

Primary Pupils' Preconceptions About Child Prenatal Development

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The research deals a problem of primary pupils' preconceptions about a child prenatal development. Even the pupils cannot experience the phenomenon and can get only mediate information; their idea about the prenatal development is quite well constructed. The quality of the preconceptions depends mainly upon variety of informational sources kept at their disposal and on their own personality.

Keywords: Preconceptions, Child Prenatal Development

INTRODUCTION

Research into children's structure of biological knowledge has provided contradictory results. Carey (1985) claims that before the age 10, children's understanding of biological phenomena does not belong to any biological theory. Subsequently indicating that is conflated with the same theory by which they understand psychological phenomena. This indicates that they have undifferentiated psychology and biology theory. Carey (1985) further proposes that an intuitive biology emerges from an intuitive psychology between the ages of four and ten. Recently, Inagaki and Hatano (1997) argue that children's biology knowledge is gradually constructed through daily experience with living systems.

Although we can study children's concepts about birth as gradual construction of biological knowledge, the role of social experience is in this specific topic undoubtedly evident.

The process of acquiring biology knowledge involves children's concept of the human body. Numerous preconceptions about human bodily function have been reported (Nagy 1953a, Gellert 1962, Mintzes 1984). Most of the current research within this area was concerned with the human digestive system (Teixeira 2000, Rowlands 2004). It was discovered that the

predominant idea of children aged four relating to food they ate, is that all the ingested food remains in the body entirely. This misunderstanding of the food consumption process almost totally disappears at the age of 10 (Teixeira 2000).

The digestive processes can be largely explained by the children's first-hand experiences with food. For example, children can perceive intestinal sounds, feeling of being full or pain of the stomach. However, there exist other important biological phenomena with which no first-hand experiences might be expected.

Nagy (1953b) investigated children's concepts about birth. Using interview and essay writing, she found that children's knowledge about how they were born, (ages 4 to 10) rapidly increase. More specifically, she divided four "theories" of children's explanation of birth:

Theory (level) 1: There is no birth, as life has no beginning.

Theory (level) 2: A mammal's life begins, but without the mother.

Theory (level) 3: There is birth from the mother only.

Theory (level) 4: Mammalian birth also implies the father.

Theories 1 and 2 were found only before (age 8 years) and Theory 4 appeared only after eight years of age. The main theory was 3 in overall frequency.

Bernstein and Cowan (1975) continue their research and study the problem in connection with the Piagetian developmental theory. The results they obtained particularly correspond to Nagy's results. Equality can be found mainly in the upgrade of children's ideas in connection with the child's age that is evident and expected. Bernstein set 6 levels of idea understanding.

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For comparison, here are short descriptions of the levels.

Level (theory) 1 – *preoperational*: The baby has always existed (in mother's belly or elsewhere).

Level (theory) 2 – *preoperational*: Assigning babies to some phenomena (usually persons, who function as manufacturers).

Level (theory) 3 – *transitional: preoperational – concrete operations*: To create a baby we need three major ingredients: relationship, mechanics of sexual intercourse and fusion of biological-genetic material. The ideas are mainly aimed at relationship (marriage, love and so on).

Level (theory) 4 – *concrete operations*: Ideas rely completely on physical causes of conception. We can find also sperm and ovule in these ideas.

Level (theory) 5 – *transitional: concrete operations – formal operations*: The embryo is preformed in one germ cell and sexual intercourse merely provides necessary and sufficient conditions for development to occur (warmth, food and so on).

Level (theory) 6 – *formal operations*: The Embryo begins its biological existence at the moment of conception and that it is a product of genetic materials from both parents.

In Kreitlers' (1966) research we can find only 3 theories (levels), but this study was aimed at children in the age range of 4-5½ years.

Theory (level) 1: The baby has always existed in the mother's belly.

Theory (level) 2: The baby is created in the mother's belly from the food she eats.

Theory (level) 3: The baby should be swallowed by the mother.

These 3 levels correspond to mentioned Nagy's and Bernstein's levels 1 and 2.

Considering the purpose of our research we would like to mention Bernstein and Cowan's finding, that children do not change their ideas only and mainly under the impression of (mis)information they can obtain. More important to this process is cognitive development. The progress in cognitive development is evident mainly in consecutive occurring of causality (not only in a material world, but also in its social sphere) in ideology.

