PROJECT APPROACH IN SCIENCE: AN EXPLORATORY CASE STUDY

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ABSTRACT

The aim of this study is to investigate the effectiveness in implementing Project Approach (PA) among year one pupils. The focus of this study is to identify pupils' alternative concepts while implementing PA in the chosen science topic. An exploratory case study research design and purposeful sampling was employed in a year one classroom consisting of 22 pupils from different background and abilities. In this study, PA was used as a teaching and learning approach, whereby pupils carried out science projects according to the phases in PA. This study employed observations, interviews and document analysis techniques to collect data. Through the projects, the study found that PA was able to elicit pupils' alternative concepts related to float and sink through representations in the form of drawings and verbal interactions which were recorded. This study provides implications on teaching and learning that pupils' prior knowledge needs to be take in consideration in ensuring the formation of scientific concepts.

Key Words: alternative conceptions, project approach, exploratory case study.

INTRODUCTION

The teaching and learning of science in the early stages of primary schooling requires an appropriate and effective approach to be implemented among young learners. They should not be learning science purely through the memorization of the scientific concepts or ideas. In addition, the learning of science should not be focused on scientific facts, principles, laws or theories only, but must be able to engage pupils in activities involving the exploration and investigation of topics that are of interest to them. According to Mclnerney (2005), pupils need to go through learning experiences that provide them with opportunities to become collectors, compilers, and assessors of the knowledge gained. The experiences gained by these pupils will enable them to explore their environment, leading to discoveries and resulting in the development of concrete scientific ideas or concepts. Research findings also indicated that pupils understand better when learning is meaningful and relates to everyday life experiences that are familiar to them (Zurida, Norhaidah & Maznah, 2004; Dan & Alan. 2004; Jacobs & Crowley. 2007).

Effective science learning experiences can also improve pupils' intellectual development through the exploration of the world around them and applying skills such as observations and making predictions. Indirectly, the ability of a pupil to understand the environment and relating it to the scientific concepts or ideas is facilitated during learning. A pupil's language ability can also be developed through the activities conducted. They also acquire new scientific terms or vocabularies throughout the teaching and learning process. In fact, pupils' social and emotional development can be strengthened since the learning environment demands pupils to work in groups and share their ideas. Hence, teaching and learning activities must be planned and implemented effectively to have significant impacts on them.

In this study, PA as an instructional design and approach to learning is defined by Katz (1994) as an in-depth investigation on a topic which can be conducted as a class, in small groups or individually. This approach is also a pupil directed learning based on their interests, finding relevant information and materials to support their exploration. Hence, the learning of science through PA can assist pupils in the development of science process skills and thinking skills, provide opportunities for problem solving, focuses on pupils' naturual curiosity, promote creativity, encourage teamwork, improve their oral and writing skills by providing a learning environment that is far more interesting and fun for them. Based on the discussions on the benefits of effective learning and relationship with PA, the objective of this study is to elicit pupils' alternative concepts on float and sink during the implementation of PA.

Implementation of PA

PA which has been practised widely in some countries was documented as one of several teaching approaches in the implementation of the science subject in the Primary School Curriculum Standard (PSCS) since its introduction in 2011.

Based on the historical account of PA, DuCharme (1993) recalls it as an outcome of educational ideas by several educationists which include, Friedrich Froebel, William James, Francis Wayland Parker, G. Stanley Hall, John Dewey and William Kilpatrick throughout the period from 1890 to 1930 in the United States. According to Froebel in Duchamrme (1993: p.10) :

> The great aim and end of the whole enterprise (kindergarten) is the education of a person from the earliest years through his own doing, feeling and thinking and in conformity with his own nature and it's relationships so that his life is an integrated whole.

Specifically, Katz (1994: p.1) describes PA as follows:

> A project is an in-depth investigation of a topic worth learning more about. The investigation is usually undertaken by a small group of pupils within a class, sometimes by the whole class, and occasionally by an individual child. The key feature of a project is that it is a research effort deliberately focused on finding answers to questions about a topic posed either by the pupils, the teacher, or the teacher working with the pupils.

In this study, the three-phased PA consisting of Phase One: Initiating the Project, Phase Two: Constructing the Project and Phase Three: Concluding the Project, as proposed by Helm and Katz (2001) was applied.

