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Full Length Research Paper

Physics in preschool

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Even though physics and preschool are two concepts not generally used in the same context, physics is an issue of importance in the preschool period. Physics activities stimulate children's inquiry and problem solving skills, and also support children's social and language skills. This paper presents a conceptual framework about using physics in preschool settings. It shows techniques that may be used in preschool physics instruction and points to consider, gives information about scientific thinking processes, and offers a brief summary of physics as a daily life experience in preschool classrooms. It also stresses the importance of choosing physics topics that preschool children face in their daily lives and of making children grasp the basic principles of physics, learn by living and incorporate physics in their daily lives.

Key words: Physics in preschool, children, teaching physics.

INTRODUCTION

Children become sensitive to certain causal principles and mechanisms from an early age (Shultz and Kestenbaum, 1985). They learn about physical properties in their environment by acting on objects, materially and mentally, and by observing the reactions of objects (Kamii and Lee-Katz, 1982). `Physics activities stimulate children's inquiry and problem-solving skills. While preschool children cannot define physics, they can make discoveries about matter and energy. For instance, activities with balls and ramps offer children experiences with their physical world, upon which they can later build more abstract physics knowledge (Woodard and Davitt, 1987). Through such manipulation, children learn how their movements affect the movement of other objects in different ways (Woodard and Davitt, 1987).

Estach and Fried (2005) stress the need of young children for physics and list their reasons as follows (Eshach and Fried, 2005; Greenfield et al., 2009): (1) Children naturally enjoy observing and thinking about nature and tools; (2) exposing children to physics develops positive attitudes towards science; (3) early exposure to scientific phenomena leads to better understanding of the scientific concepts studied formally later; (4) the use of scientifically informed language at an early age influences the eventual development of scientific concepts; (5) children can understand scientific concepts and reason scientifically; (6) science is an efficient means of developing scientific thinking. Physics activities improve children's social and emotional, communicative and cognitive skills (Featherstone and Hardy, 2003). Their social and emotional development is encouraged by selecting and using resources independently and interacting with other children during physics activities (Featherstone and Hardy, 2003). At the same time, taking turns in conversations and extending their vocabulary by exploring the meanings and sounds of new words supports children's communicative skills (Featherstone and Hardy, 2003). On the other hand, investigating objects and materials, building objects, selecting appropriate resources and adapting their work where necessary, and finding out about the different features of events they, observe boost their cognitive development (Featherstone and Hardy, 2003). Owing to these reasons, physics is an important subject for preschool children.

Techniques that may be used for physics instruction in the preschool period and points to consider

There are certain techniques to be used and points to be considered in physics instruction during the preschoolperiod (Smith, 2001; Erbas et al., 2002).

Building models

Building models is an effective method in physics instruction. To illustrate, building models with easy-to-find materials such as paper planes and parachutes, and

experiencing and observing these models will ensure learning by playing and thus, support the continuity of the process.

Choosing topics that will attract children's interest

Topics such as floating-sinking are interesting for preschool children. What is important here is to treat the selected topics in appropriate detail for the children, neither in a too detailed nor in a superficial way. Preschool children comprehend topics after many experiences. Therefore, the activity should be continued for as long as the children are interested in it, and the topics should be recycled through different activities so that children gain enough experiences.

Knowing how children learn

Children learn through concrete experiences. For instance, learning about magnets by observation and sensory experiences is much more effective than learning by looking at colorful and illustrated books.

Encouraging children to ask questions and express their views

Children need to be asked open-ended questions and encouraged to express their opinions by listening carefully to their responses.

Trips

These involve preplanned trips to nearby places or museums where children can examine physics concepts, simple machinery or historical tools and improve their observation and discovery skills.

CONCRETE MATERIALS AND REAL PROBLEMS

Young children need to be presented with problems to be solved through games and other activities that challenge their minds. They must work with concrete materials and real problems (Lind, 2005).

Properties of objects

Children investigate the properties of objects through hands-on exploration. For example, materials such as cardboard tubes, lengths of plastic rain gutters, balls, and objects with wheels help children develop notions about the position and motion of objects. For another example, playing with measuring cups, funnels and eyedroppers foster the understanding of volume, weight, gravity and force. (Bosse et al., 2009).

Earth and space

Young children can record the number of sunny versus cloudy days, check the playground rain gauge and record precipitation, and notice the effect of wind direction on a windsock. Playing with sand and water develops familiarity with the properties of earth materials (Bosse et al., 2009).