Results of both the mentioned studies (Bernstein and Kreitler) corresponded with the Piagetian developmental theory. Alternatively, in Kreitlers' study disagreements with Freud's theory about the infantile belief in the universality of the penis were found. Piagetian insufficient causal thinking, alternatively Freudian infantile libidinal development do not hinder the adequate sexual enlightenment of children (Kreitler, 1966).

To know more about children's birth ideas Bernstein used the (analogous to Nagy) interview technique. She

set out additional methods to discover the connection with cognitive development. We discovered that both studies were aimed at similar tasks, for instance: "How does the baby happen to be inside the mother's body?" These studies (and other's similar) did not investigate children's conceptions about prenatal development, thus the main idea of our research was to examine, what children aged 6 to 10 know about prenatal development. As we progressed deeper into qualitative research, we needed to support interview as a main research method with other method(s).

RESEARCH PURPOSES AND TASKS

The basic purpose of the research was a qualitative analysis of children's birth ideas and ideas about prenatal baby development. Twenty primary school pupils participated in this study; 5 at each of four primary school grades (6 – 10 years old, Table 1).

Table 1. Respondent group.

grade	age	boys	girls	Σ
1.	6-7	1	4	5
2.	7-8	1	4	5
3.	8-9	0	5	5
4.	9-10	2	3	5

We were trying to discover what a standard child idea is about and how deep differences can be found between the peers.

Partial purpose of the research was to find out the main source of information from which the pupils develop the data to create and modify their birth ideas.

The pupils age, is very specific. Primary pupils' age is known as the age of a concrete reality. Pupils adhere to their own experience in their local reality. Their level of cognitive development does not allow them to modify their own ideas with the help of visions, projections, abstract conceptions. As per norm pupils of this age don't possess much experience with the main amount of aspect typical for the researched situation. Their ideas are built mainly on mediate information. Therefore, we would like to know, who or what mediates/enables them this information?

Although the research topic is quite clearly defined; the research problem is still very wide for a particular qualitative investigation. We have set a few issues for further investigation:

Issue No1: How is the children's birth idea changed with age?

The purpose is to find out the differences between ideas of various age group pupils. We will explore ideas' details to be competent for expression of ideas plenitude and integrity valuation.

Issue No2: Are there differences between children's birth ideas of the same age?

As we expected, ideas about such a specific topic (in comparison to the pupils age and their ability to understand the reality hidden behind it) are not built on own experience and direct observation. Pupils use for the idea creation rather different information (often very vague and obscure). Also, pupils tend to manipulate the information into a very personal way, depending on many factors for example family background, age of the siblings, parent's extroversion, contra introversion, parents-fixation, including curiosity and accessibility to secondary information sources and much more. This is why the way of idea creation is very specific and individual and we can expect the differences.

Issue No 3: Have the children included in their ideas also aspects of prenatal baby development?

We can say that knowledge about prenatal baby development is in some way more biological than other aspects of the birth idea. Following the theory of Inagaki and Hatano (1997), children acquire knowledge mostly out of their own experience. The problem being is that the right observation of prenatal development is not accessible for the children. We suppose that they create the ideas only via indirect experience (pregnant mother or other woman) with use of imagination and acquired secondary information. Predominantly they do not think about phenomena they cannot experience.

Issue No 4: What kind of information influences the children's birth ideas the most?

There are many aspects of the birth idea. For example: conception, prenatal development (development of different apparatus, development of the apparatus function), the way of prenatal nutrition, childbirth, the role of a man at different stages of pregnancy and so on. We would like to discover, which part of the complex birth idea is the most developed. Of particular interest we would like to discover what type of information is the most accessible for the pupils, let us say the most receptive

Issue No 5: Have pupils access to more than one source of information for their preconception improvement?

On one side is a pupil's curiosity and on the other side his or her receptiveness to obtain information. We know that pupils can obtain certain informative information at school, however, we are trying to discover how strong a role of school is (for the preconceptions improvement) in comparison to the role of other information sources (encyclopaedias, TV programs, spontaneous learning and so on) and influences (fantasy, self interpretation etc).

