean gain score of the IBL group was 9.14 (SD = 4.32). Comparing their gains, both groups had a t-value of -11.670 with an associated probability of 0.000.

Table 1
The hypothesis that, “There is no significant difference in the gain score of Science achievement of the respondents in the non-IBL group and IBL groups”, was rejected. The data in Table 1 show that the achievement of the respondents between the Non-IBL and the IBL groups was significant. Providing children with inquiry-based learning would be of great help to the young science learners.

The result of the study conveys the meaning of what Kilbane and Milman (2014) stated that when pupils engage in the inquiry model, they benefit from involvement in the process of inquiry and from its product solution. Pupils’ involvement in inquiry and discovery is all more important because it helps the pupils develop critical-thinking skills.

The findings agree with the result Veloo, Perumal, and Vikneswary (2013) which revealed that inquiry-based learning significantly influences science achievement among grade school pupils. It was clear that the findings of this study have important implications for primary school children specifically in evaluating science achievement.

Moreover, the findings obtained in the study made by Abdi (2014) concluded that there is significant difference between the achievement levels of the pupils who have been educated by inquiry-based learning and the pupils who have been educated by traditional teaching methods.

It is also emphasized by Nighat et al. (2015) that if Science education is properly arranged and presented, there are more chances of understanding it and further strengthens students’ broader skills and habits of mind. The skills to ask questions and observe minutely to find evidences and rational arguments are the products of rich learning experiences at the very initial stage. It is not only to achieve higher grades but to improve pupils’ interest in Science.

### Difference in the Gain Scores of the Non-IBL and IBL Group in Science Achievement Considering Gender

Considering the gender of the respondents, the Mann-Whitney U and Wilcoxon W test values in the non-IBL group registered at (z) -0.191 with a significance level of (p) 0.849 and in the IBL group at (z) -1.959 with the significance level of 0.50. The results presented in Table 2 show that there is no significant difference in the gain scores of Science achievement in the Non-IBL and IBL groups considering gender.

<table>
<thead>
<tr>
<th>Group</th>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t-value</th>
<th>Sig. (2-tailed)</th>
<th>Verbal Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>Non-IBL</td>
<td>66</td>
<td>1.51</td>
<td>2.89</td>
<td>-11.670</td>
<td>0.000</td>
<td>Significant</td>
</tr>
<tr>
<td>Achievement</td>
<td>IBL</td>
<td>62</td>
<td>9.14</td>
<td>4.32</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Group</th>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>z</th>
<th>P</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>Non-IBL</td>
<td>39</td>
<td>33.13</td>
<td>-0.191</td>
<td>0.849</td>
<td>Not Significant</td>
<td></td>
</tr>
<tr>
<td>Achievement</td>
<td>Male</td>
<td>39</td>
<td>33.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>27</td>
<td>34.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>66</td>
<td>34.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IBL</td>
<td>31</td>
<td>35.97</td>
<td>-1.959</td>
<td>0.50</td>
<td>Not Significant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>31</td>
<td>35.97</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>31</td>
<td>27.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>62</td>
<td>27.03</td>
<td></td>
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</tbody>
</table>
Considering 0.01 level of acceptance, the result implies that the gain score is not significant in males and females on the Non-IBL and IBL groups. This means that no gender is better than the other when it comes to Science achievement. Thus, the hypothesis that, “There is no significant difference in the gain scores of science achievement in the Non-IBL and IBL groups considering in gender”, is accepted.

The findings obtained in the study made by Abdi (2014) concludes that there is a significant difference between the achievement levels of the pupils who have been educated by IBL and the pupils who have been educated by traditional teaching methods. The same findings were confirmed in the TIMSS (2007) report with respect to gender that there were no consistent differences in science achievement, and very few in science attitude and perception. However, these findings are contradicted by the study of Secreto (2014) that there is a significant difference between science academic achievement of males and females.

### Difference in the Gain Scores of the Non-IBL and IBL Group in Science Achievement Considering Parents’ Income

Table 3 presents the achievement gain scores, mean rank, and the probability and interpretation of the results considering the parents’ income of the respondents in the non-IBL group and IBL group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Income</th>
<th>N</th>
<th>Mean Rank</th>
<th>z</th>
<th>p</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-IBL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15 000 &amp; below</td>
<td>50</td>
<td>32.07</td>
<td>-1.080</td>
<td>0.280</td>
<td>Not Significant</td>
</tr>
<tr>
<td></td>
<td>16 000-40 000</td>
<td>16</td>
<td>37.97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>66</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBL</td>
<td>15 000 &amp; below</td>
<td>46</td>
<td>32.93</td>
<td>-1.067</td>
<td>0.286</td>
<td>Not Significant</td>
</tr>
<tr>
<td></td>
<td>16 000-40 000</td>
<td>16</td>
<td>27.38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>62</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

As shown in Table 3, the study reveals that there was no significant difference in the mean rank gain scores in the Science achievement of the Non-IBL and IBL groups when parents’ income is considered.

The findings of Imperio (2013) support this result. Her research findings revealed that there was no significant difference in the mean rank of academic achievement when parents’ income is considered.

### Conclusions and Recommendations

Between the two groups, the IBL group had a higher gain score than the non-IBL group’s mean gain score which means that the IBL is more effective than the traditional way of learning. The independent test results showed that there was a significant difference between the respondents’ gain scores. The result also showed that females were better than males in the non-IBL group and males were better than females in the IBL group. However, the mean gain score is not enough to tell whether there is a significant difference between the performances of the groups. Inquiry-based learning is an effective strategy which teachers can use to help students
improve the science achievement of every learner, regardless of their gender and their economic status.

Based on the findings of the study, it is recommended that pupils must inquire to develop high-level thinking skills for them to shape their environment more effectively. Teachers may use inquiry-based learning to give needed guidance and confidence in dealing with science teaching and to develop a framework of year long and short-term goals for students. Curriculum developers may use the results of this study as bases in planning educational programs and instruction. School administrators may select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners. Finally, future researchers may replicate the same study focusing on other topics in Science and other subjects. The same study can be conducted on a larger scale.

References


