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The Formation of Children's Technological Concepts: A Study of What it Means To Do Technology from a Child's Perspective

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Constructivist theory epitomizes learning as an active, continuous process whereby learners take information from their environment and construct personal interpretations and meanings based upon prior knowledge and experience (Kozulin, 1998). In a socio-cultural interpretation, learning is understood to take part in a personalized social context. Thus, the acquisition of skills, knowledge, attitudes, and values are a process of enculturation, especially when the learner participates in authentic and context dependent activity (McCormick, Murphy, Hennessy, & Davidson, 1996; Koulaidis & Tsatsaroni, 1996). It follows that individual construction of technological knowledge occurs predominantly in socially interactive settings, which are shared with the members of the learning community, essentially through the meanings of context dependent language and actions (Gergen, 1995; Wertsch, 1991; Vygotsky, 1986).

Within the educational context, there are certain important considerations that need to be kept in mind when seeking to apply such a socio-cultural perspective to design and technology teaching. For example, technological problem solving, through a focus upon a solution, should relate to each child's real life environment, allowing the child to make appropriate and meaningful connections from it. Importantly, the children should actually be encouraged to identify technological problems, even deficient features in their everyday environment, as well as being given opportunities to apply the technological knowledge and skills which they have acquired in subsequent problem solving (Schwarz, 1996; Lehto, 1998; Adams, 1991).

In addition to the perspective above, the children should be given opportunities to act according to the technological processes required to solve the problems they face. Technological process can be claimed to have some certain and specific features which should be taken into account, regardless of the materials used (Sparkes, 1993). Children need to be educated as much in technology as through it (Twyford, 2000a).

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Purpose

The purpose of this study was to investigate empirically some essential features of children 'doing' technology (DeVries, 1999). More specifically, the study aimed to explore pupils' acquisition of technological understanding in collaborative settings, through authentic tasks in employing the principles of counterweight technology. An example of counterweight technology is the weight that "counters" the weight of the car in a lift or elevator installed in a tall building.

The study assumed that pupils make connections between their previous knowledge and skills and the given problem in order to formulate their version of a technological solution (Järvinen & Twyford, 2000). Consequently, the focus of this research was on exploring the technological processes that the children spontaneously went through when they used counterweight technology in their design and technology work.

The Study

The "Nodding toy" materials (Twyford, 2000) were introduced to a class teacher at Haapavesi Central primary school in Finland. The twelve hour assignment was taught to a 5th grade class containing 17 boys and 9 girls. The teacher used the "Nodding toy" materials to introduce experiments for his pupils to explore the idea of balance and counterbalance, especially to enable them to experience the use of counterweights. Thus, the materials were used as a stimulus for children to establish their own distinctive assignment, as well as to discover and make use of their understanding of counterweight technology.

After a class discussion about where and why counterweights are applied in things known to the children, they were required to work in groups and to find their own version of a real tool, device, or machine which used balance and counterbalance to make it operate and to be useful.

Pupils were required to freely explore their model design ideas in order to decide where and how they were going to use them and apply the idea of counterweight technology. The teacher took on the role of an observant tutor and demonstrated sensitive support for pupils in bringing about their personal ideas and knowledge (Honebein et al., 1993; Gallimore & Tharp, 1990). The pupils were also told that there were no right or wrong answers to the problems and that they were not going to be formally assessed in this assignment. Moreover, they were all encouraged to use their imaginations and personal creativity.

Method

Constructivism concerns the meanings constructed by pupils taking part in context-specific and socially situated activity through social interaction (Schwandt, 1994). Therefore, the research method employed was designed to elicit data from the socio-cultural context using semi-structured interview techniques.

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The methodological perspective of the study was qualitative in nature and based on interpretative skills and inductive analysis, whereby the researchers continually explored the relationship between data and emergent findings (Ritchie & Hampson, 1996; Järvinen & Hiltunen, 1999).

The study employed an open search for categories, concepts, and patterns emerging from the children's assignment on counterbalance technology. The emergent patterns, relative to the theme of the study, were thereafter categorized and classified to enable interpretation to be made from the data (Erickson, 1986; Patton, 1990).

Data were collected by means of semi-structured interview (Hitchcock & Hughes, 1989). The interview took place one month after the project when all the pupils were available without affecting their school routine. The pupils were asked following questions:

- Could you describe what did you did in the project?
- Please explain how you applied the idea of balance/counterbalance in your work?
- Why did you make what you did?
- Where did you get your ideas from?