RESEARCH INSTRUMENTS

There are several ways for gathering information about students' knowledge (more in: White and Gustone 1994). As a written word is not for our respondents the dominant expression form, we decided to use methods that are based on other forms of expression (more used in our respondent group). Two consistent methods were chosen: children's drawings and semi-structured interviewing. In contrary to mentioned research, we set children's drawing as the dominant method, interview only supported as a secondary method in this method.

Drawing is a one of the very first manifestation of human's mental life. The drawing speaks about a person's inner world, about favours, demands, living, thoughts, and attitudes, also about many other factors of the developing personality. Specifically the ability of a young child can communicate via drawings with his or her social environment by very specific way.

Usage of the children's drawings as a diagnostic method is not a novelty. More often it is used in diagnosis of different mental characteristics (as a tool of psycho-analysis; Backett – Milburn and McKie 1999). Specifically, the method looks very interesting and helpful, important is to realize that the method is not possible to apply in every respondent age.

Initially, the respondent has to be in a stage of so-called *spontaneous contextual drawing*. In this stage the respondent is unconscious of what is the purpose of the draw making (in our case: diagnosis of his or her idea).

Until the age of 2, children draw lines without real context. It is more about feelings and learning to express their own ideas. Later this stage of draw continuously enters the stage of *spontaneous contextual drawing*. This period of time is characterised by naive realism and constructive thinking. This period is also called a *golden age of children's drawing*. The drawing is a basic form of emotional life expression and can be considered as an important way of cognitive development and creativity manifestation.

This stage of drawing development holds over between the ages of 7 – 8 and is continuously replaced with stage of *real drawing*. The main target in this new stage is to draw down objects of reality in exact shapes (as they exist). In this stage we still can use the drawing method for the idea diagnosis. Children can be inhibited by the feeling that they are not able to reproduce the reality to an expected standard of reality. The result being that children probably will not draw every aspect of the idea we asked them to draw. They will draw just the aspects they are sure they are able to draw. The drawing interest trails off in age of 11 – 15. Written and spoken word becomes the main express tool.

In a stage of spontaneous contextual drawing, children drawings have few specifics, which relates from children's imperfect reality perception. A child usually draws objects in reverse perspective, as if he or she was a part of the drawing. Beside this, typical for these kind of drawings are big objects drawn in the background and small objects drawn in the front. In common we can find few different perspectives in one drawing (side view, top view, so on). We can also discover much usage of emotional expressions (for example, emotionally important objects and persons tended to be drawn bigger or closer to him/herself; nearly always all what is perceived as important was seen to be drawn markedly or with details). Children tend to often have a problem in drawing movement.

Ability to represent the shape of the objects as they exist depends on many factors. For instance it depends on the amount of experience the respondent has with the drawn object. It also depends on the observational ability of the respondent and generally on a larger scale it depends also on an individual's personal talent. Considering that we investigate the idea (not the ability to draw it), we do not evaluate shape precision, but only endeavour to draw the object as it exists (not via applicated design as for instance "pillow-shaped clouds" or "smiling sun" are). By utilising this method we try to eliminate the level of talent. The main objective being to evaluate details of the drawings.

The number of drawn elements is a very significant indicator not only for drawing richness, but also for creativity, free thinking/liberalisation and the ability to express self-expression. To evaluate these aspects we need to determine the absolute frequency of the drawn elements per individual drawing. It is useful to set a few categories of drawn elements. Thereafter we counted frequencies for these categories. By using this method we were able to assign relevant elements of the drawing out of accessory elements (relevance considered in relation to the research problem).

In many cases, children used to draw elements that were not in a clear connection with the drawing content. Usually, the elements are related to some subjectively importance. Indications show that the researcher does not need to understand the connection to the content.

The efficient way to deal with this deficiency is to use interview.

Procedure

Every pupil had a task to draw his or her own idea about a prenatal baby development and also (if known) baby conception and childbirth. The task was explained in detail in a clear way that the children understood. In the event of uncertainty the children had the possibility to ask the researcher for further explanation. The pupils had adequate time to draw in detail their ideas. They stopped drawing after 40 minutes. Thereafter, we individually interviewed every child.

The interview was recorded and lasted in average about 20 minutes. The main target of the interview was to gain a better understanding of the child's drawing. We were also asking for explanation of the absence of things we did not find on the drawing.

