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How Food is processed in the Human Body or Children´s Concepts of How the Digestive System Works

Wiegerová Adriana[a]* & Dalajková Andrea[b]

[a]*Department of School Education, Faculty of Humanities, Tomas Bata University in Zlín (Czech Republic)*
[b]*master´s degree study programme, Faculty of Humanities, Tomas Bata University in Zlín (Czech Republic)*

Abstract

The study focuses on the concepts of preschool children about the human digestive system. The author presents the analysis of a research implemented in a group of 18 five to six-year-old children. The study is based on qualitative research. It analyses children´s drawings and interviews, during which children expressed their concepts regarding the digestive system. Importantly, the study identifies the possibilities of working with children´s concepts from the position of a preschool teacher. In the conclusion of the study, the author interprets the results of the research and provides suggestions for the application of appropriate didactic strategies for preschool teachers in kindergartens.

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1. Theoretical background

From the moment they are born, children begin to explore their immediate surroundings. They are aware of the stimuli affecting them and allowing them to create specific concepts related to their environment and to the world they live in. These concepts are defined children's concepts. They represent children's understanding of the world on the basis of their experience. Children's understanding is supported by a variety of children's explanations on the workings of a specific phenomenon. Furthermore, these explanations vary in many aspects from adults' understanding.

* Corresponding author. Tel.: +420 602719104 ;
E-mail address: wiegerova@fhs.utb.cz

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Actually, from a child's perspective her understanding is a finished thought product which the she is able to justify. A child's understanding of the world is very specific. In fact, today's conception of children and childhood is characterised by the fact that we no longer perceive the child as an "unfinished adult." Children live in their own world, but that world is real and unique. From this perspective even children's reactions to phenomena are finished, perfect and evident at all stages in life.

1.1. Brief introduction to the theory examining the perception of the child's world

The literature provides several designations to map the child's world, including 'children's ideas', which is the most commonly used, but also 'student's concepts', 'naive theory' or the term ‚misconceptions'. Nonetheless, in recent years preference is given to the 'agency children' theory which designates the child's own perception of the world considered to be perfect and inimitable.

Children's perceptions of the world are formed through experiences and influences affecting their lives. The factors affecting their concepts can be exogenous and endogenous. Among the exogenous factors we can find social, exonomic, ethnic, cultural and religious influences, etc. Endogenous factors are formed from the individual, psychological and biological prerequisites of each child, and they are developed on the basis of exogenous factors. It is not about knowledge, but about intrinsic concepts having their own structure.

Children's thinking and its gradual development has been mapped for a century by psychologists, educationalists and sociologists. Among the figures who initiated and contributed to the formation of a theory on the child's understanding of the world there is J. Piaget, L. S. Vygotski, J. Bruner, D. P. Ausubel, F. J. Dochy. In recent years, however, the theory of agency (Kehily, Woodhead, 2009) has also influenced the theory of the development of child's world perceptions. Research results now focus on arguments related to children's acceleration and their increasing ability to describe phenomena. The consequence of these changes can also be explained by the fact that children nowadays have more possibilities to access information than their parents had.

1.2. Children's concepts of the digestive system in the human body in terms of research

As mentioned above, specialists have been investigating children's world perceptions for almost on hundred years. When determining children's concepts, the researcher has to take into account factors such as incomprehensibility of speech, emotional stability and other problems. Gavora (2010) is of the opinion that when investigating a child's concepts it is necessary to talk to the child without using scientific terms at the first reactions. Only when the child herself uses specialized terminology, can we continue to build on it. This finding is also supported by Turán's research (1996) on blood and blood circulation in humans. Specialized words, such as blood, heart, pulse, blood circulation, oxygenation, etc., are used only after the child has first mentioned them.

