The Impact of PBL on the Students' Attitudes towards Science among Nine Graders in Hamza Independent School

Ahmed Faris

June 28, 2008

The Impact of PBL on the Students' Attitudes towards Science among Nine Graders in Hamza Independent School

Abstract

A weak negative attitude towards learning science was noticed among the students in Qatar, a matter that was reflected on their achievement in national tests. To test if the use of PBL would improve the students' attitudes towards learning science, a sample of 25 nine graders from Hamza school were motivated to plan their own investigations and to implement their projects on the following two problems:

1. One World, One Environment.
2. Obesity Survey Study.

The main objectives of the study were

1. To test if the use of PBL would improve the students' attitudes towards learning science among nine graders in Hamza school?"
2. To provide high quality learning by allowing students to do some "real" science through developing and testing their own hypothesis.
3. To improve teamwork skills.
4. To boost the students' confidence in their ability to apply knowledge and skills to problem-solving.
5. To enhance the presentation skills of the students.
6. To encourage the students to use ICT effectively.

A questionnaire was developed to measure the students' attitudes. The analysis of the results and reviewing the reflective journal showed that 22 students out of 25 students, who participated in the project, have strong positive attitudes towards learning science, working in groups and participating in project based learning. Only 3 students could not yet determine their educational needs.

Introduction and Background

Through out his long service in the education field, Mr. Eassa Al-Naemi, the principal of Hamza Independent Preparatory School for Boys, has noticed a weak attitude towards learning science among students in Qatar. When offering me a position in his school, he motivated me and asked me to do an action research to find solutions for this problem.

I started my action research by defining, documenting, analyzing and characterizing the problem. I observed the students during the science sessions, interviewed many of them, talked with the available science teachers in focus groups whenever possible, and finally discussed the problem with the principal and the vice-principal who provided me with the results of the students in the national tests. The results were disappointing; none of the students had achieved the national standards in the QCEA. The interviews with the students, the talks with the teachers as well as my personal observations gave me clear indicators about the weak attitude towards science among the students. Many hypotheses and assumptions came to my mind. I decided not to exclude them, but to emphasize on one variable that is the role of the teacher and the effectiveness of the used teaching methods and techniques. To narrow down the problem and its presumptive solutions, I reviewed the teaching strategies used in the science department and noticed that project-based learning had never been used in my school.

To learn more about the project-based learning, I attended two workshops in Qatar University and searched the open sources and literature. I found many sites discussing the topic such as (Blumenfeld 1991), (Osborne et al, 2003), (Duch, 1996) and (Foley, 2008).

Hypothesis Formulation

I came with the following hypothesis: “Would the use of PBL improve the students’ attitudes towards learning science among nine graders in Hamza school?”

I chose this problem because PBL as an instructional method is centered on the learner. It allows me to go beyond the traditional teaching methods and promotes and practices new learning habits. Instead of using a rigid lesson plan that directs a learner down a specific path of learning outcomes or objectives, project-based learning allows in-depth investigation of a topic worth learning more about (Harris & Katz, 2001). It motivates the students to think critically, challenges them to learn. The students have to think in original ways to come up with the solutions to these real world problems. It helps with their creative thinking skills by showing that there are many ways to solve a problem.

Through the construction of personally-meaningful artifacts, learners represent what they've learned (Harel & Papert, 1991 cited by Grant M., 2002). In addition, learners typically have more autonomy over what they learn, maintaining interest and motivating learners to take more responsibility for their learning (Tassinari, 1996; Wolk, 1994; Worthy, 2000). With more autonomy, learners "shape their projects to fit their own interests and abilities" (Moursund, 1998, p. 4 cited by Grant M., 2002). So, project-based learning and the construction of artifacts enable the expression of diversity in learners, such as interests, abilities and learning styles.

Objectives:

1. To test if the use of PBL would improve the students' attitudes towards learning science among nine graders in Hamza school?"
2. To provide high quality learning by allowing students to do some "real" science through developing and testing their own hypothesis.
3. To improve teamwork skills.
4. To boost the students' confidence in their ability to apply knowledge and skills to problem-solving.
5. To enhance the presentation skills of the students.
6. To encourage the students to use ICT effectively.

Participants, Methods and Tools

To test the hypothesis, I engaged 25 nine graders in my school in the following two projects:

1. How can I reduce my carbon footprint?
2. Is obesity in our school correlated to bad dietary?

Setting the context

About the School: This is a medium size independent preparatory school located in the center of Doha city / Qatar. Even though the school is relatively new but it has very ambitious goals. It is equipped with some of the most advanced scholastic facilities including smart boards, well-furnished laboratories, instructional softwares…etc. Whole-school issues include topics like behavior, health and safety, special educational needs, child protection, environmental education, service education and health and sexual orientation.

