Does the Use of Science Notebooks During Project Based Learning Increase English Proficiency?

Esther Dabagyan

California State University, Northridge
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Introduction

In the United States, we have been uniformly using standardized testing since 1930; however most students back then didn’t take more than three standardized tests in their entire educational career (Perrone, 1991). Standardized testing only became more prevalent as time when on, especially after the publication of *A Nation at Risk* (National Commission on Excellence in Education, 1983) and the enacting of *No Child Left Behind* into law by President Bush in 2002. As of today, even the Japanese are beginning to implement the first nationwide standardized testing in 43 years in their primary and secondary schools (Shimbun, 2007). Many schools find it difficult to meet their standardized testing goals. As immigration into the United States increased over the years, English language proficiency has become a major issue with regard to standardized testing. Many schools that are full of new immigrants who know little to no English struggle to meet their standardized testing goals. Many of us in California, and Los Angeles in particular are constantly pressured by our administrators who are themselves pressured by their administrators to increase our standardized testing scores. Due to the weight of this problem, content teachers are faced with a serious predicament; how do we teach our students English and their subject matter? This study attempted to answer that question by investigating one method of improving literacy in a science classroom.

Purpose Statement

The purpose of this paper was to assess the efficacy of science notebooks during project based learning in improving English proficiency. Science teachers frequently
employ science notebooks and project based learning, but can the proper use of these techniques in conjunction with one another improve English language proficiency?

Importance of Study

This study is important to any teacher who faces rigorous standardized testing of their English learner students. Teachers who have so called “sheltered” classes where different levels of English learners are mixed in with students who are native English speakers, can implement the various techniques employed in this study to help close the language gap. It can also provide insights for teachers who may not have English learner students, but who have native English speakers that simply have a difficult time grasping scientific language. When students acquire one language, they often do so in the same manner as they have acquired another, acquiring scientific language is no different.

Definition of Terms

For the purposes of this study, project based learning (PBL) is defined as an inquiry based approach where students working in teams explore real-world problems and create explanations to share what they have learned. English learner (EL) students are defined as students whose native or first language is not English. Lastly, language acquisition describes the process of learning a second language.

Literature Review

In order to develop the proper context for this study, I will present two areas of literature review. The first area explores the extensive literature available about PBL and the few articles that have studied its affects on EL students. The second area presents
more limited information available about science notebooks and how to implement them in a classroom.

*Project Based Learning*

There is much research published regarding project based learning. Sometimes it is called kit-based science, other times guided-inquiry science. Most research suggests that PBL is most effective in engaging children with authentic questions centered on a “big idea” (Amaral, Garrison, Kelntschy, 2002; Moje, Collazo, Carrillo, Marx, 2000; Lynch, Kuipers, Pyke and Szesze, 2004). Descriptions of PBL typically have a strong correlation to the definition of inquiry-based science. Some common features include (a) posing questions; (b) planning investigations; (c) collaboration with peers and the community; (d) communicating results through written and oral formats; and (e) revising of previous thoughts based on on-going feedback (Diaz-Rico and Weed, 2002; Moje, Collazo, Carrillo & Marx, 2000). There are also contradictory studies in how effective project based learning can be for students who struggle with the English language. Moje et al (2000) argued that for project based learning to be effective for English language learners a greater care must be used to merge discourse within the activity. They found that PBL is especially difficult for EL students who are newly acquiring English in an everyday context yet are asked to interpret their PBL discourse in a scientific context (Moje et al. 2000). Lynch et al (2004) found that among a 1500 diverse eighth grade group of students, the EL students were the ones that benefited the least from PBL in measurements on scientific achievement tests. Yet, Amaral et al (2002) found that EL students increased their achievement in not only science, but math, reading and writing over a 4 year period of participating in PBL.
In a study conducted by Hug, Krajcik and Marx (2005), a student population that was 60% below grade level on state-mandated achievement tests, could nonetheless make strong and meaningful connections from their own lives to the curriculum when taught through PBL. The students repeatedly related their projects to real life experiences and the central driving question of the unit. The students discussed the ideas behind the central question and included scientific terminology and concepts in a meaningful way. This personal connection has been found to be one of the most important factors in not only language acquisition but also the building of content knowledge. PBL has high discourse content, encouraging students to engage in conversations about what they are learning. While this does place a difficult demand on EL students, when the project is exciting and relevant, students want to talk. Often times, these conversations and other means of communication (writing reports, oral presentations) need additional scaffolding form the teacher for EL students to gain true depth of knowledge. There is a spectrum of how effective PBL can be that is largely dependant on implementation and project type. Not all PBL will benefit EL students and the research points to mixed results.

