SSOAR Open Access Repository
www.ssoar.info

What does the skill of observation look like in young children?

Johnston, Jane Susan

Postprint / Postprint
Zeitschriftenartikel / journal article

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:
www.peerproject.eu

Empfohlene Zitierung / Suggested Citation:
Johnston, J. S. (2009). What does the skill of observation look like in young children? *International Journal of Science Education*, *31*(18), 2511-2525. https://doi.org/10.1080/09500690802644637

Nutzungsbedingungen:
Dieser Text wird unter dem "PEER Licence Agreement zur Verfügung" gestellt. Nähere Auskünfte zum PEER-Projekt finden Sie hier: http://www.peerproject.eu Gewährt wird ein nicht exklusives, nicht übertragbares, persönliches und beschränktes Recht auf Nutzung dieses Dokuments. Dieses Dokument ist ausschließlich für den persönlichen, nicht-kommerziellen Gebrauch bestimmt. Auf sämtlichen Kopien dieses Dokuments müssen alle Urheberrechtshinweise und sonstigen Hinweise auf gesetzlichen Schutz beibehalten werden. Sie dürfen dieses Dokument nicht in irgendeiner Weise abändern, noch dürfen Sie dieses Dokument für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen.
Mit der Verwendung dieses Dokuments erkennen Sie die Nutzungsbedingungen an.

Terms of use:
This document is made available under the "PEER Licence Agreement ". For more Information regarding the PEER-project see: http://www.peerproject.eu This document is solely intended for your personal, non-commercial use.All of the copies of this documents must retain all copyright information and other information regarding legal protection. You are not allowed to alter this document in any way, to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public.
By using this particular document, you accept the above-stated conditions of use.

gesis Leibniz-Institut für Sozialwissenschaften

Mitglied der Leibniz-Gemeinschaft

Diese Version ist zitierbar unter / This version is citable under:
https://nbn-resolving.org/urn:nbn:de:0168-ssoar-207271

For Peer Review Only

What Does the Skill of Observation Look Like in Young Children?

Journal:	*International Journal of Science Education*
Manuscript ID:	TSED-2008-0062.R3
Manuscript Type:	Research Paper
Keywords:	early years, primary school
Keywords (user):	observation, process skills

scholarONE™
Manuscript Central

What Does the Skill of Observation Look Like in Young Children?

Abstract

Fifty six children, aged between four and eleven years of age, in seven groups, were videoed playing with, being questioned about and sorting a collection of toys in order to identify what skills of observation looked like in young children, how observations influenced other scientific skills and what supported the skill of observation. Children's skills of observation were found to be similar across all ages and included affective, functional, social and exploratory comments, actions and questions. These initial observations led to the use of other scientific process skills: classification, prediction, hypotheses, along with explanation for younger children and interpretations for older children. There was generally a greater sophistication of observation skills with increasing age of the children. Observation in young children was found to be tactile and developed in two ways; by engaging in more unique close observation and interpreting observation by utilising previous knowledge and experiences. Important factors affecting the development of observational and other scientific skills were found to be the context (activity, environment, resources) and combination of social interactions between individuals, peers and adults. This combination supported the development of both observational and other scientific skills, although the nature and amount of this interaction appeared individual to different groups of children and could not be predicted.

Deleted: ;

Deleted: s

Deleted: individual

Formatted: Right: 18 pt

For Peer Review Only

What Does the Skill of Observation Look Like in Young Children?

Background

Observation as a skill

Observation has been recognised as an important initial skill in early years and primary science (Harlen, 2000; Covill & Pattie, 2002; de Bóo, 2006). It is also an integral part of international early years (MOE, 1996; DfES, 2007) and primary science curricula (DfEE, 1999; Australian Academy of Science, 2005) and approaches (see Edwards, 2002). Observation assists in the recall of details of an investigation and aids problem-solving (Grambo, 1994), as it is an important component in other scientific skills (Macro & McFall, 2004). However, there has been little common understanding of how observation develops in young children. One view is that as children develop, they begin to focus their observations, 'filtering out' those that are unimportant to the investigation in which they are engaged (Harlen & Symington, 1985). This can give the impression that the children's observational skill has declined, although it may be more sophisticated (see Strauss, 1981) and be influenced by teaching and expectations.

Deleted: Observation has helped to recall details of an investigation and aided

Observation as a theory-dependant process is not a new idea (Hanson, 1958) and is evidenced by research into children's conceptual understanding (Driver, 1983). This research indicated that intuitive observations have been replaced by "instrument and theory-driven observations and the development of scientific

Deleted: 6

Deleted: '

Formatted: Font: Not Italic

Formatted: Right: 18 pt

For Peer Review Only

explanations" (Duschl, 2000 p.191). However, in younger children observation has been found to involve fewer theoretical inferences as compared to older children (National Research Council of the National Academies, 2007). Other research into children's ideas about astronomy (Kameza & Konstantinos, 2006) and features of plants, during a visit to a garden (Johnson & Tunnicliffe, 2000) indicated that it is not direct observation that leads to conceptual development, but metacognition and social construction (Shayer & Adey, 2002). Observation is also influenced by previous ideas (Tompkins & Tunnicliffe, 2001) and interests (Tunnicliffe, & Litson, 2002), so that children observe only what interests them. Support for scientific observation has not always been seen in practice in very young children and it is the child's intuitive theory that has prevailed (Johnston, 2005a), rather than the scientific theory.