Photographs of the pupils' products taken during the project were used in the interview session to help them remember their work, including how they developed their designs. Interview sessions were recorded on a dictating machine.

During the transcription process, irrelevant data were excluded according to the analytic procedures suggested by Miles and Huberman (1994). During the first round of analysis, the researchers began to form an idea of the emergent phenomena relative to the theme of the study. As the analysis progressed, the researchers were continually seeking to re-explore the relationship between data and emergent findings; revisions were correspondingly made. They discussed and shared thoughts on many occasions. Data were analyzed by the researchers, both individually and collaboratively (Ritchie & Hampson, 1996). Finally the researchers reached a stage where they considered that they had investigated the data sufficiently.

Results

It was observed that the children in the study handled many variables simultaneously, including issues of complexity. It was therefore concluded that they were engaged in holistic designing, making, and using. Thus, it was believed that their conceptual understanding of technology might be revealed through assertions developed from the data. Two assertions were thereby developed, along with categories under them. The assertions demonstrate children's overall analytical skills in how they used their acquired processes of technological thinking when employing counterweight technology and their natural abilities to represent their understanding, especially through language. There was some overlap between the categories, but it was felt that it would not blur the essence of each category. Once the assertions and categories were developed from the data analysis, examples were "microanalyzed" in order to clarify the interpretative analysis process (Erickson, 1986; Miles & Huberman,

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1994). This was done by the researchers independently and collaboratively to verify consistency.

Each assertion and its categories will be presented, followed by examples from the data, and then by the interpretation of the data. For ethical reasons, all names in the transcriptions were pseudonyms.

Assertion 1 (A1)

Children demonstrate their technological understanding through their acquired analytical skills.

A1—Category (1)

Spontaneously establishing a model idea by forming connections between their understanding of counterweight technology and authentic examples of devices or machines which use counterweights in their operation by means of synthesizing discussions between themselves, their teacher and their parents.

Examples of A1—Category (1)

Leena
Leena: "I learned how draw wells work in real life."
Questioner: "Have you seen one?"
Leena: "Yes in our summer cottage."
Questioner: "While making this model did you think about the one in your summer cottage?"
Leena: "Yes."

Sami
Sami: "I made a lift…people are the counterweight in lift they make it go down and when they leave it goes up by the counterweight."

Pentti
Pentti: "I made a lift…."
Questioner: "Did you know before hand how balance and counterbalance is applied?"
Pentti: "I knew it was applied in a lift somehow."

Lauri
Lauri: "I said, 'lets make a railway crossing barrier.'"
Questioner: "How is balance and counterbalance applied in a barrier?"
Lauri: "The bulky thing affects it." (He explains how weighted barrier works with a bulky weight in place.)
Questioner: "Where did you get your idea from?"
Lauri: "From seeing real ones at a railway crossing—they stop cars crossing the lines before a train comes—it controls cars."

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Oskari
Questioner: “Why should the beam be weighted down?”
Oskari: “It is easier to lift up the load of water from the well. It came to mind—for both of us in the group. I worked with Lauri.”
Questioner: “Was it your idea or the teacher’s?”
Oskari: “Our idea—Lauri and mine.”
Questioner: “Did you discuss it?”
Oskari: “Yes we did.”

Malla
Malla: “We did an old fashion fish scale.”
Questioner: “Why did you make this?”
Malla: “We had to choose some work at home—to think about where counterweight technology is used at home.”
Questioner: “Was it your idea?”
Malla: “My mother helped me.”

Pentti
Questioner: “Did the idea of a draw well come from the pupils?”
Pentti: “Yes—and from the real world.”
Questioner: “What other ideas were there?”
Pentti: “Yes—like an elevator and such things.”

Interpretation for A1—Category (1). Leena, Sami and Pentti simply demonstrated their acquired knowledge, but Lauri demonstrated spontaneity in his choice of a model idea. He spontaneously and pragmatically analyzed his solution for which form of counterweight technology to model by various direct, but intuitive, means. Some children also identified and analyzed authentic devices or machines that use counterweight technology through discussion with their teacher and parents, as well as with their classmates. For example, Oskari’s answer shows evidence of discussion with Lauri, who is his peer. They clearly analyzed what they discussed to make a workable connection between their observations and the idea of counter balance. Here, model identification was through socio-cultural experience connected to peer discussion.