*Science Notebooks*

Almost all the research publications about PBL had students utilize some sort of science notebook to keep track of their progress during the unit. There is little to no quantitative research that measures what exactly the effects of science notebooks are on test scores or student achievement. However, many guides and recommendations exist on the topic of how to prepare and use science notebooks in the classroom. Gilbert and Kotelman (2005) stated that students need to practice writing to learn writing and that
science notebooks offer them various forms of writing such as procedural, narrative, descriptive and labeling. In enhancing student communication, science notebooks can help develop EL language acquisition. Gilbert and Kotelman (2005) also outline some of the other benefits to using science notebooks, including using writing for thinking, allowing teachers access to students’ thinking, differentiated learning support and fostering collaboration.

Klentschy (2005) found through the research of Valle Imperial Project in Science that the six essential sections of a science notebook are question/problem/purpose, prediction, planning, observation/data/claims-evidence, what have you learned, and next steps/new questions. Each section requires modeling by the teachers and clear rubrics regarding the quality of entries into the notebook. Klentschy (2005) has found that science notebooks empower students to take ownership of their own learning and develop their own personal meaning and ideas about the world surrounding them.

Other types of science notebooks exist, such as science journals, and interactive science notebooks (Chesbro, 2006). However, in order to support the inquiry process that takes place during PBL, the most effective method of employing science notebooks is to actually allow the student follow the investigative process in their notebook in a clear method as outlined by Klentschy (2005) and Nesbit, Hargrove, Harrelson and Maxey (2004).

Methodology

Participants

The study took place at Le Conte Middle School in Hollywood, California. Le Conte is a public school located in an urban environment where 97% percent of the
students qualify for the free lunch program. The study included two groups of 30 eighth grade students studying physical science in two different periods taught by Esther Dabagyan. The majority of students were EL level 2 and 3 students, and the classes are ethnically diverse with multiple language backgrounds including Spanish, Armenian and Filipino.

**Materials**

The students studied 2 PBL immersion units. The first was Forces and Motion, while the second was Density and Buoyancy. The two groups alternated using science notebooks as described by Klentschy (2005). Science notebooks were used daily to document events, use vocabulary and to reflect at the end of the period. An example of student science notebook entries are included in Figure 1 and 2. Both PBL units were designed and implemented by the Los Angeles Unified School District in conjunction with the National Science Foundation and the California State University of Dominguez Hills. They each took about 8 weeks to implement and began with a core question presented to the students. Following the core question, students were shown various discrepant events and asked to generate their own questions relating to the topic. Of those questions, several are chosen and pursued. As a culminating task, students were given the opportunity to share their conclusions and reflections through the construction of a power point presentation or a video.

When science notebooks were not used, students were asked to simply fill out handouts and complete writing assignments as needed. Pre-tests and post-tests were given before and after each unit using the same questions about the unit of study. Key students
were interviewed before and after each unit to gage their advancement in discourse and use of the English language in a scientific context.

**Procedures**

Both periods two and four began the Forces and Motion unit on July 12 after learning about measurement and scientific investigation. Period two did not use scientific notebooks while period four did. Period four was also taught how to use the notebooks prior to beginning the unit. Five students from each class were picked based upon their reading level and interviewed. They were the lowest five students. The unit began with a pre-test for both groups. These tests were collected and evaluated for prior knowledge and misconceptions. According to these findings, several discrepant events were set-up the following day for the students to observe and interact with. From these observations, students were asked to generate questions, first individually and then collaboratively about the central theme. The classes discussed which questions were possible to investigate, which aren’t and why. From the list, several questions were revised, and the classes each selected four questions to investigate based upon available materials.

There were five groups of four students and two groups of five students in each class. The groups were selected by the instructor to be heterogeneous according to ability level; however they were homogenous in gender as much as possible. Each class then had two groups investigate one of the selected questions. At the end of each day, period two students were asked to reflect in their journals about any conclusions they had reached or how they needed to modify their procedure. Period four students were working off of worksheets as shown in Figure 3. Once every week, students were asked to share-out
different aspects of their investigations including their hypothesis, procedures, data collection techniques, conclusions and further questions.

Whenever new vocabulary was introduced, the students working with science notebooks were asked to write them down with their own definitions and a quick drawing that would help them to remember the meaning of the words. With further guidance from the teacher, the immersion unit ran for about 8 weeks when the students took the post-test and those same five students were interviewed again. The same procedure was followed for the second immersion unit with the only exception being that period four did not use science notebooks and period two did. Student notebooks were collected at the end of each unit and coded for key terms and explanation styles.

**Analysis**

The data was organized into three sets, the coded science notebooks from each period, the coded interviews, and the pre and post tests. The data was supplemented with field notes taken during the study.

Science notebooks and interviews were coded for sentence structure (syntax), use of new vocabulary, and use of new vocabulary in a correct context. The results were tabulated and analyzed for patterns and trends within student subgroups according to EL level. The pre and post tests were graded for accuracy and the results were graphed for the total population of students, and for each subgroup of EL students.

Following the analysis of each set of data, all three were compared to one another using inductive analysis. Student groups were followed across three sets of data where patterns regarding language growth were identified.
References