Deleted: '

Formatted: Font: Not Italic

Supporting the Development of Observation

Observation has not always been seen as the initial starting point of an exploration of scientific phenomena (National Research Council of the National Academies, 2007). Kallery and Psillos, (2002 p.55) identified in their evaluation of classroom practices that observation formed 5% of activities and mainly involved teachers making the observations, "attended" by children. There has been agreement (Harlen, 2000; de Bóo, 2006) that the development of good observational skills needs to be supported by focused and structured teaching in order to develop thinking and linguistic skills (de Bóo, 2006) and creative thinking (Johnston, 2005b). There have been a number of pedagogical factors affecting

Deleted: There is evidence that o

Deleted: &

Deleted: .

Deleted: Supportive and structured teaching has supported the development of

Formatted: Right: 18 pt

For Peer Review Only

the quality of observational development throughout early years and primary education (Harlen, 2000; Johnston, 2005a). These have included time to observe and discuss observations, especially where this involved the creation of conceptual conflicts (Hand, 1988), which are debated and argued (Naylor et. al., 2004). There has also been increased understanding of the pedagogies that support early scientific learning (Harlen, 2000; Kallery and Psillos, 2002; BERA, 2003; Howe and Davies, 2005; Johnston, 2005a; National Research Council of the National Academies, 2007; Fleer, 2007). In explorations, children have observed using their senses, by noticing details, sorting, grouping and classifying objects or sequencing events. Children also began to use observational aids (Harlen, 2000), although these aids have detracted from the actual observations as the children focus on the use of the aid itself (Johnston, 2005a). Contexts where children can observe natural phenomena, especially animals, have been found to produce positive effects on the development of children's language, social skills and attitudes (Tompkins & Tunnicliffe, 2007). However, in recent years, children have had fewer formal and informal opportunities to observe and explore natural scientific phenomena because of concerns over child safety (Palmer, 2006).

The use of motivating scientific phenomena or objects has helped children to make close observations (Ashbrook, 2007) which can be recorded in written or pictorial form. There is evidence (National Research Council of the National Academies, 2007) that written records are rarely referred to, although rapid

Deleted: growing

Deleted: &

Deleted: &

Deleted: A context

Formatted: Font: (Default) Arial, 12 pt

Deleted: , where children can observe natural phenomena, especially animals also has positively effected the development of language and social skills and attitudes (Tompkins and Tunnicliffe, 2007), as well as other scientific skills.

Deleted: less

Formatted: Right: 18 pt

For Peer Review Only

sketching of detail has been found (Grambo, 1994) to improve observational skills by focusing on important features which are then remembered.

Social Constructivism and Children's Scientific Development

Like other process skills, observation is best developed through structured experiences recognised in learning models in science. Examples of these include, Renner's (1982) "experiences" provided by the teacher, Karplus's (1977) "exploration" with minimal guidance, Erikson's (1979) "experimental manoeuvres", Cosgrove and Osborne's (1985) "generative learning" and the constructivist approach (Scott, 1987), popular in primary science education. However, practical play or exploration is felt to be more appropriate for younger children (BERA, 2003; Howe and Davies, 2005; Johnston, 2005a; de Bóo, 2006).

Deleted: &

It is well known that social interaction has supported children's scientific development (Vygotsky, 1962), especially where accompanied by practical autonomous experience, which builds upon previous knowledge (Piaget, 1929). Children should be active participants in their own scientific understanding as this helps to scaffold both their own (Bruner, 1991) and each others learning in a complex social process, with the child learning alongside the teacher (Stone, 1993). The complexity of this social interaction has been identified by Rogoff's sociocultural "inseparable, mutually constituting planes" (1995 p.139); personal, interpersonal and community/ contextual. These have been found to be useful in analysing early scientific development (Fleer, 2002; Robbins, 2005). Young

Deleted: s

Deleted: will

Deleted: 77

Formatted: Font: (Default) Arial, 12 pt

Formatted: Right: 18 pt

For Peer Review Only

children actively engaged in scientific activities learn through "dynamically changing" social interactions with peers and adults (Rogoff, 1995, p. 151), and will begin to raise new lines of scientific inquiry to follow. Without social interaction and support children are likely to move from their limited unsophisticated creative and imaginative general observations (Tunnicliffe and Litson, 2002) to unsophisticated particular observations, rather than improve their skills in both types of observation. Whilst young children can make very sophisticated and detailed observations, they can get distracted easily and may need support to refocus (Keogh and Naylor, 2003). However, the quality of intervention and interaction is recognised as important (BERA, 2003; Howe and Davies, 2005).

Deleted: Young children actively engaged in scientific activities have learnt through “dynamically changing” social interaction with peers and adults (Rogoff, 1995 p.151) andl begun to raise new lines of scientific inquiry to follow.

Formatted: Font: (Default) Arial, 12 pt

Deleted: &

Deleted: &

Deleted: &

The research presented in this paper aims to answer the following research questions:

Deleted: ,

- What does the skill of observation look like in young children?
- How does the skill of observation influence other scientific skills?
- What supports development of the skill of observation?

