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Children's ideas about the human body – A Nordic case study

Abstract

This paper explores the findings of a study of the ideas young school children in the Nordic countries have about the human body e.g. structure and location of bones and organs (heart, lungs, stomach and brain etc.) before being taught about it formally at school. The aims of the study were to investigate children's ideas about the human body and to see if their ideas differ between Nordic countries and if so, in what way. Twenty 6 year old children in each country were chosen (7–8 year olds in Finland) and asked to draw the bones and the organs in the body and to explain their drawings. Mixed methods were used in this study to get a broader view of the double aim of the study. Special scales were used to get a quantitative view of children's ideas as put forward in their drawings and the study also had some elements of a case study as it was meant to focus on children's ideas about a special issue, that is, the human body. The results show many similarities between the children's ideas presented in the drawings and also interesting differences. The results also suggest that the culture aspects in each country such as cooking habits, typical foods, pictures in books and language expressions influence children's ideas about bones and organs in the human body.

INTRODUCTION

Making drawings has always been a part of children's activities at school. Children's drawings are important to get access to their ideas (Walker, 2007), or as Fisher (2005) says:

Drawing is a wonderful way of making thinking visible (p. 57).

Children's drawings have been viewed by researchers as a means of investigating children's understanding of specific concepts. Greig and Taylor (1999) point out that children's drawings have been neglected as a tool of educational research, and along with Haney, Russel and Bebell (2004), they stress that it is best to have the children clarify their drawings themselves. Haney et al. (2004) also point out that drawings can be of great value for assessment and evaluation of educational practices and issues and students' drawings provide a rich opportunity to document students' perspectives.

Anning and Ring (2004) argue that children's drawings are undervalued in school education and that drawings should be taken into account as an important part of children's development. They believe that drawings are a powerful tool for knowing what children are telling us and offer insight into their thinking and understanding of their world. They build their conclusions on their own study of children's drawings that were collected over three years, between the ages of 3 and 7 (Anning & Ring, 2004). According to Gross and Hayne (1999), by the age of 5 or 6, children understand the symbolic potential of a drawing, and their graphic skills allow them to produce drawings that resemble the items they set out to depict. Óskarsdóttir (2006) has pointed out that children's fine motor skills can vary greatly at the age of 6–7 and therefore it is important to encourage the children to explain their drawings, a point also noted by Einarsdóttir, Dockett and Perry (2009). Their research that related to the transition to school showed that when children draw and talk, they construct and convey their meaning.

According to Reiss and Tunnicliffe (2001), drawings are of special value for children that have difficulties in expressing themselves verbally. Drawings can also be helpful for those children who are shy, lack linguistic skills or speak only a foreign language, especially when used in international studies (Reiss, Tunnicliffe, Andersen, Bartoszeck, Carvalho, Chen et al., 2002). Reiss and Tunnicliffe have undertaken extensive research on children's ideas about the body (Reiss & Tunnicliffe, 1999a, b; Tunnicliffe & Reiss, 1999). Results from their studies show that the 8 year old pupils had broad knowledge of the internal structure of the body and were aware of a wide variety of organs although they did not know how the organs were connected or how they were part of an organ system (Reiss & Tunnicliffe, 2001). Other studies also give considerable information about the young children's understanding of the human body (e.g. Osborne, Wadsworth & Black, 1992; Carvalho, Silva, Lima & Coquet (2004); Óskarsdóttir, 2006; Jeronen, Niemitalo, Jeronen & Korkeamäki, 2010). All these studies used drawings to investigate children's ideas about the human body.

In the English Primary SPACE study (Science Processes and Concepts Exploration), a variety of different methods were used, including drawings (Osborne et al., 1992). The youngest children in the SPACE study (5-6 year olds) drew the bones which they can feel and the organs that are more easily sensed, like the heart which beats (Black & Harlen, 1995; Osborne et al., 1992). The study also revealed that many children were not aware of the correct size or the location of the organs which is probably because the internal organs are not visible or touchable and therefore it is difficult for the child to develop knowledge of their size and correct location. Organs that are not part of everyday language like kidneys, liver, intestines and even lungs were usually excluded by the children. Although most of the children knew that we need air to live, very few of them were able to locate the lungs on a drawing of the human body (Osborne et al., 1992). Óskarsdóttir (2006) also showed that most children in her study (age 6) were able to name the parts of the body that they could see, touch or hear and drew organs that are more easily sensed such as the heart and were therefore more aware of the position of their heart than of their lungs. In both Osborne et

al. (1992) and Cuthbert's (2000) study it was shown that the majority of the 8-9 year old children drew isolated and unconnected organs in their body-maps. Most children drew hearts and veins but very few connected the veins to the heart in their drawings and the majority of them drew brains but very few included nerves.

