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

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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 the skill of observation looks like in young children and what pedagogical approaches support observational development. Analysis of the data identifies that initial observations were similar in all children and included affective, functional, social and exploratory comments, actions and questions. Initial observation led to the use of other scientific process skills; classification, prediction, hypotheses and explanation for younger children and interpretations for older children. There was generally a greater sophistication of skills with the age of the children. The research indicates that observation in young children is tactile and develops in two ways; by engaging in more individual close observation and interpreting observation by utilising previous knowledge and experiences. Important factors affecting the development of observational and other scientific skills are the context (activity, environment, resources) and combination of social interactions between individuals, peers and adults. This combination supports the development of both observational and other scientific skills, although the nature and amount of this interaction is individual to different groups of children and cannot be predicted.
Background to the Topic

Observation as a skill

Observation is recognised as an important initial skill in early years and primary science (Harlen, 2000; Covill & Pattie, 2002; de Bóo, 2006), as well as being 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 helps to recall 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 is not 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 they are engaged in (Harlen & Symington, 1985). This can give the impression that the children’s observational skill is declining, although it may be more sophisticated (see Strauss, 1981) and be influenced by teaching and expectations.

Observation as a theory-dependant process is not a new idea (Hanson, 1956) and is evidenced by research into children’s conceptual understanding (Driver, 1983), which indicates that intuitive observations have been replaced by ‘instrument and theory-driven observations and the development of scientific explanations’ (Duschl, 2000: 191). However, in younger children observation will 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) indicate 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, &
so that children observe only what they want to. Support for scientific observation is not always seen in practice in very young children and it is not necessarily the scientific theory but the child’s intuitive theory that prevails (Johnston, 2005).

Supporting the Development of Observation

There is evidence that observation is not always seen as the initial starting point of an exploration of scientific phenomena (National Research Council of the National Academies, 2007). Kallery & Psillos,( 2002: 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 is 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, 2005a). There are a number of pedagogical factors affecting the quality of observational development throughout early years and primary education (Harlen, 2000; Johnston, 2005) including time to observe and discuss observations, especially where this involves the creation of conceptual conflicts (Hand, 1988), which are debated and argued (Naylor et. al., 2004). There is growing understanding of the pedagogies that support early scientific learning (Harlen, 2000; Kallery & Psillos, 2002; BERA, 2003; Howe & Davies, 2005; Johnston, 2005; National Research Council of the National Academies, 2007; Fleer, 2007). In explorations, children observe using their senses, by noticing details, sorting, grouping and classifying objects or sequencing events. Children also begin to use observational aids (Harlen, 2000), although these aids can detract from the actual observations as the children focus on the use of the aid itself (Johnston, 2005). A context, where children can observe natural phenomena, especially animals also has a positive effect on the development of language and social skills and attitudes (Tompkins and Tunnicliffe,
2007), as well as other scientific skills. However, children have less 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 help 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 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**


It is well known that social interaction supports children’s scientific development (Vygotsky, 1962), especially where it accompanies practical autonomous experiences, which build upon previous knowledge (Piaget, 1929). Children should be active participants in their own scientific understanding as this will help to scaffold both their own (Bruner, 1977) 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: 139); personal, interpersonal and community/contextual. These have been found to be useful in analysing early scientific development (Fleer, 2002; Robbins, 2005). Young children actively engaged in scientific activities will learn through ‘dynamically changing’ social interaction with peers and adults (Rogoff, 1995: 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 & 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 & Naylor, 2003), although the quality of intervention and interaction is recognised as important (BERA, 2003; Howe & Davies, 2005).

This research aims to answer the questions,

- ‘What does the skill of observation look like in young children?’
- What pedagogical approaches support the development of the scientific skill of observation?

Research Methods

Paradigm

The research falls within the interpretative, sociocultural paradigm, used successfully in science education by Lemke (2001) and in early years science contexts by Robbins (2005) and Fleer (2002). Both Robbins (2005) and Fleer (2002) drew upon the analytical techniques of Rogoff (1995) in analysing different aspects of interaction and in this research the individual, peer and adult/teacher interaction is 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 is subject to concerns about objectivity, especially, as in this case, the researcher/author actively advocates an exploratory, discovery teaching and learning approach. To address problems of validity and provide alternative perspectives, the research data was co-analysed by teachers on Masters programmes (coming from a variety of backgrounds) and by undergraduate early childhood students.