RESEARCH RESULTS AND INTERPRETATION

Drawing

As we reviewed the drawings, we discovered that it is possible to set 4 different categories of the drawings (Table 2).

Considering the results presented in Table 2 we assume that pupils from lower grades of primary school consider it very important to draw how the baby looks before birth. As the pupils become older, they put into their drawings also a mother. Significant difference can be found in drawings of the forth grade pupils, where we can find also development of the baby in a mother's womb. Indications look as if the older pupils have significant more information; and we cannot consider it via this simply way. It is mainly because pupils receive more information about the subject in third grade at school including the ability to record the development in drawings becoming clearly defied.

Further investigation of the drawing was targeted at detail. We have set categories of the drawn elements and count frequencies of appearance (Table 3).

Table 2. Categories of children's drawings.

Categories of the drawings	Drawings of pupils from grades				Σ	%
	1	2	3	4		
draw of foetus without development	5	2	0	0	7	35
draw of pregnant woman with foetus in her belly, but without development	0	2	5	0	7	35
draw of pregnant woman with developing foetus	0	1	0	0	1	5
draw of pregnancy development	0	0	0	5	5	25

Table 3. Categories of the drawn elements.

Category of the drawn elements	Frequency of appearance				Σ	%
	1st grade	2nd grade	3rd grade	4th grade		
foetus head, body and limbs	5	5	5	4	19	95
eyes	3	5	5	3	16	80
mouth	5	4	5	3	17	85
ears	0	1	0	0	1	5
hair	3	3	4	0	10	50
eyelashes	0	1	0	0	1	5
eyebrow	3	1	1	0	5	25
gender	0	1	0	0	1	5
umbilical cord	5	2	5	2	14	70
womb and foetal coverings	4	3	4	2	13	65
childbirth	0	0	0	1	1	5
fertilization: ovulum and sperm	1	0	1	5	7	35
foetus development	1	0	0	1	2	10
foetus growth without development	0	2	0	1	3	15
growth after birth	0	0	0	3	3	15
making love	0	0	0	3	3	15

Almost all pupils participating in our research (19/20) drew the foetus with a head, body and limbs. Not one respondent was able to draw any foetal inner apparatus. Although they were asked to draw also the apparatuses; they did not indicate nor include them in the drawings. It can probably be affected not only because of lack of knowledge, but also because of the difficulty to imagine such a projection. Pupils were asked to draw things they have never experienced. They saw it on pictures or photos and also they completed the idea using a combination of imagination and fantasy. Indicating that they are able to imagine what is inside of mother's belly, however, it is not easy for a young mind to imagine what is inside of a baby belly inside of the mother's belly. Even though the pupils did not have possibility to see pictures of how the inside of the foetus looks, we cannot say that this is the only reason that they did not draw the information. Perhaps it could be influenced by their ability of reality imagination.

Fourteen out of 20 respondents drew an umbilical cord. The result looks interesting; it seems that pupils know how the foetus gets the food. The connection to this knowledge is clearly indicated in some of the drawings. The Umbilical cord is directed to the foetus mouth, not to the umbilicus (30%), even in certain drawings it is drawn the right way (40%). We did not find any significant difference between knowledge of pupils from different grades.

The pupils did not draw placenta but they were clearly trying to draw at least the womb and some kind of foetal coverings. It can be assumed that to explain the function of the placenta is not as easy as the explanation of the umbilical cord function. We also still have to think and consider the fact that pupils draw

their idea of presentation, things only they perceive as important.

The pupils drew also the foetus eyes and mouth (an interesting observation is, that pupils thought that the foetus before birth is not able to see). Only one pupil drew also the ears (it is also interesting, because in contrary to the subject of drawn eyes, pupils claimed, that the foetus before birth is not able to hear anything). Sometimes eyelashes and eyebrows occurred in the drawings. We feel these are details to which some pupils pay attention to, and others do not.

Only one respondent differed foetus gender. Even though we can perceive it also as a detail, after the interview we discovered that pupils mainly think that the foetus has the gender differed from the beginning. They also claimed that the doctor is able to identify the gender through mother's pregnancy.