Clément (2003) wrote about a special kind of didactical obstacles when learning science. The obstacles can be found when using textbooks where concepts are simplified by the illustrator and this can eventually lead to a longer life of misconceptions. This is also pointed out by Carvalho et al. (2004) who view the influence of textbook illustrations on children's drawings as obstacles to learning. In their study, the drawings of the digestive system made by 8-9 year old pupils seem to be especially influenced by the figure of the digestive process in their school textbook. The teaching material used in Óskarsdóttir's study (2008) was also found to have an effect on children's drawings because they tended to imitate the pictures in the book when they were asked to draw their ideas.

The main aim of the study described in this paper was to investigate the ideas 6 year old children in Denmark, the Faeroe Islands, Finland, Greenland, Iceland and Norway have about the human body e.g. the structure and location of bones and organs (heart, lungs, stomach, brain etc.) before formal teaching about the human body begins. Since the children in the study are from different Nordic countries and speak different languages, drawings were chosen as the research method to ascertain information about children's ideas about the body. Another aim was to see if children's ideas about the body differ between Nordic countries and if so, in what way.

METHODS

Mixed methods were used in this study to get a broader view of the double aim of the study (Flick, 2009; Silverman, 2010). Special scales were used to get a quantitative view of children's ideas as put forward in their drawings. The study has also some elements of a case study as the focus was on children's ideas at a certain age about a special issue, in this case, the human body. The term 'case study' draws attention to the question of what can be learned from a single case. A case study, however, optimizes understanding rather than generalizes beyond that particular study.

The purpose of case study is not to represent the world, but to represent the case (Stake, 1998, p. 104).

A case can be simple or complex: one child or a group of children. The present study can be identified with a type of a case study Stake calls 'intrinsic case study', which is a study undertaken because the researcher is interested in better understanding of a particular case or an issue. It is not undertaken because it represents other cases although it can shine light on other cases.

Twenty children (age 6) from Denmark, Faroe Islands, Greenland, Iceland and Norway (10 boys and 10 girls from each country) and 19 children (ages 7-8) from Finland participated in the study. The intent was to collect data before formal teaching about the body had begun but the Norwegian children had however had two weeks of teaching about the body at the time of data collection. The Finnish children were older than the children in other countries but they had not yet received any formal teaching about the human body at school.

The children were asked to draw bones and organs on two previously made outlines of the body so that they would concentrate only on what was 'inside' the body, otherwise some might put much effort into drawing the outlines, hair and eyes and forget the things they were asked to do. In addition, children's capabilities to draw are very different, so having a previously made outline gave them to some extent the same starting point. The children were given 10 minutes to complete each of the two drawings. Every child was subsequently asked about the drawings e.g. names of

bones and organs, and the teacher or the researcher wrote the child's answers on the papers. Identical instructions were given to the children in all the countries. First the children were asked to draw bones in their body. The children understood the concept of bones and did not need extra information to complete the task. On the other hand, most of the children did not know the word organ and extra information was needed. It was agreed to use the phrase: "Draw what is inside your body. Not bones this time, but the other things that are inside the body that we call organs".

Each drawing of the bones was analyzed by two persons together, by using a scale developed by Reiss and Tunnicliffe (1999a, see Table 1). Their seven level scale reflects different levels of biological understanding about the human skeleton. They also did another scale with seven levels that reflects different levels of biological understanding about human organs and organ systems. Their organ scale was modified by Óskarsdóttir (2006) in order to suit the aims of her study of 6 and 7 years old children as the Reiss and Tunnicliffe scale was developed for a broader age group, not for a group of such young children. The drawings of the organs were analyzed using the modified scale by Óskarsdóttir (Óskarsdóttir 2006, see Table 2). This analysis was done by the same two persons who analyzed the drawings of the bones.