Participants
The sample involved fifty six children, aged between four and eleven years of age, working in seven groups with eight children in each group. 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 were chosen by the class teachers to be involved in the research, which took place during the school day, as part of normal teaching. The researcher was known to the school and most of the children, but was not a regular member of staff. This posed some problems with the youngest children who were unfamiliar with the researcher and this was taken into consideration in analysis of the data. Within the school science was taught, in common with many primary schools, as discrete lessons, with more cross curricular links and practical work in the lower 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).
Table 1: The research sample

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Children</th>
<th>Age of Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (Reception)</td>
<td>6</td>
<td>4 years</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5 years</td>
</tr>
<tr>
<td>2. (Year 1)</td>
<td>8</td>
<td>5 years</td>
</tr>
<tr>
<td>3. (Year 2)</td>
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<td>6 years</td>
</tr>
<tr>
<td>4. (Year 3)</td>
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<td>7 years</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8 years</td>
</tr>
<tr>
<td>5. (Year 4)</td>
<td>7</td>
<td>8 years</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>9 years</td>
</tr>
<tr>
<td>6. (Year 5)</td>
<td>8</td>
<td>9 years</td>
</tr>
<tr>
<td>7. (Year 6)</td>
<td>5</td>
<td>10 years</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>11 years</td>
</tr>
</tbody>
</table>

*Ethics*

Permissions were 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 different from the activities that others in the class were engaged in and this had an effect on validity, as the children did not always behave in the same way as in their classrooms.

*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;
• 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. The first part involved independent, free play 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. In the second part of the activity, which was also five minutes in length, 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 by the researcher to ascertain what they 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 and interacting with them whilst they did this. 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?’

Video of the interactions were transcribed and analytical induction (Znaniecki, 1934) used to identify the types of initial observations made, 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 according to whether they were,

- 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.

The different parts of the activity were analysed to ascertain the effect of personal, adult participatory and peer participatory interaction has on the scientific skills of observation.
and how observation leads to the skills of 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**

All children immediately engaged with the toys during the initial part of the activity, picking up toys, playing with them in a very tactile way, looking at 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.

This part of the research produced a large number of spontaneous observations on the part of the children (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!’;
- 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 responses during the first part of the research activity; independent play with the toys

<table>
<thead>
<tr>
<th>Type of Initial Responses</th>
<th>Reception</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affective</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td>11</td>
<td>2</td>
<td>5</td>
<td>39</td>
</tr>
<tr>
<td>Functional</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>6</td>
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<td>Social</td>
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<td>9</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>44</td>
</tr>
<tr>
<td>Exploratory</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>10</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>16</td>
<td>20</td>
<td>18</td>
<td>23</td>
<td>20</td>
<td>29</td>
<td>138</td>
</tr>
</tbody>
</table>

The initial observation and exploration of the toys appeared to be a vital pre-requisite for all the children to motivate them, 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 and 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’. Other children shared ideas within the group during the initial play, with one nine year old girl showing another child a toy, with the words ‘Oh look at this’ and ten and eleven year olds sharing both 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, although the older children did appear to look more 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);

‘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)


‘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’. They 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 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, ‘Do you want to swap it?’ (child aged nine years of age) and social questions which were also 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, whilst all nine year old children and those aged ten and
eleven years of age played quietly with toys, looking at how they work 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 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?’.

In all cases, initial observation, in the first part of the research activity and researcher questioning, in the second part of the research activity, led to the use of other scientific process skills (see Table 3), such as predicting, hypothesising and explaining/interpreting. The second part of the research activity 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. 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 with for example, a seven year old child, explaining how a flashing ball works by saying ‘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’.. There were a number of factors which appeared to influence the number and type of skills shown,
• 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 child 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?’

Five year old boy (holding up a trapeze artist): ‘This one.’

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

Five year old 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, as can be seen 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?’

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’.

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).
Table 3: The scientific skills evident during researcher questioning

<table>
<thead>
<tr>
<th>Skill</th>
<th>Reception</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questioning</td>
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<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Predicting</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>8</td>
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<td>Hypothesising</td>
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<td>14</td>
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<tr>
<td>Total</td>
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<td>4</td>
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<td>2</td>
<td>5</td>
<td>4</td>
<td>17</td>
<td>138</td>
</tr>
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</table>

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?’