Several authors have written studies on research conducted on children's concepts of the human body. Pupala and Osuská (1997), for example, focused on children's concepts of the formation and function of the digestive system using a method they called conceptual mapping. They linked this method to the conversations which originated from the initial question about what was happening inside the children's bodies. This question led the children interviewed to spontaneously describe the digestive process. The main aim was to partially capture the trends in the development of children's concepts and the function of the digestive system. The research was carried out with 206 children between the ages of 5 and 16, of which 34 were preschool children. They also analysed children's drawings which were followed with interviews. The children commented on their own draws where they had illustrated their concept of the digestive system on a given contour of a human body. At the end of the study, the authors pointed out that children have several explanatory "theories" which they use to justify relevant phenomena and processes. Of particular interest was the tendency to personify the stomach; for example, a six-year-old child compared its activity of food processing to the work of manual workers.

The studies by E. Gellert (1962), C. S. Porter and E. C. Smith discussed the issue of when we can expect boundaries in a child's ability or inability to describe and identify phenomena. The conclusions of these studies revealed that when a child begins primary school she is capable of identifying the brain, bones, heart and blood vessels. The authors also stated that the term stomach is used in their speech when children reach the ages of 10 or 11 while more specialized terminology such as lungs, muscles, nerves, kidneys and intestines is used by children older than 11 (Pupala, Osuská, 1997, p. 36). Gellert (1962) also reported that children knew they grew because of food, but that they didn't know how food passed through the human body. Her findings showed that preschool children were

unawares of the biological transformation of food for the functioning of the body. The majority of children knew they should eat, but they did not know what happened to food in the digestive system, which means that they did not connect the transformation of food with the final product when they went to the toilet (Bajd, Verbovšek, Brečko, 2011, p. 233). More complex results were obtained by M. H. Nagy (1953). Her study included the results of three surveys of children in the following age groups: five, two to eleven, eleven from different backgrounds (Hungary, England and the USA). The aim of the research was to determine the concept of the digestive processes on the basis of the question of what happens to the food we consume. One remarkable finding related to children's concepts about the formation of the stomach, which according to them consists of skin, bones, blood and flesh. Another finding was that children tended to describe the function of the organ itself by specifying its task, for example they would say that the stomach is for food.

As is evident from the research presented, children are unable to provide a relevant description of the separate parts of the digestive system before the age of 12. Our research, however, overturns this reality. As we will show below, already at 5 years of age a child is able to describe the internal activities of the human body, in our case the digestive system. Therefore, we believe that research performed in the 20th century proves that children's perceptions and explanations of phenomena have changed and today's children are better informed, they have more experience, and are even more capable of providing detailed descriptions.

Children have some concepts which are built on their experiences. Such concepts are the basis for further development. Children often form concepts on the basis of the media or according to other people's opinions. Nowadays, they are subjected to such influences to a much greater degree than the children who grew up in the last century.

2. Research methodology and findings

The research was carried out in 2015 with 18 subjects. In this section of the study we present the partial results of the complete findings.

2.1. . Research subjects and research methods

We selected two research methods to work with the research subjects - children's drawings and interviews. The aim of the research was to determine children's concepts of the digestive system in the human body.

The research subjects consisted of preschool children. We worked with eighteen children between the ages of 5 (twelve children) and 6 (six children). There were eleven boys and seven girls in the group. All the children attended the same class at a kindergarten in the Zlín region. It is an urban kindergarten. The parents and kindergarten teachers gave their consent to the research.

In the Czech Republic the kindergarten in question belongs to the urban type of kindergartens located in towns and consisting of three to four heterogeneous classes. Children between the ages of 3 and 6 usually attend these kindergartens. Children who are 5 and 6 years old are called "pre-schoolers" because they soon move to the first grade of primary school. Children start primary school once they have reached the age of six, although in recent years there are discussions are taking place about a reform of compulsory education and a new law on education is being prepared.

Our research was realized in the kindergarten system we described above since so far there has been no change in the law. The law is not expected to be approved before 2017.

Once the data was collected and processed, we proceeded to analyse it on the basis of the so-called recursive reading. We also applied the principle of induction to the research. The benefit of this principle was to provide a potentially new perspective on the researched phenomenon or phenomena.