Table 1. Reiss and Tunnicliffe scale of the bones (Reiss and Tunnicliffe, 1999a).

<p>Bones – skeleton</p> <p><i>Level 1</i> No bones.</p> <p><i>Level 2</i> Bones indicated by simple lines or circles.</p> <p><i>Level 3</i> Bones indicated by 'dog bone shape' and at random or throughout body.</p> <p><i>Level 4</i> One type of bone in its appropriate position.</p> <p><i>Level 5</i> At least two types of bone (e.g. backbone and ribs) indicated in their appropriate position.</p> <p><i>Level 6</i> Definite vertebrate skeletal organisation shown (i.e. backbone, skull and limbs and/or ribs).</p> <p><i>Level 7</i> Comprehensive skeleton (i.e. connections between backbone, skull, limbs and ribs).</p>
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Table 2. Reiss and Tunnicliffe modified scale of the organs, called here the modified R/T scale. (Óskarsdóttir, 2006).

<p>Organs</p> <p><i>Level 1</i> No representation of internal structure.</p> <p><i>Level 2</i> One internal organ (e.g. brain or heart) placed at random.</p> <p><i>Level 3</i> One internal organ (e.g. brain or heart) in appropriate position.</p> <p><i>Level 4</i> Two internal organs (e.g. brain, heart or stomach) placed at random.</p> <p><i>Level 5</i> Two internal organs (e.g. brain, heart or stomach) in appropriate positions but no extensive relationships indicated between them.</p> <p><i>Level 6</i> More than two internal organs in appropriate position but no extensive relationships indicated between them.</p> <p><i>Level 7</i> More than two internal organs in appropriate position and one organ system indicated (e.g. gut connecting head to anus or connections between heart and blood vessels).</p> <p><i>Level 8</i> Two or more major organ systems indicated out of digestive, circulatory, gaseous exchange and nervous systems.</p>
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Statistical analysis to compare different countries was not done since this study was focusing more on the qualitative differences and similarities between drawings made by the children from the different Nordic countries. The scales, however, proved to be an important tool to chart the drawings and give some important information about the ideas the children have about bones and organs, along with their verbal explanations.

RESULTS

In this chapter the findings from the research are presented. First the ideas the children in the study had about the bones as presented in their drawings and then their ideas about the organs.

Bones

The drawings of bones made by the children from the Nordic countries gave information that was of both qualitative and quantitative nature. As Figure 1 shows, most of the children drew bones as simple lines or circles (level 2). They did not draw the whole skeleton with the bones connected to each other (see Figure 2a). The children in the Faeroe Islands were generally more aware of the ribs in the Faeroe Islands than the children in the other countries. Thirteen of the Faroese children indicated the ribs on their drawings even though most of them were still at level 2 (simple lines/circles - see Figure 2b). One child said that these were the bones you eat! Eight children each from Iceland, Greenland and Finland drew the ribs on their bone drawings, but only four children from Denmark did so.

The second most frequent type of drawing showed 'dog bone' shaped bones (level 3) as seen in Figure 2c. If the children placed a specific type of bone in its appropriate position (level 4) it was very often the skull.

No child reached level 7 on the scale but two children from Denmark and one from Iceland and the Faeroe Islands scored at level 6 (see example on Figure 2d). The drawings of Finnish children were nearly equally distributed between levels 2, 3, 4, and 5.

As mentioned earlier, the Norwegian children had had lessons about the human body before they made their drawings. Just over half of their drawings were scored at level 4 (one type of bone in its appropriate position) on the bone scale but five of them were still at level 2 (bones indicated by simple lines and circles).