Younger children tended to explain their observations (see Table 4), 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).

Table 4: Table to show examples of explanations and interpretations at different ages

<table>
<thead>
<tr>
<th></th>
<th>Explanations</th>
<th>Interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception</td>
<td>‘it jumps when you squeeze it’ (jumping frog)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘You push it down and let go and it jumps up’ (sprung jumping man)</td>
<td></td>
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<tr>
<td>Year 1</td>
<td>‘You have to use the button to make it move’ (electric van)</td>
<td></td>
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<tr>
<td></td>
<td>‘You twist it’ (trapeze artist)</td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td>‘If you pull the string, the head goes up’ (pecking chicks)</td>
<td>‘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? (flashing ball) I think it’s got a bulb holder and two wires connected to a battery. flashing ball)</td>
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<td></td>
<td>‘You press- I don’t know where, but it makes it talk like a chick’ (cheeping chick)</td>
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<tr>
<td>Year 3</td>
<td>‘It’s a wheel and the wheel turns and then it’s a magnet’ (magnetic gyroscope)</td>
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<td></td>
<td>‘When you slow it down, you just… it turns the other way and when you rub it, it just goes the other way’ (propeller)</td>
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<tr>
<td>Year 4</td>
<td>‘If you pull that down, the chickens come up and if you let go of it the chickens go down and it looks like they are pecking the board’ (pecking chicks)</td>
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<tr>
<td></td>
<td>‘When you squeeze it (trapeze artiste)</td>
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</tbody>
</table>
Year 6

‘Well, you twist this up and there’s probably like a little band in there that’s stretching and it flips upside down.’ (wind-up jumping dog)
‘I think it’s got a little bit of… maybe like a bit of plastic raises it up so it has to come down like a spring’
“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” (wind up ladybird)

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 with the older groups choosing derived functional criteria, indicating what you had to do to the toy (push or pull) or what it did (spin, jump) and 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 classification, although the most complex classification, with interrelated groups was seen in the group of six year old children, who 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 appears that initial observation in young children is tactile and involves the sense of touch and hearing as much as sight. It also appears that the skill develops in two ways. Firstly that as children mature they begin to engage in more individual close observation and for longer periods of time. Initially their motivation can
appear to hamper close observation, but they begin to move from broad observations to more specific observations (Harlen & Symington, 1985) and the oldest children move past the affective comments quickly to make close observations. Whilst observation is more than just seeing (Johnston, 2005), the initial affective comments appear to link with the idea that most children initially begin to observe using more than one sense. Later as these children have developed, they appear 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 bring their previous knowledge and experiences to the observation and these enable them to increasingly explain then interpret their observations. In this way the theories developed through prior exploration, investigation and teaching are applied to their observations (Duschl, 2000; Tompkins and Tunnicliffe, 2001), so the children move from simple to more complex and sophisticated hypotheses and from explanations of their observations to more complex interpretations. However, it does not follow that the children’s interpretations are more scientifically accurate, although they do appear to be more conceptually sophisticated.

Observations do appear to lead to other scientific skills, although the type and sophistication of the skills appears 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 practiced. Gardner (2006) describes this type of context as a nurturing environment, that is one that stimulates 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) describe how exploratory activities, support social interaction and this research appears to indicate that social interaction
can support scientific development. Whilst previous research (e.g. Maynard and Waters, 2007) suggest that an outdoor environment has the potential to support observation of natural phenomena, allowing children to explore the world around them, this research suggests that the resources and context are also important.

One of the most important factors supporting the development of observational and other process skills appears to be social interaction, with a combination of individual, peer and adult interaction being important (Vygotsky, 1962; Rogoff, 1995). The nature and amount of this interaction is individual to different groups of children and cannot be predicted, although 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 and this means that perceptions and understandings of science have shifted too, from skills (Johnston, et. al 1998) to more subject knowledge (Johnston & Ahtee, 2006; Ahtee & Johnston, 2006). This combined with more formal early education (e.g. DfES, 2007) and restricted environments for children (Palmer, 2006; Mayall, 2007) may create difficulties in the development of observational skills as opportunities to interact with resources, the environment and others is restricted.

References


http://www.ecrp.uiuc.edu/v4n1/edwards.html.


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