2.2. Samples of interviews and drawings of the digestive system

In order to process the children's drawings of the digestive system, we first arranged the drawings and then matched them to the children's interviews. It is not possible to look at the drawings and decidedly say that this is what the children imagine the digestive system to be like. In many cases, children give explanations they are not able to put down on paper. Therefore, we consider the oral descriptions in the form of interviews extremely important. The age and pseudonym of each child is written on the pictures.

As illustration we provide the results of the drawings and interviews of two five-year-old twin boys. Their statements are unique and suggest that a preschool child knows more than what children knew at the same age twenty or thirty years ago.

Petr created a unique drawing not only of the digestive system but of the whole body. When asked the first question, i.e. whether he recognizes what is on the picture, he answered differently to the other participants: "Yes, it's a girl." When we asked him how he knew it was a girl, he answered: "*Because of the eyes. Aha, because of the eyes. And because of the eyebrow*s."

Since eyebrows were missing from the contour of the body, we asked him where the figure had eyebrows, "*Well, she might have done something to them."* We then asked the boy to draw them in, and happily he filled in the eyebrows and said: "*Hair is missing, too. She has long hair, and a ponytail ... (he draws), there. And also a hairband.*"

I praised him and we continued with the next question: what he thinks happens to the apple when he eats it. Without hesitation he replied: "*It is digested. Aha and how is it digested? In the stomach.*" When we asked him how the apple reached to the stomach, his interpretation suggested the structure of the esophagus: "*It slips through this hole into the stomach. It slips through a hole, aha. Yeah, through this tube is gets into the stomach. And the stomach is like this (pointing to his own body).*" Then we asked to draw it and he agreed with a smile. He began by drawing two vertical lines leading from the mouth to approximately halfway of the abdominal cavity. He added an oval which he called stomach. We asked him if the tube continued somewhere else from the stomach. He began to explain his ideas of evacuation: "*Yeah, here (he points to the bottom part of the abdominal cavity on his picture). But if you have a drink, then you need to pee. Aha, when I have a drink then I need to pee. And so it goes through the stomach? Yeah."*

We followed up on his answer with the question of how food can get out of the stomach, or how we can urinate or defecate. He thought for a while, "*Hm, well, I still …*" and he said that all information is in books at home, so he does not know it exactly. After a moment's thought, he replied: "*I think that here there's a hole. Poo goes through this hole poo and pee through this one. And here there's a string … Well, or they are together."* Suddenly, he produced a surprising concept: "*Here are the lungs.*"

All by himself he realized that lungs appear in a different place in the body and corrected himself: "*No, no, they are somewhere else … They are here.*" He began to think and exclaimed: "*It's the intestines. I couldn't remember.*" He then added that from the intestines the apple goes into the toilet.

Since Petr was always highly concentrated and we could see that he was interested in the human body, we asked him whether he ever suffered from stomach aches and what could cause them. We were surprised that he himself hadn't brought up the negative experience because he replied: "*Yeah, it's always aching. When I eat, then it hurts the most, when I eat a lot. When you eat a lot, aha. But now my belly is only hurting a little. Your belly is only hurting a little? Yeah, because now I can't digest much.*"

We suggested to Petr that we could go over once again what he had drawn and said, and that we would probably think of something else to add. He nodded in agreement and on his own began from the mouth to the stomach. At this point we interrupted him and asked him what actually happens in the stomach. "*It's all there together and it's being mixed,*" answered Petr. Then he continued. "*… through the hole to the intestines and then to the toilet.*"

When we were about to stop the interview, Petr spontaneously added: "*Yeah, but the heart is still missing. The heart is here and I'll draw the way it's beating*" and he began to draw. He also told us where the lungs were. We asked him if it was everything. He said the brain was still missing. It was interesting to hear him say "*the brain is almost the same as the lungs.*" We think that he confused the concept of lungs with that of intestines. During his description of the digestion he confused these two concepts, and when he was drawing the brain he continuously followed the intestines and copied their structure. In the end, he also added that bones were missing. First he began to draw the bones of the hands, then the feet and lastly the rib cage and the ribs. He even mentioned the "tube" leading from the mouth to the stomach: "*This is also a bone. It is also a bone? Yeah. Food goes through this? Yeah, it's the tube food goes through, but inside it there are bones. Here there are bones, too, such ones.*" He sketched some small slanting lines as bones. Then he drew the bones representing the pelvic girdle and the shoulder girdle with the words: "*Well, these are the bones which hold the legs. And here the arms are held by these.*" Then he just said it was all.