The lack of drawings including gender differences as a result of the absence of drawn genitals was also noted by Reiss and Tunnicliffe (2001). They found, that drawings with reproductive organs among 4/5 – 11 year old children were scarce.

Concerning the drawings of older pupils (3rd and 4th grade, including one pupil from 1st grade) we can find an indication of fertilization. Pupils drew ovulum and sperm, sometimes also act of its fusion. A few of the older pupils drew their individual interpretation of the act physical love of man and woman (3 respondents out of 20, all from 4th class pupils) indicating an important part of prenatal development of baby. This is in compliance with Bernstein (1975) research results and particularly we can find it also in results of Nagy (as importance of father contribution; 1953b).

Interview

By obtaining and discovering further information, enabling a clearer understanding of the drawings, we decided to include an interview as additive research method. It often appears very difficult for pupils to speak about the subject freely, that is why we directed the dialog and leads the pupils by asking direct questions.

The pupils mainly experienced initial problems with direct questions relating to conception, the principal role of the father during conception, the duration of the pregnancy term, interpretation of different senses before birth and including an understanding of the environment in which a foetus lives before birth.

As we indicated at an earlier stage in this report, older pupils tended to include in their drawings thoughts about conception, (note: one exceptional pupil from the first class had a very clear idea about whole process of conception, surprisingly quite a scientific idea. This also included knowledge of descriptive words he used for the explanation). They draw especially sex cells. Their responses seem to be more schematic as it is common in children of that age (Nagy 1953b), they really did not understand how the baby can develop out of few cells.

In contrast, younger pupils have very interesting ideas about conception. The ideas differ and vary greatly, probably due to their initial lack of information. This is in comparison to that of older children who have gained and been exposed to advanced stages of information gathering. Strong indications show that pupils were probably influenced by various information and they significantly differ in their individual methods of expressing how they create and modify their own personal preconceptions.

A similar scenario is a clear interpretation and understanding of the father's role in conception and the whole pregnancy. Only 5 respondents indicated a clear understanding about this specific role. We are dealing here specifically about pupils having approximately the right idea. Pupils tended not to speak about physical love, sex or love making, but only about kissing and loving each other by an emotional way. Particularly they connect it with marriage status. These findings exactly correspond with Bernstein's (1975) findings.

All pupils were able to say, that the foetus develops in the mother's belly. By asserting further asking, it was quite clear that they were not able to exactly explain, what does foetus development mean? Also most of them said, that the foetus inner apparatus only grows (not develops). They further conceived that the foetus has some parts of the inner apparatus from the beginning and some occurs later, and more after birth. Mainly they indicated that the foetus has bones, a heart

and a stomach from the beginning. Thereafter the brain develops (or occurs) later, after the birth. These preconceptions were more typical for younger children, but the preconceptions did not differ by any significant way. Surprisingly, most of the respondents were able to explain, how limbs develop, especially they were able to explain, that shape of the limbs, changes from the beginning of the pregnancy to the baby's birth.

As the pupils did not have a clear idea about the foetus inner apparatus and its development, it would be interesting to discover how they perceive the apparent function of the apparatus (breathing, eating, secretion, hearing, seeing etc.). When we asked pupils to explain how the foetus breaths and eats, we discover further imperfections in the pupil's conceptions. The partial problem of nutrient uptake was not so uncertain. Older pupils used to explain it by the existence of the umbilical cord. Some of them thought that it ends in the foetus mouth. The entire pupil research group had problems with the explanation of the foetus breathing. Only a few older respondents have had particularly the right idea. Most of the respondents experienced problems with the explanation and their ideas and responses were varied. For example, they thought that the foetus does not need to breath, nor that the foetus's nose is connected with the mother's lungs.

Most of pupils thought that the foetus does not have hair (younger pupils drew the foetus hair), and they are particularly convinced, that foetus has eyelashes and eyebrows.

Only one pupil from the first class thought that the foetus can see before birth. When we asked if the foetus can recognize darkness and light, some pupils said that it is not possible. Thereafter, we summarised the pupils think that the foetus is not able to use eyes despite the fact that the foetus already has the eyes (eyes are drawn in 19 out of 20 drawings). They argue: "If there is light in the mother's womb, foetus would not see anything". Some of the pupils think that foetus can hear. There are not any significant differences between opinions of younger and older respondents.