A1—Category (2)

Using personal abilities to analyze the whole model as a product in relation to its component parts using acquired knowledge of solutions and their uses.

Examples of A1—Category (2)

Mika
Mika: “Firstly, we constructed the supporting wooden beams and then a card plate and drilled holes in the base and put a wooden beam (axle) between the two plinths and a wooden ball used like a pulley with the counterweight the other side.”
Ville

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Ville: “We constructed and sawed the base and we put the stop sign and chevron marking to make it look real.”

Pentti
Pentti: “I made a lift in our group—firstly we planned it then we collected materials and cut suitable pieces out of cardboard and placed sticks between tables. We used two boxes, one for people and one for the weights to make it go up; when we took the weights off the lift went down.”

Jarkko
Jarkko: “Jouni and others were good at this project because they made a lift and lift shaft.”

Maija
Maija: “It was Tarja’s idea to do a catamaran.”
Questioner: “Why?”
Maija: “It was different to others who had moving parts in their models, which ours did not. To my mind it can be a boat without a catamaran, but the catamaran stops it toppling over. Paddling without the side boat would make it tilt more.”
Questioner: “Have you tested it in water?”
Maija: “Yes, it floated.”

Tero
Tero: “The most difficult part of the work was to have the right size of weight in place.”

Malla
Questioner: “Why did you make your model?”
Malla: “We had to choose some work at home.”
Questioner: “Was it your idea?”
Malla: “My mother helped me.”
Questioner: “Why was it successful? Did it work like you expected?”
Malla: “Yes—because it is similar to a real fish scale and because it had the same purpose as the real thing—it illustrates this and therefore it is successful.”

Kati
Questioner: “How might it be useful?”
Kati: “To weigh small things in the kitchen. The most difficult part was to make the fish scale; the easiest was the blue-tac fish.”
Questioner: “Did you learn anything?”
Kati: “You can make many things using balance and counterbalance. You need ‘good nerves’ (tenacity) to do technology.”

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Jukka
Questioner: “Is it useful?”
Jukka: “One can learn about how it works. We can demonstrate the idea of a lift to first and second grade pupils, to explain what a lift is.”

Sami
Sami: “In lifts and draw wells, they use balance and counterbalance. People are the counter weight in a lift, they make it go down and when they leave it goes up by the counterweight in real ones there is a motor but—not in ours.”
Questioner: “Did you know about construction cranes?”
Sami: “I knew something—but I didn't know about how the counter weight is used although I knew about the cables in it.”
Questioner: “How about draw wells?”
Sami: “The counterweight lifts the bucket of water.”

Interpretation for A1—Category (2). Children understood that their models have component parts that are required to fit together to form the whole model. Maija aimed to simplify this by choosing a design that required a minimum of parts. Moreover, her explanation revealed her understanding of moving and non-moving components in a model, as well as a sense of what makes up a simple model that incorporated balance without moving parts. Interestingly, Jarkko made an observation (when he refers to “Jouni and others”) of the usefulness of component parts to the whole project.

Children gave many different personal explanations of how counter-weight technology was used, as well as how it could be employed in their chosen model of an artifact. It was clear in Malla’s response that she values the connection between her model and its real life equivalent. Importantly, according to her, this connection makes the work successful. The fact that Malla’s mother helped her to formulate the idea of a fish scale does not weaken the value of the work; the school should not act in a vacuum, but rather should be in constant interaction with its surrounding reality. Parents can be an important source of information and ideas as well.

Kati, who worked as a partner with Malla, found the fish scale useful for weighing small things in the kitchen. Jukka saw the model of a lift from an educational viewpoint, using it as a means to demonstrate the idea of counterweights to the younger children. The responses of Kati and Jukka give evidence that they are thinking divergently, at least to some extent (Feldman, 1993). Sami also made a clear connection between a real use of counterweight technology and his experience with how it worked in a model.

Assertion 2 (A2)

Children acquire technological understanding through several forms of representing their solution-focused ideas.

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A2—Category (1)

Modeling ideas through craft-design activities and directly constructing a particular model.

Examples of A2—Category (1)

Oskari

Questioner: "What did you do?"
Oskari: "We found a picture of a draw well, (picture in the classroom). We didn't plan it beforehand—we just made it."

Timo

Questioner: "What did you do?"
Timo: "We made a lift with Jukka."
Questioner: "How did you begin?"
Timo: "We had a mutual idea to do a lift and we went to the wood shop and I took a motor from home and we used the marbles as a counterweight."