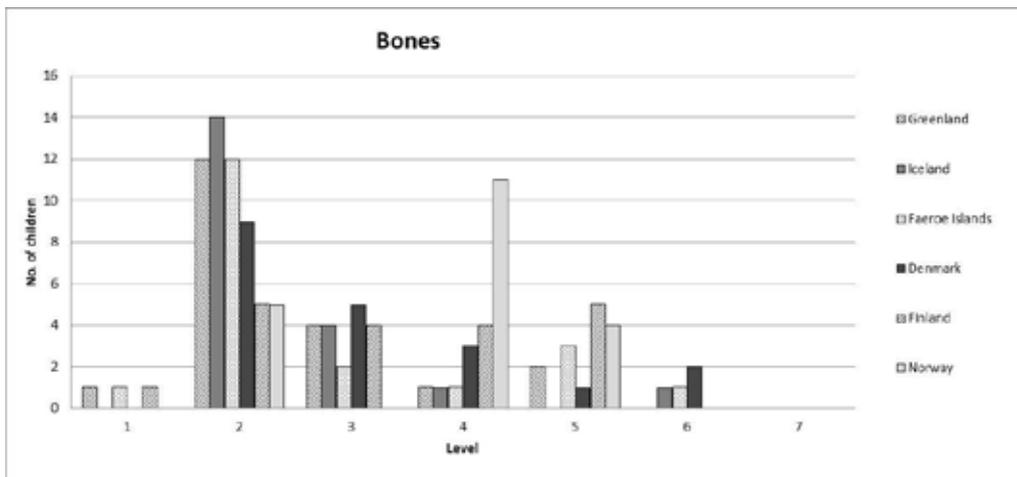


Figure 1. Children's drawings of the bones. The columns show how the children scored on Reiss and Tunnicliffe's scale (Reiss and Tunnicliffe, 1999a).