A very difficult task for the pupil's was to explain how the foetus environment in the mother's womb looks like. We saw on the drawings that most of the pupils used red colour for filling space inside the womb. We have discovered that they think the foetus floats in the mother's blood. A few pupils said that the foetus floats in water the mother drinks. Others thought that the foetus has a space filled with air in the womb. Only a few respondents (significantly older) defined the environment as amniotic fluid.

Respondents also know about foetus movements. Just two younger girls thought that the foetus cannot move.

Table 4. Information sources for the pupils' preconception construction.

Information source	Frequencies in the grades				Σ	%
	1.	2.	3.	4.		
parents	2	2	1	2	7	35
other relatives	1	1	1	0	3	15
schoolmates	0	0	0	1	1	5
books, encyclopaedias	2	4	3	1	10	50
documentaries on TV	2	0	0	2	4	20
kindergarten or school	1	0	0	0	1	5
only own idea	1	1	1	0	3	15

Older pupils had a quite clear idea about pregnancy duration (9 to 10 months). However, younger pupils differ in the explanation significantly. Some of them said that the pregnancy lasts about 5 weeks, few respondents claimed, that it lasts about 2 or 4 months. On the other hand, some of them said that it is about one or two years and one pupil claimed, that pregnancy can last one month, but sometimes also one or two years.

Pupils' Preconceptions and Information Sources

The construction of the preconception about prenatal development is a very individual process; children use various cognitive skills, feelings, imaginations, but also various sources of information. In our research we were trying to identify informational sources which influenced our respondents the most (Table 4).

Our respondents indicate books and family members (mainly parents) as the main informational sources for the construction of the preconceptions. In this aspect, there are no significant differences between older and younger respondents. It seems that even school offers some basic information about the prenatal baby development; pupils do not accept the information. Similar trends were found in UK research aimed at children's ideas about animals (Tunncliffe and Reiss 1999). We suppose it could be caused by the fact that information they already have and they acquire at school are not coherent. Pupils rather stay with their preconceptions as they would change it under the influence of external information, especially if they do not understand the new information comprehensively.

Lack of information from school till age 10 is another explanation for the observed phenomenon. Although 8/9 year old children (grade 3) should acquire basic information about a human body, in Slovakia primary science curriculum is not focused on prenatal development. The possible role of school vs. other information sources cannot be clearly explained in Slovak conditions.

It is important to mention that the idea development continues regardless of information provided by mainstream education (similar finding was obtained also

in the mentioned Bernstein's research, 1975). Stability of children preconceptions is high, that is why some of the infantile concepts are generally not corrected through knowledge acquired later, but are merely covered up by it (Kreitler and Kreitler, 1966).

The cognitive skills development plays the main role in the reconstruction of the preconception. Especially it is a way how the children manipulate with information and how important their own experience is (the same experience is accepted by a different way depending up the age). And like other aspects of Piagetian theory, the development seems to occur in a spiral line. In the children's ideas of different age we can find similar (or the same) issues, but the children deal with them in a more sophisticated way, where we can find much more integrated knowledge.

SUMMARY

Even at the beginning of the data analysis it seemed that older pupils dispose of more perfect and authentic idea about prenatal development; after a more detailed analysis we have found that the preconceptions differences (depending on a pupils' age) are not so significant as we expected they would be. We have discovered more significant differences between pupils of the same age.

Very specific information (like sperm and ovule) can be found in the ideas of the older respondents, the whole conception is not compact, and pupils do not understand the interconnection of the information acquired in mainstream education with their previously constructed idea.

In compliance with previously realised researches we have to accept the fact that the children preconceptions develop, but the topic is very specific. The preconception development depends on both the quality and quantity of informational sources the children keep at their disposal. The children's personality plays a very significant and meaningful role (curiosity, extroversion contra introversion, self-consciousness, etc.). We have also observed a development of ability to select relevant attributes of the idea for the expression. Younger pupils perceive quite

different attributes of their preconception as the most important for understanding the phenomenon. Particularly it relates with intense development of ability to change their own preconception under the thumb of different information (disappearance of egocentrism typical for preschool age) and with intense development of the time perception ability.

Pupils' preconceptions about prenatal development vary, but not only in connection with age. The great role plays individualism and different access to various informational sources.

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