This three phase model provided guidance for the researchers to conduct PA in a systematic and effective manner. Phase One of the model involves topic choosing activities, development of an anticipatory web by the teacher, child focused activities, and generating questions related to the objectives of the investigation in Phase Two. According to Helm and Katz (2001), the topic of interest for the project can be initiated by the pupils themselves or the teacher. These topics may arise spontaneously from the discussions between teacher and pupil. Alternatively, topics can also be introduced by the teacher based upon a particular theme or unit in the targeted curriculum.

The purpose of developing an anticipatory web is to examine to what extend the emerging topics or the ones prepared by the teacher meets the learning standards of the existing curriculum, and also the interests and abilities of the pupils. An anticipatory web also serves as a guide for teachers to see how the project can be developed based upon the selected topics.

The focused activities carried out in Phase One involving discussions serve to stimulate interest and indicate pupils' existing knowledge or ideas related to topics or concepts being discussed. At this stage, pupils' alternative concepts can be elicited, documented and gathered using picture quiz, drawing and discussion.

Phase Two involves investigations, field trips, classroom visits by specialists and the use of secondary materials such as reference books and the internet. During this stage, pupils will also represent their learning and outcomes in the form of writing, drawing, models, or verbal interactions. These representations need to be carefully recorded and documented. Pupils are also encouraged to document their own learning using video, camera or journal writing..

In Phase Two, the pupils will begin to build their projects based on the chosen topics, paying particular attention to the questions generated earlier in Phase One. They will also be prepared to conduct field work and engage with experts identified. Teachers will have to play a major role in supporting the planning of the investigation which may involve visits, field work or inviting experts to the classroom. Important aspects such as safety, equipments, parental support, location and selection of experts need to be planned and considered carefully before initiating activities with the pupils. During this stage, teachers need to revisit the anticipatory web and questions gathered to identify aspects of the curriculum to emphasize such as the development of science process skills, concepts and other components of learning.

Finally, Phase Three of the model demonstrates how the activities that form the peak of PA should be carried in concluding the project. During this phase, pupils discuss with the teacher on how to share the outcomes of their learning through their projects with friends and family members. Activities such as exhibitions, journal writing and drama were among those proposed by Helm and Katz (2001). Throughout all three phases in PA, parental involvement can be encouraged in several ways. They can assist pupils to look for information and ideas, or they directly can be involved throughout the project by providing the necessary support until the completion of the project in the form of a product.

Methodology

The study conducted was an exploratory case study used by researchers to answer questions such as 'why' and 'how'. This study is also known as a pilot case study (Chua Yan Piaw, 2006) since it is conducted on a small group before implementing to a larger one. Generally, case studies involve s systematic collection of information and insights into the behavior of individuals (Chua Yan Piaw, 2006) which also includes an explanation of the individual and his/her experiences (Sabitha, 2006).

Since this research focuses on the implementation of PA as a teaching and learning approach on a topic in the Year One Science curriculum, a detailed account of the processes involved must be documented, analyzed and reported through field observations. The researchers were constantly with the pupils during the implementation of PA, which coincides with the data collection stage. Besides, the researchers needed to observe, explain and interpret the implementation of PA without any attempt to manipulate the situation under investigation.

In this study, data from observations were collected during the implementation of PA on a chosen topic namely float or sink from the year one science curriculum. Field notes and recordings of the activities were conducted and further supported by journal writing on a daily basis. Focus group interviews were conducted among the pupils in two sessions to probe further into the pupils' alternative concepts based on their drawings.

The sample in this study consisted of 22 year one pupils aged 6-7 years old from a national primary school in the state of Selangor, Malaysia. These pupils were selected using purposive sampling according to the purpose of the research besides meeting the characteristics in terms of age and exposure to the PSCS. These pupils also came from diverse family background such as: fishermen, lecturers, teachers and labourers. The two teachers who were involved as participant observers consists of a Science subject teacher and the class teacher of the pupils involved in this study.

Findings and Discussions

Alternative conceptions refer to pupils' existing knowledge or ideas which is not congruent with the scientific ideas or concepts used by scientists (Tamby, 1999; Chin, 2001; Martin et al, 2005; Sacit Kose, 2008; Osman Cardak, 2009b; Smollect & Hershberger, 2011). Alternative conceptions were also referred to, using various terms such misconceptions, preconceptions, pupils' naive or scientific theories (Chin, 2001; Sopia et al, 2003; Read, 2004 and Cardak Osman, 2009b). Pupils' alternative conceptions in this study were recorded during preliminary discussions on the selected topic, interviews held with pupils during the elicitation activities and building the Boat Project in Phase Two of PA.

