The Use of Interview about Events to Explore Children's Basic Science Process Skills

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Abstract

Doing science is a natural part of children learning to explore their curiosity about the natural world. In early science exploration, children gradually develop their science skills for exploring and drawing conclusions of the natural world from their experiences. There are eight basic science process skills that children should use in their explorations, which are; observing, classifying, measuring, using numbers, communicating, using space/time relationships, inferring, and predicting. There have been numerous research studies about how children develop science process skills, but rarely research done about how children use these skills. Most of the instruments used for exploring science process skills are multiple choice and written tests, which are not suitable for children, especially in early childhood. This study presents the invention of an instrument for exploring children's basic science process skills using interview about events with children for familiar objects and events such as jelly bears and drinks. The children were asked to use their science process skills to complete each task step by step and the interviewer recorded the children's behavior, dialogues, and collected their writing and drawings. This instrument was used with 30 children from Kindergarten 2 to Grade 4 (ages 6 to 10). The results suggested that the instrument could be used for exploring children's basic science process skills at all ages. The results of the children's science process skills indicated that children develop some science process skills when they get older, but some do not. The results of each of the skills were that children: 1) usually use only eyes as one sense when observing objects, 2) usually use more than one criteria to group the objects, 3) at an early age could not use any basic measuring instrument, 4) can count and order the numbers correctly, 5) can communicate their results using drawings, 6) can draw a 2D image of a 3D object and communicate about the geometrical shapes, but not the form of the objects, 7) cannot make an inference from the evidence in that they could only explain what they observed but could not draw a conclusion, 8) can make predictions based on evidence they observed.

1. Introduction

Science process skills are tools that scientists use in their investigation to get a better understanding about natural phenomena [1]. These tools are not only physical abilities but also mental abilities [2], they include the thinking skills that scientists use to construct knowledge while they solve the problems or formulate results [3]. In Thailand, science process skills are generally classified into 13 skills, which are according to the American Association for the Advancement of Science (AAAS). The 13 skills are divided into eight skills for basic science process skills, and the other five skills for integrated science process skills [4]. The basic science process skills are appropriate for children in the early grades, and the integrated science process skills are more appropriate for children at grades four or above [5].

Children use science skills to explore phenomena and materials of the world surrounding them as a natural part of children's learning [6]. At the early ages, children will usually use observation and classification skills, but when they get older they will start using other more sophisticated skills, such as inference and prediction.The science process skills are essential, not only to science, but also to other disciplines [1]. Appropriate guidance is required to scaffold children in gradually developing their science process skills for exploring and drawing conclusions about the natural world from their experiences [6]. Understanding the science process skills of children would be useful to help teachers and educators in order to scaffold the science process skills of their students. The paper-and-pencil tests, both the multiple choice and written tests format are commonly used to probe the science process skills of students in primary and secondary school levels. However, the paper and pencil tests are not appropriate for young children especially from the earlier grade levels. In this inquiry, interview

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about events was developed and used as an instrument for testing the science process skills of children which would give rich and depth information about their understanding and abilities.

2. Research Methodology

The aim of this study was to develop an instrument to explore the basic science process skills of children using an interview about events technique.

2.1 Basic science process skills

The basic science skills in this study include eight science process skills:
1) Observation – using any one or a combination of the five senses to gather information about an object.
2) Classification – grouping or ordering objects into categories based on their properties or criteria.
3) Measurement – using both standard and nonstandard measures to describe the dimensions of an object such as length and volume.
4) Calculation (using numbers) – counting the number of an object and doing calculations using simple mathematic operations.
5) Communication – using drawings, words, graphics, or symbols to describe an action or object.
6) Space/Space and Space/Time relationship – describing objects by some types of coordinate systems (spatial dimensions), and one temporal dimension (time).
7) Inference – making a conclusion or an interpretation about an object or event based on gathered data or information.
8) Prediction – stating the outcome of a future event as to what may happen or what is going to happen based on a pattern of evidence, principles, rules, or theory.

2.2 Interview about Events

Interview about events is one of the interview techniques that used to prove students in science education developed by Osborne and Gilbert [7]. In this technique, the children carry out a specific set of activities and the interviewer ask the particular questions to explore the children concepts. The conservation during the activities will indicate students' prior experiences about their concepts [8], and practical skills could observe while interviewing.

Two interview about events were developed, jelly bears& drinks. Each event was designed using a series of tasks for each basic science process skill. The content validity of the instrument was established through experts' judgement. The experts weretwo science educators and one early childhood educators who had experiences in children science learning.

2.3 Participants

The participants were 30 children from Kindergarten 2 to Grade 4 (about 6 – 10 year olds). Six children were from each grade level, three boys and three girls. They were from three different schools in different contexts.

2.4 Data collection and analysis

Children were interviewed one by one. The interview time was about 20 minutes for each event; so two interviews about events took about 40 minutes for each child. However, some interviews were shorter or longer depending on a child's prior knowledge. There were three interviewers in this study. All the interviews were audio recorded and some were video recorded. The interviewers took field notes during the interviews. In addition, all the children's documentaries during the interviews were collected. The audiotapes were transcribed, and compared with the corresponding field notes before being categorized into groups. The rubric of each science process skill was set based on the responses of the children.