Methodology

Paradigm

The research design draws upon interpretative studies in science education (Lemke, 2001) and in early year’s science contexts (Robbins, 2005; Fleer, 2002). Both Robbins (2005) and Fleer (2002) drew upon the analytical techniques of Rogoff (1995) in analysing different aspects of interaction. In this research the

Deleted: falls

Deleted: within the interpretative, sociocultural paradigm, used successfully

Deleted: by

Deleted: (

Deleted: by

Deleted: (

Deleted:) and

Deleted: (

Formatted: Right: 18 pt

For Peer Review Only

individual, peer and adult/ teacher interaction has been analysed in an attempt to understand the skill of observation from both child and adult perspective and the part played by different types of interaction. The interpretative sociocultural paradigm has been subject to concerns about objectivity, especially, as in this case, the researcher/ author has actively advocated an exploratory, discovery teaching and learning approach.

Participants

Fifty-six children, aged between four and eleven years of age, participated in this research. The children were split into seven equal sized groups of eight children. Table 1 outlines the different groups involved with the research. The children all attended a one form entry primary school and eight children from each class volunteered to be involved in the research, which took place during the school day, as part of normal teaching. The researcher, who had over thirty years of experience of working with primary children and was also the author, was known to the school and most of the children. The youngest children were unfamiliar with the researcher and had to be encouraged in their play. Within the school, science was taught, in common with many primary schools, as discrete lessons and lower primary classes had more cross curricular links and practical work than the upper primary classes. Despite some limited practical work (as indicated by the staff) standards for science were very high (as indicated by national assessments and inspection results).

Deleted: were

Deleted: by

Deleted: the class teachers

Deleted: , but was not a regular member of staff

Deleted: and this was taken into consideration in analysis of the data

Formatted: Right: 18 pt

For Peer Review Only

Table 1: The Research Sample

Ethics

Permission was given by parents and teachers prior to the research being undertaken. At the start of the research, the nature of the activity was explained to the children, by the teachers and researcher. The teachers invited the children to take part in the research and they had the right to withdraw and remain in the classroom. The research was conducted in a part of the school used by all the children and they were familiar with additional activities of this sort. However, the activities were not the 'norm' for most of the children and were different from the activities in which other children in the class were engaged.

Deleted: Permissions

Deleted: ere

Deleted: engaged .

Methods

The research activity followed the same format for each group of eight children. Each group was introduced to a collection of small toys, which could be grouped into the following categories (although some fall into more than one category),

- Electrical toys, such as a cheeping chick, an electric car, two sound and light balls and a flashing ball;
- Magnetic toys, such as a monkey and an elephant with magnetic body parts, jumping beans, magnetic frogs and magnetic marbles;
- Wind-up toys, such as a spinning aeroplane, a jumping dog, a wobbling rabbit, a mouse, a pecking bird and a roll-over ladybird;

For Peer Review Only

Formatted: Right: 18 pt

- Spinning toys, such as a magnetic gyroscope, electrical spinning top, two gyroscopes and a propeller;
- Toys that use air to move, such as a jumping frog and a jumping spider (who move when air in a bulb is squeezed into their legs), a pop gun and a snake (whose tongue sticks out when it is squeezed);
- Other toys, such as a slinky, pecking chicks (who peck when a ball attached to them with string is moved), a sprung jumping man (who jumps up after being pushed down onto a sucker) and a trapeze artist and monkey (who somersault when the wooden sides of the trapeze are squeezed).

The toys were placed on a table with seats for the children on three sides and the video camera facing the open side. Although the camera was introduced to the children and they were fully aware of it, none took any notice of it during the activity and it did not appear to have any effect on the results. The activity was structured into three parts: independent play, explaining a toy, and sorting toys. The independent play allowed the children to play freely with the toys for five minutes without any intervention from the researcher, who sat to one side and made notes and was mainly ignored by the children. The second part of the activity, explaining a toy, was also five minutes in length. Here, the children were asked by the researcher, in an open-ended way, to choose one toy and tell others about it; "What can you tell me about your toy?" Follow-up questions were both closed, such as "Why does it jump?", "So why is it flipping?" and open-ended, such as, "Why do you think that happens?" These questions were asked

Deleted: freely

Formatted: Right: 18 pt

For Peer Review Only

by the researcher to ascertain what the children noticed about the toy and how it worked. The final part of the activity was also five minutes in length and involved the researcher giving the children coloured sorting hoops and asking them to sort the toys into groups of their own choice. The questions to support this part of the activity included, "Can you find any other spinning toys?" and "Where do you think that toy can go?"

Deleted: whilst interacting with the toys

The video of the interactions was transcribed and analytical induction (Erickson, 1998) was used to identify the types of initial observations made by the children, the number and types of observations made in the different parts of the activity and how these observations led to or influenced other scientific skills. The initial observations were grouped into four categories:

Deleted: V

Deleted: ere

- affective, showing interest and motivation, such as expressions of glee, "Wow", "Cool", "Wicked";
- functional, observing how the toys work, such as noticing that they are magnetic, wind-up or electrical;
- social, involving interactions between children and the adult, such as negotiation for the use of a toy, demonstrating how a toy works, or helping another child;
- exploratory, leading to further scientific exploration and inquiry, such as questions that can lead to further exploration or inquiry.

Formatted: Right: 18 pt

For Peer Review Only

The three parts of the activity were analysed to ascertain the effect that personal, adult participatory and peer participatory interaction had on the scientific skill of observation. The skill of observation was further analysed to determine how it leads to higher skills, such as raising questions about the toys that can lead to further exploration and inquiry; predicting as to what will happen to a toy next; hypothesising by providing a tentative suggestion as to how a toy works, interpreting or scientific deduction, using scientific knowledge to explain or provide evidence as to how or why a toy works.