Pupils' alternative concepts were also documented from their drawings on the design of their projects or topics discussed. Follow up interviews during Phase One and Phase Two triangulated the data collected during PA, which were then analyzed to address the objective of the study.

The five categories described below which were derived from Sacit Kose (2008), Cardak Osman (2009a) and Cardak Osman (2009b) to classify the pupils' drawing and responses were employed in this study.

i. No drawings.
   No drawings produced. Pupils responded 'do not know'.
ii. Non-representational drawings.
   This drawing shows the elements of a concept that can be identified.
iii. Drawings with alternative concepts.
   Drawing indicates some understanding of a concept with alternative concepts.
iv. Partial drawings.
   Drawing indicates partial understanding of a concept.
v. Comprehensive representation drawings.
   Drawing indicates full understanding of a concept.

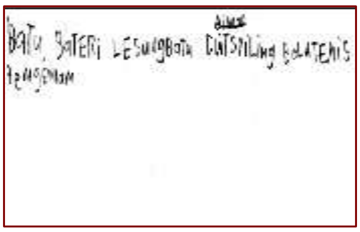
Based on the five categories mentioned above, pupils' alternative concepts with regard to float and sink are presented.

In Phase One, pupils in groups of four to five, were involved in an activity whereby they were required to classify objects as float or sink through drawings. Each group were provided with picture cards of objects that will float or sink such as nail, ball, steel ruler, wooden ruler, small stone, large stone, plastic bottle, tennis ball, and others. An analysis of the pupils' drawings identified four categories namely: no drawings, non-representational drawings, drawings with alternative concepts, and partial drawings. None of the pupils' drawings demonstrated a full understanding of the concepts related to float and sink. It can be seen from Table 1 that 14 (66.7%) of the pupils presented drawings with alternative concepts on float and sink.

Table 1
Respondents, Number and Percentage According to Categories of Alternative Concepts

Categories of Alternative Concepts	**Respondents**	**Frequency**	**Percentage (%)**
i. No drawings.	M19/M21	2	9.5
ii. Non-representational drawings.	M05/M13	2	9.5
iii. Drawings with alternative concepts	M01/M02M04 M06/M07/M08 M09/M10/M12 M15/M16/M17 M18/M22	14	66.7
iv. Partial drawings.	M11/M14/M20	3	14.3

Figure 1 below are some examples of pupils' alternative conceptions with regard to objects that float or sink elicited from their drawings classified according to the categories identified earlier.

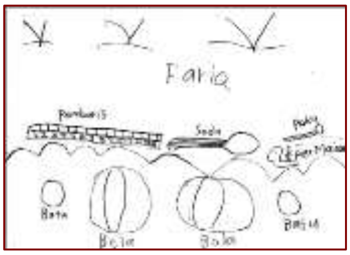


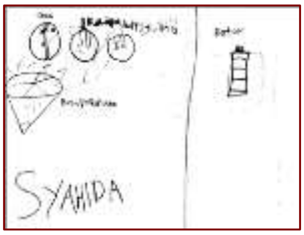
M05

13

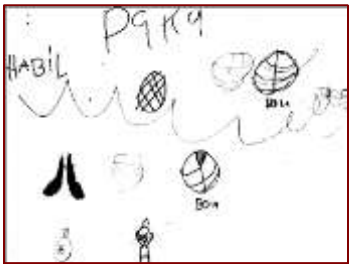
Figure 1 Non-representational Drawings Category by M05 and M13

Both drawings by M05 and M13 indicated no understanding of the concept of float and sink. It can be seen that M05 merely wrote the names of the objects without any drawings or classification. On the other hand, M13 wrote the names and drew the objects without making any relationship to the concept of float or sink. Both M05 and M13 also took some time to respond to the activities and tried to imitate other pupils' drawings.





M04 M17



M07

Figure 2 Drawings with Alternative Concepts Category by M04, M17 and M07

The drawings by M04, M17 ad M07 shown in Figure 2, represent another category with evidence of alternative concepts. M04's drawing showed objects such as a wooden ruler, plastic spoon, nail and plastic duck above the water surface and not touching it. On the other hand, the ball and rock were drawn in the water.