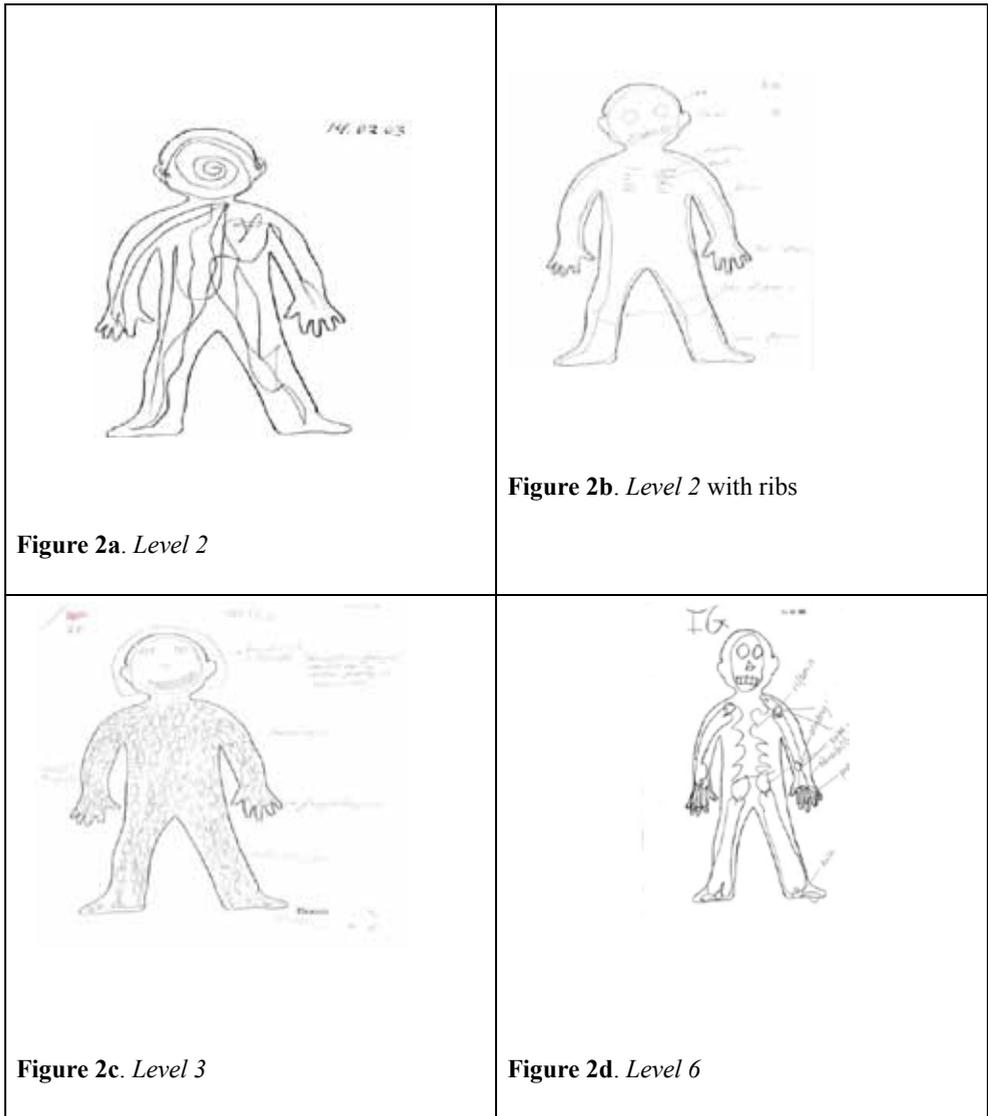


Figure 2a, b, c, d. Examples of children's drawings of the bones.

Organs

The drawings of the organs show that most of the children did not include any connections between the organs on their drawings. However, the results show that the majority of the children knew about the brain and the heart before formal teaching (level 4 and 5 – see Figure 3).

Many of the children scored at level 5 with two internal organs (e.g. brain, heart or stomach) in appropriate positions but no extensive relationships indicated between them). If they did show a connection it was usually between heart and veins. All the Icelandic children drew a heart on their drawings; 17 of them drew a V-shaped heart, see Figure 4b. In Denmark, 13 children drew V-shaped hearts and 15 children from the Faeroe Islands and Greenland did the same. Twelve of the Finnish children drew a V-shaped heart.

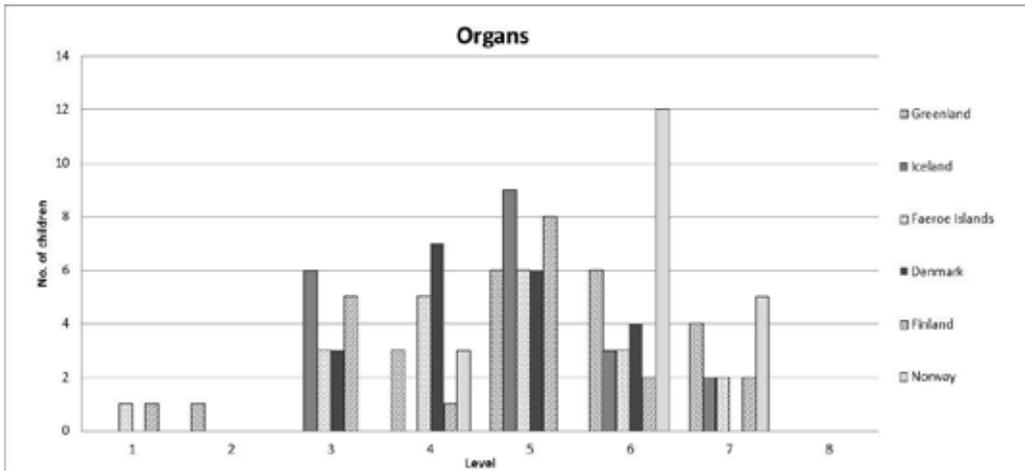


Figure 3. Children's drawings of the organs. The columns show how the children scored on a modified R/T scale (Óskarsdóttir, 2006).

Seven children from the Faeroe Islands drew the bladder but no children from other countries did so, see Figure 4c.

Nearly all Danish children (19) drew a brain, while 16 from Greenland, 15 from the Faeroe Islands, 13 from Finland and 12 children from Iceland did so (see examples Figures 4a and 4d). Thirteen children from Greenland drew lungs on their drawings but only two from Denmark, four from Iceland and five from the Faeroe Islands drew lungs (see Figure 4c and d). Half of the children from Denmark, Iceland and the Faeroe Islands drew only one lung on their drawings. Five of the 7–8 year old Finnish children drew lungs.

Just over half of the Norwegian children's drawings were ranked at level 6 (More than two internal organs in appropriate position but no extensive relationships indicated between them) on the organ scale and five drawings at level 7 (More than two internal organs in appropriate position and one organ system indicated, e.g. gut connecting head to anus or connections between heart and blood vessels).