Results

Independent Play

All children immediately engaged with the toys during the independent play, picking up toys, playing with them in a very tactile way, looking at the toys and listening to them. The children needed no support from the researcher during this time and could have continued in their play for longer than the five minutes allocated to them.

A large number of spontaneous observation on the part of the children occurred during the independent play (see Table 2). The observations were reasonably similar in all groups of children, although the number did increase with age. Observations included,

- affective comments showing interest and motivation, such as "Whee!'" "Cool!" and "Wicked!";

Formatted: Right: 18 pt

For Peer Review Only

- functional comments on how the toys work, such as "It's magnetic", It's jumping up" and "Listen it cheeps";
- social questions and comments, such as, "Can I look at this after you?", "Can I have a go with that?" and "It's good mine is. Look at mine";
- exploratory questions and responses, such as, "What do you do with these?", "What does it do?" and "How do you do that?"

Table 2: The number and type of children's responses during the independent play with the toys.

The initial observation and exploration of the toys appeared to be a pre-requisite for all the children to motivate them and to enable them to bring their previous knowledge to the observation. For example, a six year old identified that you could have similar cow toys to the magnetic monkey and elephant. An eight year old boy, having observed an electrical toy used his prior knowledge of electricity and asked, "Is it like pushing these wires together? I think its got a bulb holder and two wires connected to a battery". Older children shared their ideas within the group during the initial play. One nine year old girl stated "Oh look at this". Ten and eleven year olds were found to share toys and ideas; "Look at this one, it's magnetic" and "Ah! It flashes". During this period, there was little or no adult interaction and no clear differences between the observational skills of the different groups of children. However, the older children did appear to look more

Deleted: vital

Formatted: Right: 18 pt

For Peer Review Only

closely at the toys and how they worked, rather than just playing with them. There were also more observational responses with age.

Affective observations, concerning interest and motivation, were similar in all groups and tended to be personal rather than shared with others. At the start of the research activity these affective observations tended to dominate and the children did not engage in many close observations. The affective observations were characterised by affective expressions such as giggling and squealing, as well as exclamations; "Oh", "Ah!", "Wow!", "Ahhh", "It's wicked", "Whee", "That's funny", "It's really fit" and "Cool". In some of the older children, the affective comments involved a social aspect, with children communicating their affective observations to their peers,

"Hey look! Look at that mouse", "Look at this" and "Look! Look! Look!" (in children aged seven and eight years of age);

By repeating a child's name and showing a toy to them (child aged eight and nine years of age);

By showing another child a toy, saying "Ah! Look at this" (child aged nine years of age).

Functional observations were concerned with the functioning of the toys and were characterised by comments such as:

"Why's this not working?" and "When I squash it, it sticks down" (children aged four and five years of age);

Deleted: ,

Deleted: ;

Formatted: Right: 18 pt

For Peer Review Only

"This is magnetic", "This one does this - look!" and "It goes cheep, cheep" (children, aged five years of age);

"You have to pull this", "Try and get this down and it does this", "It's magnetic";

"You have to pull this down" (repeated), "Oh, look at him – his feet", "Look he's jumping" and "Oh, he flips over" (children aged six years of age);

"It's jumping up" (child aged seven or eight years of age);

"Listen it cheeps", "Jumper", "It spins", "It flips", "Oh look it flips" and "It wobbles" (children, aged eight and nine years of age);

"This rebounds (gyroscope) It actually hits the (points to the end) and rebounds here" and "Oh look at this" (showing how it works) (children aged nine years of age);

"Ah! It flashes", "His head goes there, his arm goes there (magnetic elephant)", "What's magnetic?" and "Ah magnetic!" (children aged ten and eleven years of age);

These functional observations followed no clear pattern, although they all involved an element of peer interaction.

Social responses were less sophisticated in the youngest children (aged four and five years of age) as they tended to make statements such as "Look what I've got" and "Give it to me". These younger children were also very static in their play and reluctant to move out of their seats, even to pick up a fallen toy and appeared to be worried that they would be reprimanded for doing so. This was possibly due to the children's unfamiliarity with the researcher and with formal

Deleted: ,

Deleted: .

Deleted: .

Deleted: .

Formatted: Right: 18 pt

For Peer Review Only

education. Although the four and five year olds were used to play activities they were unused to table-top play and more used to formal table activities in which they were expected to remain in their seats. With older children an element of sharing was observed, with a group of five year old children pairing off to share specific toys, children aged seven and eight years of age asking “Can I look at this after you?” and children aged eight and nine years of age asking “I’ll swap you”. Social responses with the older children were characterised by greater negotiation so they could play with a particular toy, such as "Do you want to swap it?" (child aged nine years of age). These children also asked social questions which were exploratory or functional, such as, “How do you do this?”, “Look at this one, it’s magnetic” and “What do you do with these?” (children aged ten or eleven years of age). The older children also tended to move around the table more, exploring the toys with other children.