Jiří is Petr's twin brother. At first glance it is possible to see that their drawings are very different. Even the answer to the first question of whether he can tell what is in the picture is the complete opposite: "*a boy*". When we further asked him how he knew that it was a boy, he answered: "*Well, because he doesn't have a ponytail.*" However, the twins gave the same answer to the following question: "*What do you think happens to the apple when we eat it? I don't know … It's digested.*" It was the only concept the brothers agreed on. When we asked him where the apple is digested, he replied: "*In the tonsils*", and he drew some small oval shapes in the throat area. Next he said that food

moves "*here close by*" and pointed to the abdominal cavity. Similarly to his brother, he mentioned the book they have at home but did not know how it continued. He thought for a while and then said: "*Well, it is digested in the tummy.*" Then without prompting he began: "*And here is the heart*", and at the same time started to draw it. Then he returned to digestion "*Well, I also read in the book that here there is something where it is digested. Aha, a place where it is digested. And what can that something be?*" He did not describe a specific place, but only the process he imagined took place: "*It's like when you eat bread, then it is broken up into small pieces here. It's broken up into small pieces, aha. Yeah, and then it is digested.*" At the same time he also began to describe the process of vomiting: "*and the stuff which is not healthy comes to the surface and we spit it out. And what happens if it is healthy? If it's healthy, we digest it.*" It is interesting to note that he only described evacuation in terms of vomiting. The concept of intestines, or any similar word, did not appear either. In the end Jirka described the digestive process: "*I have eaten a lot. Have you digested it or not? No, but some other day I digested it. Aha, so over a few days. Yeah, I have to wait, and when I eat a lot then I have to wait longer.*"

The other 16 interviews based on the drawings proceeded in a similar way. The one factor which was common to all children was their ability to name with specialist terminology some parts of the human body. They all remembered a film, fairytale or book where they had heard or seen something about the digestive system. Some children also reported seeing the digestive system on the computer or tablet.

3. Findings beyond the scope of the research, or that something extra in children's concepts about the human body.

In this section we present the children's perceptions which do not directly relate to the digestive system, but which the children reacted to during the interview.

Some children did not distinguish the digestive system and started spontaneously to describe other systems and processes which take place in the body: *"And here is the heart" (Jiří), "And I also know that when there are snots, then the snots are stuck here in the throat (he points to the throat), just like I have got them, too. But maybe … when … I always do this (we show with our hands a sphere), this makes a kind of little ball and I have to spit it out somewhere." (Martin), "Well, but the heart is still missing. And the lungs will be here. And the heart is here, and I will also draw how it's beating. Well, still the brain. The brain is almost the same as the lungs. They are similar … There are these, these little arcs. The brain thinks …. And still the bones. Well, these are the bones which hold the legs (he draws the pelvis). And here these bones hold the arms (he draws the shoulder blades)." (Petr).* The little boy likens the brain to the lungs. We believe that he confused the term lungs with the word intestines. When he was describing digestion, he mentioned these two terms, and when he drew the brain he followed the intestines and copied their structure.