About the Class: 9th graders, 25 students from different countries (Qatar, Palestine, Egypt, Jordan, Syria, Iran, Pakistan, and India); therefore, I best describe the class environment as being Multicultural where the classroom itself becomes a new learning experience. This made me create effective links between the school and other cultural contexts in which students are socialized, to facilitate learning.

Questionnaires

After the accomplishment of the projects and the students presented their final products, I distributed a questionnaire to measure the students' attitudes towards learning science, working in groups, problem solving and the use of PBL in science (See appendices). The used questionnaires in the study were collected and pooled from different resources with modification where necessary to make them more appropriate to the objectives of the current study (White et al, 1997), (Fraser, 1982 cited by Osborne et al, 2003).

Follow-up

To follow up the students and to observe them professionally as well as to record the events and my reactions to them and to organize my feedbacks on my strategies, I used a Reflective Journal. It basically consisted of three columns, what went well? what were the concerns? and what are the strategies for the future.

More about the Projects: Before starting the project, the students had a fair scientific background about the studied issues, sufficient for them to start their own research. The first research required the students to calculate their carbon footprints and then to take actions to reduce it. This research was implemented in cooperation with iEARN. The students later on extended the question to cover more details such as raising awareness among other students towards pollution, documenting a pollution problem in the local area and reporting it to the local community. In the second problem the students surveyed 300 students for obesity, calculated their BMI, and asked other students questions about their dietary habits and life style. The students also extended this question to find out if there is any correlation between obesity and diabetes. In both projects, the students interviewed experts from the correspondent organizations and authorities.

The students prepared power point presentations, movies; excel sheets, bar graphs and pie charts as well as models and posters. Their artifacts were displayed and presented during the school's scientific and cultural exhibition. For more details about the projects see the appendices.

The projects that the students joined were chosen carefully and designed in a way to make them relevant to the students' daily life. The studied problems were used to engage students' curiosity and initiate learning the subject matter. The studied problems were applied to real life situations. In the projects, the students were encouraged to work in groups and to carry out their own investigations. During the different phases of the projects, the students developed the necessary research skills. The students were engaged in the project design, solving the problem and making the decisions. This has allowed them to come up with ideas and realistic solutions and presentations. During the different phases of the projects my role was limited to facilitation and coordination but not guidance.

ICT: The role of ICT in PBL was emphasized by many educators (Solomon, 2003), (Cunningham, 1991 cited by Carr & Jitendra, 2000), (Maguire & Matejka, 2000). In the analyzed projects, the students used technology in meaningful ways to help them investigate or present their learning. They used it not only as a web-quest or for internet research tasks, but also for the following purposes:

- Organizing the work.
- Performing the statistical analysis
- Preparing the presentations.
- Preparing the movie clips.
- Gathering the data and documenting the problem.
- Sharing their results and artifacts with others using the iEARN website forums.
- Giving constructive feedbacks and reflections to others who work on similar projects online.

Assessment

Formative:

Students were evaluated based on their ability to accomplish the different activities in the projects and come with reasonable outputs.

Summative:
By the end of this chapter, students were given an End of Month Test.

Results and Discussion:

The statistical analysis (ANOVA, P=0.05) of the results showed that there are statistical differences among the responses of students in regards to their overall attitudes towards science, problem solving in PBL and to PBL in general. However, there was no statistical difference among the students' responses towards group work in PBL. Therefore, the attitude scale was divided into three intervals [1-3: students with weak attitude], [3-3.5: for students with positive attitude] and [3.5-4: for students with strong positive attitude] as shown in table (1).

Analysis of the questionnaires, reviewing the reflective journal and further interviews of the students showed that 22 students out of 25 students who participated in the project, showed positive to strong positive attitudes towards learning science, working in groups and participating in project based learning. Only 3 students could not yet determine their educational needs. Additional paragraphs were added to the questionnaire to assess the students' attitudes towards work group in PBL, problem solving in PBL and generally towards PBL. The results show that some students still hesitate when it comes to problem solving.

I was really satisfied with the improvement in the students' attitude towards science, a matter that was clearly evident from their enthusiasm. This has been reflected on the quality of their reports compared with earlier ones, power point presentations, movies and other artifacts they have developed. During the discussion of their projects by the audience, the students showed deep understanding to the studied issues. The students showed high responsibility during the team work. They divided the roles between them, constructively criticized and corrected each other. They together organized visits to the related local organizations, went into field trips and helped each other in taking the photos making the videos. The students worked remarkably according to the time frame they have assigned, never exceeded it.