The number and sophistication of exploratory responses increased with the age of the children, with the youngest children asking simple questions such as “What is it?” and older children asking “How do you do this?” as well as engaging in silent and solitary exploration. One girl aged eight years of age quietly explored the working of three separate toys with no interaction. All nine year old children and those aged ten and eleven years of age played quietly with toys, looking at how they worked and demonstrating exploratory behaviour or producing exploratory comments. For example, one ten year old girl spent nearly one and a half minutes in independent close observation of the magnetic gyroscope, clearly

Formatted: Right: 18 pt

For Peer Review Only

identifying how it worked. This contrasted with the seconds that most younger children spent initially observing the toys. Many exploratory responses also involved a social element since the children posed exploratory questions to their peers, such as “How do you do that?”.

Explaining a toy

The second part of the research activity, explaining a toy, was very adult-led and the younger children needed more prompting than the older children, possible because of their age, their limited scientific experiences and their unfamiliarity with the researcher. In this part of the activity the questioning by the researcher appeared to move the children from observations to explanation and interpretation of observations. In all cases, the initial observation, along with the researcher questioning, led to the use of other scientific process skills (see Table 3) such as predicting, hypothesising and explaining or interpreting. The younger children provided a mainly descriptive explanation of what was happening, such as, “it jumps when you squeeze it” (four year old child, with a jumping frog) or “If you pull the string, the head goes up” (six year old child, with the pecking chicks). Older children focused on more detailed interpretation of how the toy worked. For example, a seven year old child, explaining how a flashing ball worked stated "Does it like – you know – when there’s like a snapped wire and you put it together and it works again. Is it like pushing these wires together?” and a ten year old child with a jumping dog saying, “Well, you twist this up and there’s probably like a little band in there that’s stretching and it flips upside down”.

Formatted: Right: 18 pt

For Peer Review Only

Various factors appeared to influence the number and type of scientific process skills shown by the children:

- the type of activity/ toy chosen;
- the type of questioning (open-ended or closed);
- the age of the children.

The toys and the style of questioning appeared to encourage the younger children to explain how the toy worked or why it was doing something. In the following extract the researcher is asking a five year old boy about a trapeze artist and the child explains what the toy does,

Researcher: "Can you tell me about your toy? Which toy are you going to show me?"

Boy (holding up a trapeze artist): "This one."

Researcher: "This one? And what do you have to do to that one?"

Boy: "You twist it" (swings the trapeze artist) "It swings!"

Older children tended to interpret their observations and to interact with other children in the group, rather than rely on the researcher to lead the interaction. This is illustrated in the following extract of questioning about a magnetic gyroscope with ten and eleven year old children. In this extract the children have been given numbers to distinguish them.

Girl 5: (with magnetic gyroscope) "When you tip it upside down, it goes up that way like that. It's magnetic."

Researcher: "So which bit's magnetic?"

Formatted: Right: 18 pt

For Peer Review Only

Girl 5: "Well this is" (pointing to metal sides) "and this" (pointing to magnetic ends of the wheels).

Researcher: "They are both magnetic?"

Girl 5: "Yes, but the wheel bit isn't, just the sides" (she pulls it apart and tries to reassemble).

Girl 4 (to Girl 5 as she attempts to reassemble it): "It's magnetic, it won't fall off".

Girl 5 (to Girl 4) "But I just took it off. That's why" (and she demonstrates it working).

Researcher: "So why does it not fall off?"

Girl 4: "Because this is metal and these are metal and they connect together" (showing all children).

Researcher: "Why does it not fall off when it gets to the bottom?"

Girl 4: "Mmmmm".

Girl 2: "Is it because it goes down? It's like goes speeding and when it goes up it goes like, gets slower" (shows with her hands).

Girl 5 demonstrates for Girl 2.

Girl 3: "and it gets slower every time" (as the momentum slows).

Researcher: "Why do you think its getting slower every time?"

Girl 4: "Because it goes to the top and back and it can't like go to the top because the magnetic won't let it go".

Girl 5: "Maybe its because when it was at the top, you had more pressure. It went down hill but it won't go straight".

Formatted: Right: 18 pt

For Peer Review Only

In the second part of the research activity, there was evidence that the children were moving through the levels of the Social Play Continuum, as defined by Broadhead (2004) from associative play in the youngest children to cooperative play in the oldest children. There were also opportunities in this part of the research activity to predict and raise questions, although the style of questioning did not encourage this. The oldest (ten and eleven year old) children only predicted when prompted by the researcher, whilst observing a cheeping electrical chick and asked what would happen if it was placed on different surfaces (table, hands, carpet).

Deleted: ,

Table 3: The scientific skills evident during researcher questioning

Whilst the youngest children produced more hypotheses than the older children, these tended to be simplistic hypotheses rather than the more sophisticated hypotheses seen in the older children. These hypotheses were also encouraged by the researcher questioning. Examples of the younger children's simple hypotheses included when looking at a magnetic gyroscope "There's magnets in it" (four year old child) and "Because its got magnets in the side of it and the metal – its got metal there" (six year old child). Older children's more sophisticated hypotheses, included when an eleven year old child was looking at how the magnetic gyroscope works "Because this is metal and these are metal and they connect together" and a nine year old child when identifying how a musical spinner works, "Is it because there's electricity inside which makes the bulb light and the noise?"