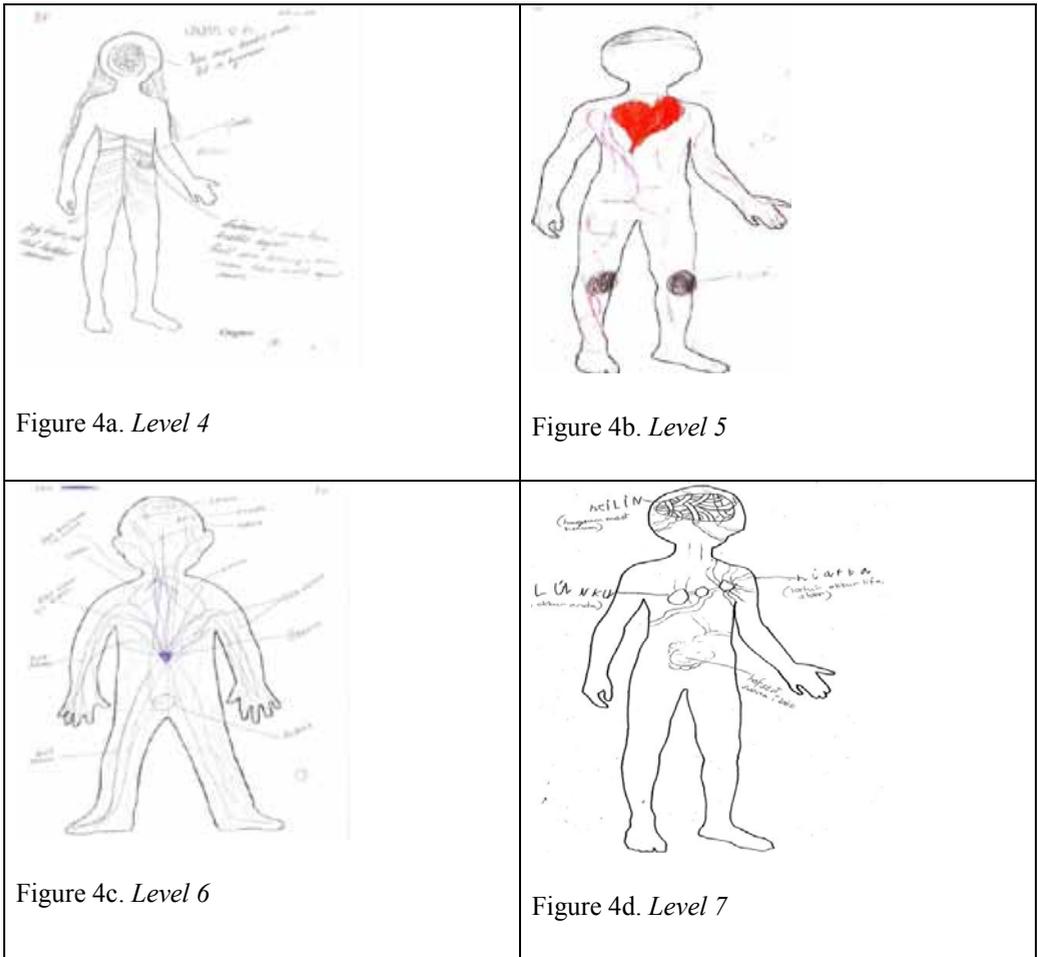


Figure 4a. Level 4

Figure 4b. Level 5

Figure 4c. Level 6

Figure 4d. Level 7

Figure 4a, b, c, d. Examples of children's drawings of the organs.

DISCUSSION

Using drawings as a research method is very useful, especially with groups of children from different countries that do not speak the same language (Reiss & Tunnicliffe, 2001) and in international studies (Reiss et al., 2002). We used clear instruction and emphasized that words and phrases used for instructions should be as similar as possible in all the countries. Both the clear instructions and the scales used for analyzing made it possible to compare the drawings. The scales proved to be an important tool to chart the drawings. However, as this study was focusing on the qualitative differences and similarities, the scales could be developed further with more qualitative information in mind. The children's verbal clarifications and explanations were very important as pointed out by Haney et al. (2004). Because of the differences in the drawing skills it is important to get the children themselves to clarify their drawings (Haney et al., 2004), an issue also pointed out by Óskarsdóttir (2006).