Interpretation of A2—Category (1). In these examples children represented their model ideas by handling both their design concept and chosen materials directly to form their product, three-dimensionally, in the form of 'craft-design' practice. For example, as Oskari says, "we just made it." Also Timo's response indicates that they have acquired the habit of handling materials directly and designing with them. They also carried out various activities while during the making process. For example, they adjusted the position of weights and other variables in their model without reference to calculations or plans. Thus, the children have acquired the techniques of classroom modeling and these personal, direct modeling skills are a vital part of knowing how to do technology in school.

A2—Category (2)

Establishing and modifying design ideas through the deliberate use of drawing and modeling prototypes to represent ideas (Kimbell, 2000).

Examples of A2—Category (2)

Jukka

Jukka: "It was interesting because we could look for, and explore, balance and counterbalance. Firstly we did something in cardboard then we did real things. We made a lift with Timo."
Questioner: "What did you do?"
Jukka: "Firstly we planned it on paper without a motor then we did put a motor in the lift and it was better."

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Ville

Ville: “We did a draw-well with Lauri and Topias who had begun with the idea of a railway barrier. We drew it first then went to the wood shop. We constructed and sawed the base and we put the stop sign with chevron markings to make it look real.”

Kati

Kati: “Malla and me planned at home. We took Malla’s plan to make a fish scale, then we made a plan on paper for a fish scale.”

Interpretation of A2—Category (2). Jukka, Ville and Kati all used drawing to plan their models, whereas Jukka also used cardboard modeling to help in making his model. The children’s work was mostly based upon their personally driven, direct, everyday, technological understanding of balance and counter balance (see Assertion 1). The drawings used information about the overall form of the model. Jukka and his team used modeling, craft-design, and drawing to represent their ideas for making.

A2—Category (3)

Using everyday concepts expressed in varying forms of language used in class discussions, especially peer discussion, as well as in response to the teacher, their respective parents, and, at times, the interviewer. This category was further broken down into subcategories based upon four distinct forms of vocabulary in order to show how children represent their understanding of doing technology, as well as how they model their design ideas. Thus, students' concepts of doing technology are revealed through varying forms of their explicit use of different types of language.

Examples of Category (3). The children’s responses indicated that they were functioning at different developmental stages with reference to the principles involved, ranging from little or no understanding to complex understanding. Thus, each language form mirrors this broad developmental sequence.

*Subcategory (a***)**. No substantial understanding expressed verbally.

Salme

Salme: “We made an elephant [with Lotta].”
Questioner: “What was the D&T work topic?”
Salme: “I don’t remember.”
Questioner: “Was it about balance and counterbalance?”
Salme: “Mmm, yes.”
Questioner: “Explain about the class experiments which you did?”
Salme: “About animals in card- (Salme explains about making part of an animal to nod, but she does not give any information about the ruler experiment concerning balance). We made an elephant?”

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Questioner: "Did you design it?"
Salme: "We planned it in cardboard."
Questioner: "Was it your idea to use balance and counterbalance?"
Salme: "We thought about making the elephant's trunk nod."
Questioner: "Why?"
Salme: "It was Lotta's idea."
Questioner: "Did you learn anything useful?"
Salme: "Yes."
Questioner: "What?"
Salme: "I don't know."
Questioner: "Did you know anything about balance and counterbalance in lifts and draw wells?"
Salme: "No. I didn't."

Interpretation for Subcategory (a). Not knowing how or what is happening is a clear indication of a lack of confidence to do technology at this level. However, children may be reluctant to talk about their work, so there may be more of an implicit understanding than is revealed here.

Subcategory (b). Direct practical understanding where the child intuitively demonstrates an ability to make something, but without a clear expression of how what they made actually works; for example, they "just do it."

Jukka
Questioner: "Does it work?"
Jukka: "Yes, but it needs a battery—then it lifts the elevator up."
Questioner: "How is balance and counterbalance applied in your lift?"
Jukka: "If there is not a counterweight in it won't go up."
Questioner: "Why did you make a lift?"
Jukka: no answer
Questioner: "Did you have a common discussion about lifts?"
Jukka: "Yes, at the beginning of the project, and then we decided to make a lift."

Malla
Questioner: "Can you find your own work in the pictures?"
Malla: "Yes—we did an old fashion fish scale. We put a counterweight on the end of the beam and then you can change the position of it."
Questioner: "How is balance and counterbalance applied in this scale?"
Malla: "You can weigh things and this is just an example of a scale."