Follow up interviews with M04, revealed that this pupil held strongly to the idea that the ball is in the water or sink.

G01 : What is this? *(Teacher pointing to the drawing of the water surface)*

M04 : Water

G01 : The ball is in the water or above the water?

M04 : In the water.

In another session, the pupils were requested to talk about their drawings with other pupils. M04 shared his drawing with the class and reiterated that the ball sinks eventough some of the other pupils disagreed with him.

M04 : Ball sinks.

M10 : No, the ball floats.

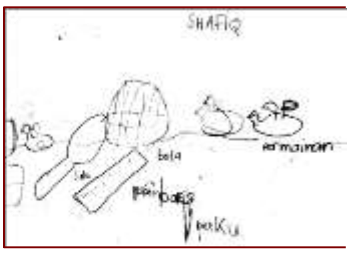
M06/M11/M05 : Yes, the ball floats.

M04 stands firm with the idea that the ball sinks and the nail floats when questioned by other pupils. The reasons given by M04 generated a variety of responses from other pupils in the class who seemed not satisfied with M04’s ideas.

M06 : Why the ball sinks?

M04 : Because it is heavy.
M10 : It is light.
M14/M06/M09/M16/M20/M21 : The ball floats.
M06 : Why does the nail sinks?
M04 : The nail does not sink …. because it is iron.

From M17’s drawing, it can be seen that the coconut was categorized as an object that sinks. A straight line was drawn to represent the water surface separating objects that float and sink. Another pupil, M07 wrote the word nail above the surface of the water and drew two balls both above and in the water. These drawings clearly demonstrate the alternative concepts held by the three pupils.



M11

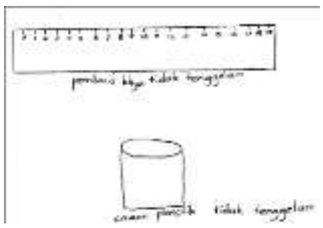

M14

Figure 3 Partial Drawings Category by M11 and M14

The drawings by M11 and M14 shown above are examples on the existence of some or partial scientific concepts related to float and sink. M11 drew and labelled nail as an object that sinks while the plastic toy duck and ball were drawn on the water surface. The plastic spoon however, was drawn as partly above and below the water surface. The wooden ruler was drawn directly under the water surface. Interviews conducted revealed the reasons for M11’s drawing of the plastic spoon and wooder ruler.

G01 : This spoon sink or float?
M11 : Half of it is inside .. eee .. and half is at the top.
G01 : Why is that so?
M11 : Because the plastic spoon is light. The holder is a bit heavier.
G01 : What about the ruler?
M11 : Sink.

G01 : It looks like it floats.
M11 : No, there is a ball Sir, below it.

It can be concluded from the pupils' drawings in the Boat Project that they demonstrated alternative concepts when requested to classify objects that sink or float by relating it to an object's mass or material that it is made up of (Suat Coştu Ünal & Bayram , 2005; Thompson and Logue, 2006; Hardy et al, 2006; Yue Yin, Miki K. Timita & Shavelson, 2008; Smollect & Hershberger, 2011). The pupils included reasons for objects that sink as heavy and float because it is light when asked to explain their observations. Although some objects were categorized as float or sink correctly, the pupils were unable to provide an explanation for their ideas. Some pupils even related the ability for objects to float or sink with the materials used in producing the objects (Hardy et al., 2006) as shown in the example of the nail which is made of iron and causing it to float. None of the pupils were found to relate the concept of float and sink with density, buoyancy, the displacement of water or effects of surface tension (Thompson & Logue, 2006).

CONCLUSION

The implementation and research on PA since its introduction in the Science curriculum is still new in Malaysia. Through the three phased PA implemented, the pupils in this study experienced a different learning environment that focused on what they want to investigate culminating in the design and construction of a project. Accordingly, the teachers adopted a different role by facilitating pupils engagement in the activities throughout the project. The pupils'alternative conceptions elicited and compiled forms a guide for teachers to consider in developing the scientific concepts through activities such as investigations, visits and the use of various form of references. Studies conducted elsewhere have shown the importance of identifying pupils' alternative concepts in the construction scientific ideas. Hence, teachers need to be prepared to change traditional forms of learning in adopting PA and more importantly, ensure that they themselves do not posesses alternative concepts.

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