The results show that there are similarities between Nordic children's ideas about the human body and the findings are in tune with the results from other studies. The children in this study, as well as the children in the SPACE study (Osborne et al., 1992) and the children in Óskarsdóttir's study (2006), drew bones and organs that are more easily sensed, such as bones which they can feel and

the heart which beats. Many of the children in this study did not show the bones as the skeleton. Most of them scored at level 2 on the Bones scale. It is interesting that more than half of the children from the Faeroe Islands (13) indicated the ribs on their drawings even though most of them were still at level 2. This differed from the children's drawings in other countries. One explanation can be found in cultural differences. Children from the Faeroe Islands are used to eating the meat of lamb ribs from a very early age as one of the Faeroese children also mentioned: "these are the bones you eat".

No child reached level 7 on the Bones scale and very few of the children reached level 6. It is possible that the given instructions, "draw the bones in your body", could have negatively influenced children's drawings in regard to level 6 (Definite vertebrate skeletal organisation shown). It would be interesting to see their drawings if they were asked to draw the skeleton. It is interesting that the Finnish children, who were older than the other children, made drawings at levels 2, 3, 4 and 5 equally and none of them scored higher than level 5. Perhaps the age difference could explain why fewer drawings from Finnish children scored at level 2 than drawings from the other countries. As mentioned earlier, the Norwegian children had had lessons about the human body before they made their drawings. Only five Norwegian children's drawings were at level 2 (Bones indicated by simple lines and circles) which equalled that of the 7–8 year old Finnish children. So, apparently the teaching has had an effect.

The results show that most of the children did not draw any connections between the organs on their drawings, i.e., do not reach level 7. This is in tune with Reiss and Tunnicliffe (2001) who point out that most children around the age of 8 in their studies were aware of a wide variety of organs although they did not know how the organs were connected or how they were part of an organ system. Our results show that many of the children scored at level 5 which means that they could put two organs in appropriate positions, most often the heart and brain. If the children showed a connection, it was usually between the heart and the veins.

In many cases there were similar results in all countries. One example was the fact that the brain was one of the two most frequently drawn organs. Nearly all the Danish children (19) drew the brain and it could be explained by media campaigns where children are encouraged to use helmets while cycling because it protects the brain. In addition, common phrases such as "use your brain" and "think with your brain" are used in all the countries and can also have had an effect. Another example was that all the Icelandic children and most of the children from other countries drew a V-shaped heart. The general explanation for this can be that the human heart is usually represented this way in pictures and books about the body which can probably strengthened these ideas.

Some of the results can perhaps be explained by cultural differences. For example, only children from the Faeroe Islands drew the bladder on their drawings. A possible explanation for this could be the traditions of slaughtering lambs at home and using a dried lamb's bladder for fun on New Year's Eve. Thirteen children from Greenland drew lungs on their drawings while only two to five children in the other countries did. In Greenland (in this study the town Ilulissat) seals are slaughtered as a part of daily life and organs from animals like seals are sold at the meat market in villages. This may explain why children from Greenland seem to have broader ideas about organs than the other children. The children from Greenland showed similar scoring as the Norwegian children who had had lessons about the human body and half of them scored at level 6 and 7 on the organ scale.

There are interesting differences in children's ideas between the countries. It seems that the experiences from everyday life have a stronger impact than the age factor which is not surprising since the older Finnish children had not dealt with the human body in school. The results suggest that the cultural aspects in each country, for example, cooking habits, typical foods, pictures, campaigns in the media and language expressions influence children's ideas about bones and organs.

Perhaps there are also signs of a worldwide use of common (maybe western) agreed representation like the 'Valentine's heart'.

The study shows that the culture and habits of different countries affect the view the children have and this study is an example of how learning is situated. It also shows how the ideas of children of same age can differ.

EDUCATIONAL IMPLICATIONS

Knowledge about children's ideas about the body is useful for teachers so that they can take it into account when planning their teaching. Useful ways of eliciting this information are e.g. drawings, children's explanations, and discussion. Careful choices regarding teaching material, pictures, models, and language use must be made when presenting new issues and concepts in instruction. The outcomes of the study can also be used as a basis for planning joint educational programs in the Nordic countries focusing on the use of a more systematic use of drawings and their explanation to get access to children's ideas and thus provide educational value for those involved e.g. children, teachers, student teachers and teacher educators.

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