Tools and machines

Distinguishing between natural and man-made items enhances children's understanding of science and technology, especially the technological tools that have become part of our daily lives (Bosse et al., 2009). Simple tools such as apple peelers, ice cream churns and egg timers invite hands-on investigations of how things function. Similarly, opportunities for children to use developmentally appropriate software and digital cameras can be catalysts for curiosity and wonder (Bosse et al., 2009). Teachers should help children analyze their observations (examine how and why), compare and contrast, infer and hypothesize. In the meantime, asking open-ended questions may foster the ability to make connections between ideas and between past and current events. It may also help the ability to analyze, infer and hypothesize.

Exploration and inquiry come naturally to children. Teachers can nurture this curiosity by helping children develop scientific thinking process.

SCIENTIFIC THINKING PROCESSES

Lind (2005) divides the scientific thinking process into 8 subheadings.

Observing

The most fundamental scientific process is observation. In this process, children gather information through seeing, hearing, touching, and so on. The first step in problem solution is information gathering. However, careful observation is necessary when gathering information. In order to improve one's observation, drawing activities are important. In observational drawing, children draw what they see and the details they notice.

This encourages them to examine objects closely and draw as they see them (Torres and Vitti, 2007). Teacher

statements and questions such as “Tell me what you see”, “What do you hear?”, “How would you describe the object?” facilitate the use of observation.

Comparing

As children’s observation skills develop, they begin to compare and contrast and identify similarities and differences. The comparing process, which sharpens children’s observation skills, is the first step toward classifying. Statements and questions such as “How are these alike?”, “How are these different?”, “Which of these is bigger, brighter, etc.?”, and “Compare the similarities and differences between these two objects,” facilitate this process. Children should first be asked to describe the properties of objects, then compare them, and finally discuss how and why they feel the objects are similar or different.

Classifying

Classifying begins as children group and sort objects. The grouping and sorting is done on the basis of the observations they make about the object’s characteristics. At first, young children group objects by one property. As they advance in the classification process, objects or ideas are put together on the basis of two or more characteristics. Statements and questions such as; “Can you group them in another way?”, “Identify several ways that you use to classify these objects,” facilitate this process.

Measuring

Measuring is the skill of quantifying observations. This can involve numbers, distance, time, volume and temperature which may or may not be quantified with standard units. To illustrate, children may be asked to measure the distance of two trees in the playground to another object with their steps, and discuss wihch one is further away and by how many feet. In addition, they may use an egg-timer to measure time, and make conclusions such as “doing this takes one turn of the egg-timer, doing that takes three turns”. Questions such as “How might you measure this object?”, “Which object do you think is heavier?”, and “How could you find out?” facilitate this process.

Communicating

In early childhood physics, communicating refers to the skill of describing a phenomenon. Children can record daily weather by writing down the date and drawing pictures of the weather that day. Communicating helps children internalize their observations and start to do higher-level thinking that enables them to begin to see the big picture. They begin to understand the scientific method, to inferr, predict, learn how to develop hypotheses, design ways to test them, record and compare findings. By exploring and discussing, children learn that physics is part of their lives. Answering questions about their observations such as “Was the sun out yesterday?”, “What did you see?”, “Draw a picture of what you see.”, “Which one is hotter, today or yesterday?”, “Were you cold today?”, “Why do you think we were not cold yesterday but we are today?” help develop their communicative skills.

Inferring

In this process, children make a series of observations, categorize them, and then try to give them meaning. For example, when they look out of the window and see the leaves moving on the trees, they infer that it is because the wind is blowing. In such situations, they have not experienced the wind directly, but their observations and prior knowledge and experience help them to infer. As inferring is a process which requires observation, knowledge and experience, topics relating to daily life will make it easier for children to make inferences. Questions such as “What did you see that makes you think that?” or “Why do you think like that?” can be asked by teachers in order to support children’s inferencing skills.

Predicting

In the predicting process, children make a statement about what they expect will happen in the future. They make their guesses on the basis of their observations. However, this is more than a simple guess. Children should have the prior knowledge necessary to make a reasonable prediction. For instance, “If you race the metal car with the wooden car, the metal one will go faster,” is a prediction. The more predictions children are able to make, the more accurate they become. It is important to ask children to explain how they arrived at their prediction.

Hypothesizing and controlling (variables = investigation)

For experiments, investigation must contain a hypothesis and control variables. A hypothesis is a statement of a relationship that might exist between two variables. A typical form of hypothesis is an “if….,then...” statement. For example, in an experiment about floating and sinking objects, the following questions may be asked: “What will happen if we place plastic beads inside the plastic bottle tops floating on water?”, “What will happen if we pour

water into these bottle tops?". In addition, children may be asked to predict and then verify how many drops of water will fit on a coin's surface (Torres and Vitti, 2007).