In the future, I'd like to engage more students in the projects and to invite more teachers to observe and help me during the implementation of the projects. Generally, it was a very interesting and exciting experiment for me, for the students and for their parents who came to watch their sons while presenting their findings.

The only drawback I faced is that it took much effort. However, having seen the quality of the work the students produced, and having read their feedback comments, I believe it was certainly worth the effort. I achieved the six goals I set out for.

	Overall attitude of St. toward Science [A1-A27]	**St. Att. toward group work in PBL [B1-B4]**	**St. Att. toward problem solving in PBL [C1-C4]**	**Overall attitude of St. to PBL in Science [D1-D7]**
Weak [1-3]	3	2	4	1
Positive [3-3.5]	16	10	8	9
Strong Positive [3.5-4]	6	13	13	15

Table 1: Analysis of the questionnaire results.

Some Students' Reflections

I organized focus groups (4-6) students and asked them about their feelings and impressions in working as part of a team to design and carry out their investigations and whether they felt they learned more or less than usual this way compared to.

- "Working with other students to carry out our own investigations was a great pleasure."
- "I now can carry out my own investigation, I feel so confident about this now."
- "The project allows me to learn more than the textbook can."
- "I never thought that science can be so closed to my daily life style."
- "I enjoyed so much working in the team, it was really fun…I now know what should I do reduce air pollution."
- "I never felt as responsible for my actions and words as I do now. From now and then I'll watch my actions."
- "Science can be fun too, that's great……"
- "I made some mistakes during the project; however, this was a great opportunity for me to learn from my mistakes."
- "The activities provided through out the project were really, fun, interesting and allowed me to learn more."
- "We were not only learning science, we were doing science."

Acknowledgment

I would like to express my deep appreciation and respect to Hamza School principal, Mr. Eassa Al-Naemi, for his constant support and encouragement. Great thanks to Mr. Sad Bin Essa, Hamza School Vice-principal, for his valuable advice, smart touches, patience...I wish to extend my thanks to the science department teachers. I also would like thank all my students who have actively participated in the projects, namely: Zeyyad Al-Khayyat, Saed Al-Biltaji, Abdul Aziz Kazim and Hasan Abdullah.

REFERENCES:

- Barbara J. Duch, "Problem-Based Learning in Physics: The Power of Students Teaching Students," J. College Sci. Teaching 25(5): 326 - 329 (1996).
- Blumenfeld, P.C. et al. (1991). "Motivating project-based learning: sustaining the doing, supporting the learning." Educational Psychologist, 26, 369-398
- Carr, T., & Jitendra, A. K., (2000). Using hypermedia and multimedia to promote project-based learning of at-risk high school students, Intervention in school and clinic (H.W. Wilson - EDUC). Sep 2000. Vol. 36, Issue 1, p. 40.
- FRASER, B. J. (1982). How strongly are attitude and achievement related? School Science Review, 63, 557–559.
- Foley B., and McPhee C., 2008. Students' Attitudes towards Science in Classes Using Hands-On or Textbook Based Curriculum. National Science Foundation, EHR, REC9980494.
- Grant M., 2002. Meridian: GETTING A GRIP ON PROJECT-BASED LEARNING: THEORY, CASES AND RECOMMENDATIONS. A Middle School Computer Technologies Journal a service of NC State University, Raleigh, NC Volume 5, Issue 1, Winter 2002ISSN 1097 9778
URL: http://www.ncsu.edu/meridian/win2002/514.
- Harris, J. H., & Katz, L. G. (2001). Young investigators: The project approach in the early years. New York.
- Maguire, M. & Matejka, D. (2000). On-line delivery: Making the rough road smooth. Paper presented at Flexible Learning for a Flexible Society. Proceedings of the ASET/HERDSA 2000 Joint InternationalConference 2000, Toowoomba, Qld. Retrieved from http://cleo.murdoch.edu.au/gen/aset/confs/asetherdsa2000/procs/contents.html
- Osborne, J., Simon, S. & Collins, S., 2003. Attitudes towards science: a review of the literature and its implications. International Journal of Science Education. 25: 1049-1079.
- Solomon, G. (2003). Project-based learning: A primer. Technology & Learning, 23 (6), 20.
- Tassinari, M. (1996). Hands-on projects take students beyond thebook. SocialStudies Review, 34(3), 16-20.
- White, H., Allen, D., Duch, B., Groh, S., Mierson Sh., and Williams B. (1997). Problem-Based Learning in Introductory Science Across Disciplines. NSF-DUE 9354606 Final Report - 29 November 1997. http://www.udel.edu/pbl/.