Very often the children spontaneously started to describe stomach ache, its causes and effects from their own experiences: *"But I also was, … that's when I ate something bad. And what happens when you eat something bad? We have to go to the hospital. I have had to go to hospital because of that, … but with mummy, I wouldn't go alone." (Eva), "… but when we want to be sick, then we have bellyache because we eat a lot. Aha, and has it ever happened to you? Yeah, I ate a lot, and then I was sick and I had bellyache." (Alex), "And have you ever had bellyache? Yeah, badly, … I ate too much." (Jiří), "And have you ever had bellyache? Yeah, my belly hurts all the time. And what could be causing it? When I eat, then it hurts more. When I eat a lot. But now I only have a little bellyache. A little bellyache, that's good. Yeah, because now I can't digest much." (Petr), "But I was sick at Christmas and Father Christmas almost didn't come. And why do you think you were sick, Tobias? I probaly ate too much food. (Tobias).*

A remarkable concept was that of the boy who described digestion in terms of specific dietary habits. He described what is healthy and what we should eat, and what is unhealthy: *"Well, that little apple went down and then what happened to the apple? Someone will be fat. Aha, someone will be fat. And if he eats the apple as a snack? Then he will be thin. Aha, and how does it happen that someone is fat and someone else is thin? Someone eats sweeties and someone eats … for example, I am thin (he smiles), … for example, I eat fruit and vegetables. I must eat them." (Vítek).*

The children who described their ideas in more detail often mentioned where the information came from: *"It's from the book at home."(Alex), "Well, we didn't continue reading the book, … well, but I read it in the book …" (Jiří), Well, I watch TV, …" (Martin), "… but we have the fairy-tale at home." (Elizabeth), "We've got a book …"(Petr).*

4. Conclusion

On the whole, we can say that preschool children divide the digestive system into three parts.

The first part, called "how it gets in", includes all the children's concepts of how food gets from the mouth into the body. The majority of the participants first mentioned a specific "fall" of the food but later on after questioning they spoke about the "tube" (also "little tube", sometimes "little ways"), which indicates the existence of the pre-concept of the esophagus. Furthermore, the so-called "tube" also featured in most of the children's drawings of the digestive system. The entrance section of the digestive system was described with similar terms (such as "little tube", "little way" or "throat") in Poupala and Osuska's 1997 research. Some children, however, began from the mouth cavity by mentioning the fuction of teeth which proves their comprehensive concept that the digestive system begins in the mouth cavity and that the teeth play a significant role.

We called the second part food storage. The first half of the participants thinks that food is stored in the "*belly"*, the second half already works with the term stomach. It is interesting to make a comparison with the reseaches of E. Gellert (1962), C. S. Porter (1974), E. C. Smith (1977), where the authors stated that the term stomach appeared in the children's testimonies at the ages of ten and eleven. Although these are older studies, it is nonetheless clear that there has been a marked shift over the years. Further, the participants described different processes which can take place in the abdominal cavity. Some subjects ended with this part because they said that food remains in the abdominal cavity, and it either dissolves or it accumulates there.

The majority of participants also started to describe the third part of the digestive system which we have called how it goes out. Here we find the concepts of the ways in which food can get out of the body. Some participants began spontaneously to describe the process of vomiting and its causes. The majority focused directly on evacuation. The children also described the structure and function of the intestines. In Pupala and Osuská's study (1997), the subjects used common colloquial terms to designate the exit part, while the older children often mistook it with the bladder, but never used the word intestines. The study also shows that younger children (up to the age of eight) imagine digestion, food processing and the separation of substances into organically necessary and unnecessary in the form of personification, in other words they imagine the presence of auxiliary animist elements – "workers" or "little people".

The findings of my study were positive since this less realistic concept appeared only in the case of the girl who described the digestive system as "medics" tasting the food. There has been a definite shift because today's children, including pre-schoolers, have more realistic concepts of the digestive system. This fact also confirms our statement that children nowadays have access to information which twenty years ago children did not have.

The participants who described their ideas in a comprehensive and detailed way also reported were the information came from. They often cited books, but also fairy tales and television. This finding is related to both the less realistic concepts as well as those which were closer to reality. This demonstrates that the children derive their concepts about the digestive system from the home environment, and never from kindergarten. Since compulsory education at the kindergarten level for pre-schoolers aged 5 will soon be introduced in the Czech Republic, children's ideas should be respected and teachers should learn about them, and know how to work with them. As a result, teachers working in kindergartens should support the children in spontaneously learning about the digestive system, the entire human body and other phenomena which surround the children.

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