Formatted: Right: 18 pt

For Peer Review Only

Younger children tended to explain their observations, such as. “You push it down and let go and it jumps up” (four year old child, with a jumping man), “You have to use the button to make it move” (five year old child, with an electric car) and “You press - I don’t know where, but it makes it talk like a chick” (six year old child, explaining how a cheeping chick works). Older children provided more in-depth interpretations of their observations, such as “I think it’s got a bulb holder and two wires connected to a battery” (seven year old child, with a flashing ball), “When you slow it down, you just… it turns the other way and when you rub it, it just goes the other way” (eight year old child, observing a propeller turning) and “Well I think maybe it’s like some string that like when you turn it backwards it gets tightly wrapped round something and so then when you let go it sort of starts spinning round” (ten year old child, with a wind-up ladybird).

Sorting toys

The third and final part of the research activity was a researcher-led classification in which each group of children decided the classificatory groups, based on their observations, and placed the toys within these. The youngest children chose mainly categoric criteria for classification such as the colour of the toy. Older groups chose derived functional criteria, indicating what you had to do to the toy (push or pull) or what it did (spin, jump). The oldest children used more derived scientific criteria, providing a scientific explanation for how the toy worked, (magnetic, electrical, air). There was a general increase in sophistication of

Formatted: Right: 18 pt

For Peer Review Only

classification, although the most complex classification, with interrelated groups was seen in the group of six year old children. They overlapped an air group with a frog group an a bouncing group and a spinning group with a magnetic group.

Discussion of Findings

From this research, it appeared that initial observation in young children was tactile involving the sense of touch and hearing as much as sight. It also appeared that the skill developed in two ways. Firstly older children began to engage in more individual close observation and for longer periods of time. Initially their motivation appeared to hamper close observation, but they moved from broad observations to more specific observations (Harlen and Symington, 1985) and the oldest children moved past the affective comments quickly to make close observations. Whilst observation is more than just seeing (Johnston, 2005a), the initial affective comments appeared to link with the idea that most children initially begin to observe using more than one sense. Later as these children have developed, they appeared to begin to focus through close observations, which provide opportunities for interpretations, and by identifying similarities and differences between the toys and patterns in the way they operate. Secondly, children brought their previous knowledge and experiences to the observation, enabling them increasingly to explain then interpret their observations. In this way the theories developed through prior exploration, investigation and teaching were applied to their observations (Duschl, 2000; Tompkins and Tunnicliffe, 2001), so the children moved from simple to more

Deleted: children

Deleted: , who

Deleted: as children mature they

Deleted: began to

Deleted: &

Deleted: and these enabled

Deleted: to

Formatted: Right: 18 pt

For Peer Review Only

complex and sophisticated hypotheses and from explanations of their observations to more complex interpretations. However, it did not follow that the children's interpretations were more scientifically accurate, although they did appear to be more conceptually sophisticated.

Observations did appear to lead to other scientific skills, although the type and sophistication of the skills was not only dependent on age but on the context and questioning skill employed. The context (activity, environment, resources) should be one that provides opportunities for observation and other skills to be practised. Gardner (2006) described this type of context as a nurturing environment: one that stimulates the multiple intelligences and provides opportunities for children to observe both adults and expert peers as role models for learning, and to observe and interact with a range of materials. Kumpulainen et. al., (2003) described how exploratory activities, support social interaction and results from this research indicate that social interaction can also support scientific development. Maynard and Waters (2007) found that an outdoor environment, where children can explore the world around them, has the potential to support observation of natural phenomena. Both the resources available to children, and the context for learning, were found to be important factors for developing children's observational skills.

One of the most important factors supporting the development of observational and other process skills is social interaction, with a combination of individual, peer and adult interaction being important (Vygotsky, 1962; Rogoff, 1995). The

Deleted: appeared not only

Deleted: c

Formatted: Font: (Default) Arial, 12 pt

Deleted: Gardner (2006) described this type of context as a nurturing environment that is one that stimulates multiple intelligences. A nurturing environment is also one which provides opportunities for children to observe both adults and expert peers, as role models for learning and to observe and interact with a range of materials.

Formatted: Font: (Default) Arial, 12 pt

Formatted: Font: (Default) Arial, 12 pt

Deleted: this research appeared to indicate that social interaction can support scientific development. Whilst previous research (e.g. Maynard and Waters, 2007) suggested that an outdoor environment has the potential to support observation of natural phenomena, allowing children to explore the world around them, this research suggested that the resources and context are also important. ¶

Deleted: appeared to be

Formatted: Right: 18 pt

For Peer Review Only

nature and amount of this interaction appears individual to different groups of children and cannot be predicted. However, with age, peer interaction appears to challenge children's ideas and lead to the construction of new and more scientific thinking (Driver, 1983). In recent years, primary science education has often been more about the acquisition of conceptual knowledge. This has meant that perceptions and understandings of science have shifted too, from skills (Johnston, et. al 1998) to more subject knowledge (Johnston and Ahtee, 2006; Ahtee and Johnston, 2006). Is this, along with more formal early childhood education (e.g. DfES, 2007) and limited opportunities for children to interact with resources, the environment and others (Palmer, 2006; Mayall, 2007) leading to difficulties in the development of observational skills?