PHYSICS AS A DAILY LIFE EXPERIENCE

The value of physical science for young children "is not to teach scientific concepts, principles, or explanations. It is, rather, to provide opportunities for the child to act on objects and see how objects react, to build the foundation for physics" (Kamii and DeVries, 1993). Experimentation and active participation in the environment supports children's intellectual development. It is important to help young children make connections between events in their lives and science concepts in preschool classrooms (Trundle and Sackes, 2010). Preschool teachers can make physics a part of children's daily experiences.

On the playground

Seesaws, slides and swings all give physical experiences to children. A seesaw shows the principals of balance, while a slide offers experiences in gravity and a swing offers experiences on laws of motion in action. Teachers can make children think and ask questions by challenging them to balance the seesaw with kids of different sizes. They can relate the topic with the balance scales in the classroom. They can also encourage the children to look under the seesaw to see how it works and which parts move. In this way, they explore principles of weight and mass.

Water and sand tables

At the water table, children learn the properties of water. They see that they can grab into the water without meeting any resistance, but if they hit on the surface of the water with the flat of their hands, it feels like a wall. They explore that the water is so thin that it comes through the space between their fingers. They learn that when it splashes their clothes, it makes them wet and under the sun, the clothes get dry. They predict whether objects will sink or float, then they test their predictions. They learn about impulse, surface tension, and evaporation (Flemming, 1994). At the sand table, on the other hand, they make explorations with sand by adding water or by filling cups of different sizes with sand. In this way, they experience volume, mass and properties of sand.

In the block corner

Children build towers and bridges by balancing blocks of different sizes and trying to produce a certain shape. As they play with blocks, they see that there must be a resting surface in the middle for the block to stay balanced. They build blocks on top of one another by taking measures not to allow them to fall. They build ramps of different heights and race cars down these ramps. They then make predictions on which car will finish first. These help them explore the concepts of spatial relations, gravity and balance.

Meteorology

The daily weather is a popular topic at preschools. The questions that teachers may ask include "How is the weather today?", "Is it cloudy?", "Is the sun out today?", "Is it raining?", and "How does the rain feel?" (Some classes may keep a container to measure and compare rainfall). In this way, children make observations, comparisons and measurements, and they record their observations in diagrams and charts.

In the discovery corner

One way to integrate physics into the daily classroom routine is to set up a discovery corner. The key to designing a quality discovery area is carefully selecting a variety of age-appropriate materials (such as magnifiers, scales and prisms that will introduce children to the wonders of the natural world; Bosse et al. (2009)). In preschool period, children begin to formulate and answer questions by using tools and materials to measure, observe, weigh, and record their findings. To begin with, teachers may need to model the use of some materials and help children consider the best types of tools to use in their explorations (Bosse et al., 2009).

Small arrangements in the classroom

Fiction and nonfiction books with science themes may be added to the classroom library. A balance scale, a basket of materials of different sizes and weights, and graph paper may be placed in the math area. A variety of objects, such as different measuring containers, tubing, and items that children can use to explore sinking and floating may be provided for the water table (Bosse et al., 2009).

In addition age-appropriate and interesting topics may be included in the curriculum. To illustrate, issues such as magnetism (Sandifer and Perdue, 2010), mirrors, light and shadows, slopes and slides, floating and sinking, lifting objects, and wheels (Featherstone and Hardy, 2003) may draw preschool children's attention. By experimenting with the basic tools around them, children can find the answers to many questions on their own (Ucok, 2005).

CONCLUSION

Physics in preschool contributes to children's cognitive, language, social and emotional development. An examination of the studies up to now also shows that physics is necessary for preschoolers. In teaching physics, the teacher should emphasize the modeling technique, choose topics that will interest children, design activities by considering how children learn, encourage children to ask questions and express themselves, and support their observation and discovery skills through occasional school trips. Concrete materials and real problems make education more effective for preschool children. The scientific thinking process is also important for effective teaching. It includes the skills of observing, comparing, classifying, measuring, communicating, inferring, predicting, hypothesizing and controlling. The process requires teachers to emphasize the development of each sub-process, and support their development by giving children opportunities for various experimental opportunities and asking open-ended questions about their experiences.

Children should not only be taught physics concepts or principles, but be offered opportunities to act on objects and see how they react. In other words, they should be able to build the foundation of physics. In order to do so effectively, it is important to make physics a part of children's everyday lives. Children need the opportunity to use simple tools to make observations, live their own experiences, and find the answers to their own questions. Physics is not a complicated and hard-to-understand topic for preschool children. If daily issues are chosen and children examine simple tools, experience them, produce and test hypotheses about simple events, and are asked open-ended questions, physics will become an understandable and enjoyable topic for them. Children love discovery and learning by doing and observing. Teaching physics by considering these, showing preschoolers the basic principles of physics, and enabling them to learn by doing and adapt physics to their daily lives will undoubtedly make important contributions to the emergence of future scientists.

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