3. Results

The number of children in each grade level was indicated separately for each science process skill based on the scoring rubrics shown in Table 1 for both interviews about events.

Table 1. The grade performance of children for the eight basic science process skills.

Rubrics		Number of Children									
Score	Criteria	K 2		Grade 1		Grade 2		Grade 3		Grade 4	
		E1	E2	E1	E2	E1	E2	E1	E2	E1	E2
Observation											
2	Used more than one sense and explained what they did observe correctly for all senses.	2	2	3	0	4	3	3	2	3	2
1	One of the following: - Used more than one sense, but explain what they did observe in some senses. - Used only one sense and explain what they did observe correctly.	3	4	2	6	2	3	1	2	1	2
0	One of the following: - No response. - Did not use any sense. - Used one or more of the senses but explain what they did observe incorrectly.	1	0	1	0	0	0	0	0	0	0
Measurement											
2	Correctly used at least one measuring instrument and indicate value and unit correctly.	0	0	0	0	3	1	3	0	3	1
1	One of the following: - Correctly used at least one measuring instrument. - Correctly read measurement values and units.	0	1	0	0	2	4	2	4	1	1
0	One of the following: - No measurement. - Incorrectly used any measuring instrument and incorrectly read measurement values and units.	6	5	6	6	1	1	0	0	0	2
Classification											
1	Correctly grouping using one criterion.	2	6	2	6	2	6	0	2	2	4
0	One of the following: - Could not identify the criteria for grouping. - Used more than one criterion in grouping.	4	0	4	0	4	0	4	2	2	0
Calculation											
2	Correctly counted and ordered the numbers.	4	5	5	5	4	6	4	4	4	4
1	Correctly counted the numbers, but incorrect in ordering.	1	1	1	1	1	0	0	0	0	0
0	Incorrectly counted numbers in some groups and incorrect in ordering.	1	0	0	0	1	0	0	0	0	0

Note: E1 represents the jelly bear event, E2 represents the drinks event.

Table 1. The grade performance of children for the eight basic science process skills (continued).

Rubrics		Number of Children									
Score	Criteria	K 2		Grade 1		Grade 2		Grade 3		Grade 4	
		E1	E2	E1	E2	E1	E2	E1	E2	E1	E2
Communication											
2	Clearly and correctly draw and explain an event.	2	0	0	0	0	2	3	3	3	2
1	One of the following: - Incomplete in drawing but correctly explained an event. - Could clearly and correctly draw, but could not explain an event.	2	5	3	4	4	4	1	1	1	2
0	One of the following: - Could not draw and explain. - Incorrectly drew and explain an event.	2	1	1	2	2	0	0	0	1	0
Space/Space and Space/Time Relationship											
2	Correctly indicated all of the following: - shape - form - position or size - drawing 2D of a 3D object.	0	0	0	1	1	4	0	2	2	0
1	Correctly indicated at least two of the following: - shape - form - position or size - drawing 2D of a 3D object.	3	5	3	5	3	1	4	2	2	4
0	Correctly indicated only one or none of the following: - shape - form - position or size - drawing 2D of a 3D object.	3	1	3	0	2	1	0	0	0	0
Inference											
2	Drew a correct conclusion.	0	0	0	1	1	0	0	1	0	0
1	Drew an incomplete conclusion.	2	1	3	2	3	2	3	2	2	2
0	One of the following: - No response. - No conclusion. - Drew incorrect conclusions.	4	5	3	3	2	4	1	1	2	2
Prediction											
1	Make correct predictions based on evidence.	2	1	3	2	5	5	3	4	4	3
0	One of the following: - No response. - Made predictions inconsistent with evidence.	3	5	3	4	1	1	1	0	0	1

4. Conclusion and Discussions

The results suggest that the children develop some of the basic science process skills when they get older as suggested in the literature, such as measurement, communication, space/space relationship, and prediction. Surprisingly, some of the basic science process skills do not develop when children get older, such as observation, classification, simple calculations, and inference. The results also suggest that children were good in some basic science process skills, however, they held some misconceptions and faced difficulties in some basic science process skills. In observation, children usually used only sight to observe and explain things, another sense that children mostly used together with sight was touching by hands. In measuring, younger age children (K2 – G1) could not use any basic measuring instruments (balance, ruler, and measuring cup), but older age children (G2-G4) could use some of the measuring instruments (mostly rulers to measure length), but they faced difficulty in reading the scales and units. Children faced difficulty in grouping objects that had more than one identical appearance where they often used more than one criterion when grouping the objects, and many children put only one object in one separate group. Children of all ages could clearly communicate their results using drawings. Children could identify the geometrical shapes of the objects, drawing 2D images of 3D objects, but could not identify the form of the objects. They did not know the terms of form such as cylinder, cube, or cone. The children could explain what they did observe but could not draw conclusions or make inferences using the evidence. Children at an early age often made predictions based on their prior experience, not evidence they observed. The results of this study indicate that the interview about events is an effective instrument to probe children science process skills at all ages. The information from the interview gives rich details of the concepts and skills of children that teachers and educators can use to improve the learning of children.

Acknowledgment

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