Deleted: ed

Deleted: ould not

Deleted: predicted, although

Deleted: ed

Deleted: &

Deleted: &

Formatted: Font: (Default) Arial, 12 pt

Formatted: Font: (Default) Arial, 12 pt

Deleted: This combined with more formal early education (e.g. DfES, 2007) and restricted environments for children (Palmer, 2006; Mayall, 2007) may have created difficulties in the development of observational skills as opportunities to interact with resources, the environment and others are restricted.¶

Formatted: Font: Bold

Formatted: Font: (Default) Arial, Bold

References

Ahtee, M. & Johnston, J. (2006). Primary student teachers' ideas about teaching a physics topic. *Scandinavian Journal of Educational Research*, 50(2), 1-13.

Ashbrook, P. (2007). Science tickets. *Science and Children,* 45(2), 18.

Australian Academy of Science (2005). *Primary connections*. Canberra: Australian Academy of Science.

BERA, (2003). *Early year's research: Pedagogy, curriculum and adult roles, training and professionalism.* Southwell, Notts: BERA.

Broadhead, P. (2004). *Early years play and learning. Developing social skills and cooperation.* Abingdon, Oxon: RoutledgeFalmer.

Deleted: *years*

Formatted: Right: 18 pt

For Peer Review Only

Bruner, J. S. (1991). The narrative construction of reality. *Critical Inquiry*, 18(1), 1-21.

Cosgrove, M. and Osborne, R. (1985). Lesson frameworks for changing children's ideas. In R. Osborne and P. Freyberg, *Learning in science: The implications of children's learning* (pp. 101-111). Auckland, New Zealand: Heinemann.

Covill, M. & Pattie, I. (2002). Science skills – The building blocks. *Investigating*, 18(4), 27-30.

de Bóo, M. (2006). Science in the early years. In Harlen, W. (ed) *ASE guide to primary science education* (pp. 124-132). Hatfield: ASE.

DfEE (1999). *The national curriculum: Handbook for teachers in England.* London:DfEE/ QCA.

DfES (2007). *The early years foundation stage; Setting the standard for learning, development and care for children from birth to five.* (DfES, 2007) London: DfES.

Driver, R. (1983). *The pupil as a scientist.* Milton Keynes: Open University Press.

Duschl, R. (2000). Making the nature of science explicit. In Millar, R., Leach, J. & Osborne, J. (Eds). *Improving science education: The contribution of research* (pp. 187-206). Buckingham: Open University Press.

Edwards, C. P. (2002). Three approaches from Europe: Waldorf, Montessori, and Reggio Emilia. *Early Childhood Research & Practice*, 4(1) http://www.ecrp.uiuc.edu/v4n1/edwards.html.

Deleted: Driver, R. (1983) *The pupil as a scientist.* Milton Keynes: Open University Press.¶

Formatted: Right: 18 pt

For Peer Review Only

Erikson, G. L. (1979). Children's conceptions of heat and temperature. *Science Education*, 63, 221–30.

Erickson, F. (1998). Qualitative research methods for science education. In B. J. Fraser & K. G. Tobin (Eds). International handbook of science education (pp. 1155-1173). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Fleer, M. (2002). Sociocultural assessment in early years education: Myth or reality? *International Journal of Early Years Education,* 10(2), 105-120.

Fleer, M. (2007). *Young children: Thinking about the scientific world.* Watson, ACT; Early Childhood Australia.

Gardner, H. (2006). *Multiple intelligences: New Horizons.* New York: Perseus Books.

Grambo, G. (1994). The art and science of observation. *Gifted Child Today Magazine*, 17(3), 32-33.

Hand, B. (1988). Is conceptual conflict a viable teaching strategy?: The students' viewpoint. *Australian Science Teachers Journal*, 34(4), 22-26.

Hanson, N. R. (1958). *Patterns of discovery*. An Inquiry Into the Conceptual Foundations of Science.. Cambridge: Cambridge University Press.

Harlen, W. (2000). The teaching of science in primary schools 3rd Edition. London: David Fulton.

Harlen, W. & Symington, D. (1985). Helping children to observe. In Harlen, W. *Primary science: Taking the plunge* (pp.21-35). London: Heinemann.

Deleted:

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Right: 18 pt

For Peer Review Only

Howe, A. & Davies, D. (2005). Science and play. In Moyles, J. (2005) *The excellence of play 2nd Edition* (pp. 154-169). Maidenhead: Open University Press.

Johnson, S. & Tunnicliffe, S. D. (2000). Primary children talk about plants in the garden. P*aper presented to the NARST Conference, April 2000, USA.*

Johnston, J. (2005a). *Early explorations in science 2nd Edition.* Buckingham: Open University Press.

Johnston, J. (2005b). Creativity in science education. In Wilson, A. (2005) *Creativity in primary education* (pp. 88-101). Exeter: Learning Matters.

Johnston, J.& Ahtee, M. (2006). What are primary student teachers' attitudes, subject knowledge and pedagogical content knowledge needs in a physics topic?' *Teaching and Teacher Education, 22*(4), 1-10.

Johnston, J., Ahtee, M. & Hayes, M. (1998). Elementary teachers' perceptions of science and science teaching: Comparisons between Finland and England. In Kaartinen, S. (Ed) *Matemaattisten Aineiden Opetus ja Oppiminen* (Oulu, Oulun yliopistopaino). 13-30.

Kallery, M. & Psillos, D. (2002). What happens in the early years science classroom? The reality of teachers' curriculum implementation activities. *European Early Childhood Education Research Journal,* 10(2), 49-61.

Kameza, M. & Konstantinos, R. (2006). An approach to the introduction of elementary astronomy concepts in early education. Paper presented at the *European Conference on Educational Research, University of Geneva 13-15 Sept 2006.*

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Right: 18 pt

For Peer Review Only

Karplus, R. (1977) *Science teaching and the development of reasoning.* Berkeley, CA: University of California Press.

Keogh, B. & Naylor, S. (2003). 'Do do as I do'; being a role model in the early years. *Primary Science Review,* 78, 7-9.

Kumpalainen, K., Vasama, S. & Kangassalo, M. (2003). The intertextuality of children's explanations in a technology-enriched early years science classroom. *International Journal of Educational Research,* 39, 793-805.

Lemke, J. L. (2001). Articulating communities: Sociocultural perspectives on science education. *Journal of Research in Science Teaching,* 38(3), 296-316.

Macro, C. & McFall, D. (2004). Questions and questioning: Working with young children. *Primary Science Review* 83, 4-6.

Mayall, B. (2007). Children's Lives Outside School and their Educational Impact, *Primary Review Research Briefings* 8/1 http://www.primaryreview.org.uk/Downloads/Int_Reps/3.Children_lives_voices/Primary_Review_8-1_briefing_Children_s_lives_outside_school_071123.pdf.

Maynard, T. & Waters, J. (2007). Learning in the outdoor environment: A missed opportunity? *Early Years*, 27(3), 255-265.

MOE (Ministry of Education) (1996). *Te Whāriki early childhood curriculum*. Wellington, New Zealand: Learning Media.

National Research Council of the National Academies (2007). *Taking science to school* .Washington, DC: The National Academies Press.

Naylor, S., Keogh, B. & Goldsworthy, A. (2004). *Active assessment: Thinking, learning and assessment in science.* Sandbach, Cheshire: Millgate House.

Formatted: Font: (Default) Arial

Formatted: Font: (Default) Arial

Formatted: Font: (Default) Arial

Formatted: Font: (Default) Arial

Formatted: Right: 18 pt

For Peer Review Only

Palmer, S. (2006). *Toxic childhood; How the modern world is damaging our children and what we can do about it.* London: Orion Books.

Piaget, J. (1929). *The Child's conception of the world.* New York: Harcourt.

Renner, J. (1982). The power of purpose. *Science Education*, 66, 709–16.

Robbins, J. (2005). 'Brown paper packages'? A sociocultural perspective on young children's ideas in science. *Research in Science Education*, 35(2), 151-172.

Rogoff, B. (1995). Observing sociocultural activity on three planes: Participatory appropriation, guided participation, and apprenticeship. In Wertsch, J. V., Del Rio, P & Alvarex, A, (Eds.), Sociocultural studies of mind (pp. 139-164). Cambridge, UK: Cambridge University Press.

Scott, P.(1987). *A constructivist view of teaching & learning science.* Leeds: Leeds University.

Shayer, M. and Adey, P. (2002). (Eds.) *Learning intelligence. Cognitive acceleration across the curriculum from 5 to 15 Years.* Buckingham; Open University Press.

Strauss, S. (1981). *U-shaped behavioural growth.* Academic Press.

Stone, C. A., (1993). What is missing in the metaphor of scaffolding? In Forman, E. A., Minick, N., Stone, C. A, (1993). *Contexts for Learning; Sociocultural dynamics in children's development* (pp. 169-183). New York: Oxford University Press.

Tompkins, S. P. & Tunnicliffe, S.D. (2001). Looking for ideas: Observations, interpretations and hypothesis-making by 12 year old pupils undertaking

Deleted: e

Formatted: Right: 18 pt

For Peer Review Only

science investigations. *International Journal of Science Education,* 23(8), 791-813.

Tomkins, S. and Tunnicliffe, S.D, (2007). Nature tables: Stimulating children's interest in natural objects. *Journal of Biological Education*, 41(4), 150-155.

Tunnicliffe, S. D. & Litson, S. (2002). Observation or imagination? *Primary Science Review,* 71, 25-27.

Vygotsky, L. (1962). *Thought and Language* Cambridge. MA: MIT Press.

For Peer Review Only

Formatted: Right: 18 pt

Group	Number of Children	Age of Children
1. (Reception)	6 2	4 years 5 years
2. (Year 1)	8	5 years
3. (Year 2)	8	6 years
4. (Year 3)	6 2	7 years 8 years
5. (Year 4)	7 1	8 years 9 years
6. (Year 5)	8	9 years
7. (Year 6)	5 3	10 years 11 years

For Peer Review Only

Type of Initial Responses	**Reception**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Total**
Affective	**4**	**3**	**6**	**8**	**11**	**2**	**5**	**39**
Functional	**2**	**3**	**7**	**1**	**7**	**2**	**6**	**28**
Social	**5**	**9**	**6**	**5**	**4**	**6**	**9**	**44**
Exploratory	**1**	**1**	**1**	**4**	**1**	**10**	**9**	**27**
Total	**12**	**16**	**20**	**18**	**23**	**20**	**29**	***138***

For Peer Review Only

Skill	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
Questioning	0	0	3	0	0	0	1	4
Predicting	1	0	0	0	0	0	8	8
Hypothesising	4	2	5	1	1	1	2	16
Explaining	4	2	8	0	0	0	0	14
Interpreting	0	0	0	1	4	3	6	14
Total	8	4	16	2	5	4	17	*138*

For Peer Review Only