Interpretation for Subcategory (b). Children know what they are doing but do not clearly indicate this in the vocabulary they use to describe their actions and decisions. They have only part of what is needed to apply their knowledge to making something work in a particular way.

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Subcategory (c). Using everyday language to signify a clear understanding of the technological concepts involved.

Lauri

Lauri: "Firstly, the other group members had ideas. Then I said, 'Let's make a railway crossing barrier.'"
Questioner: "How is counterweight applied in a barrier?"
Lauri: "The bulky thing affects it." (He explains how weighted barrier works with a bulky weight in place.)
Questioner: "Where did you get your idea from?"
Lauri: "From seeing real ones at a railway crossing—they stop cars crossing the lines before a train comes—it controls cars."
Questioner: "Was it your idea?"
Lauri: "Yes."
Questioner: "Did you discuss the barrier in the common discussion?"
Lauri: "No. It was my idea."
Questioner: "How could it be made better?"
Lauri: "The pivot in the beam was stiff, and to make it work better we could put more counterweights in the beam" (to overcome friction in the beam and pivot).
Questioner: "If you shorten from 'a' to 'b' what happens?"
Lauri: "The beam goes up quicker because there is more weight on the other side."
Questioner: "What did you learn?"
Lauri: "Nothing very new for me."
Questioner: "So you know about balance and counterbalance in barriers?"
Lauri: "Yes."
Questioner: "…and in cranes or lifts?"
Lauri: "Yes—I know that."

Ville

Questioner: "How is balance and counterbalance applied to the barrier?"
Ville: "It is a customs barrier. When it is down it's not so difficult to lift because of the counter weight which makes it work. The counterweight lifts it and it makes it easier to lift."

Interpretation of Subcategory (c). The children clearly understand counterweight technology, and are able to express their personalized concepts through procedural language (McCormick, 1998). They explain things in plain, everyday words. They can talk about how they made their models to exemplify appropriate application of counterweight technology. They can also talk about the usefulness of things, how they can be made, and how they work, without resorting to a complex technical or scientific vocabulary. Terms like 'bulky thing' (in Lauri's answer) indicate understanding that is colloquially expressed. They are able to make clear connections between what they know and what they

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make, including applying their experience of counterweights. This is the essential way in which children model their design ideas.

Subcategory (d). Using scientific language to communicate designing and making, showing a clear understanding of the concepts involved (McCormick, 1998).

Jouni
Jouni: "We had the concept of balance and counterbalance and explored it with a ruler—putting it in balance and then placed different objects at both ends of the ruler."
Questioner: "Did you discuss balance and counterbalance?"
Jouni: "Yes—its due to gravity."

Oskari
Questioner: "What was the D&T theme—where did you begin?"
Oskari: "We had to make something like a balance thing."
Questioner: "Did you use common experiments?"
Oskari: "Yes—we used a beam with a hook in it (the frame experiment), not in balance and we added some weight to make it balance."
Questioner: "Did you discuss balance and counterbalance."
Oskari: "I don't remember. We did discuss gravity as an effect of balance and counterbalance and gravity is a force which pulls things down."

Interpretation of Subcategory (d). There was some evidence among two of the students that they were using what is often taken to be scientific terminology in their descriptions of counterweight technology. For example, they used the terms gravity and counterbalance. In actuality, however, no pupil used recognizable scientific descriptions of the counterweight technology in their model making. The use of terms like balance are often taken to be precise, but in fact belong to everyday language usage.

Examples of conceptual language were evident in what Jouni said since he was beginning to be precise in his use of terminology when he mentioned the notion of gravity affecting the model system. He understood how to make a model and to employ counterweight technology. Oskari exhibited similar characteristics in his use of words concerning his understanding of gravity.

A2—Category (4)

Applying acquired skills to materials, tools, and equipment.

Examples of A2—Category (4). Applying acquired skills to materials and tools.

Mika
Mika: "We did those balance things. We had the lifts and other things using balance."

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Questioner: “How did you begin?”
Mika: “Firstly we constructed the supporting wooden beams and then a card plate and drilled holes in the base and put a wooden beam (axle) between the two plinths and a wooden ball, used like a pulley with the counterweight the other side.”

Markus
Questioner: “How did you begin making the draw well?”
Markus: “We used wood and glue in it. We should have made a wooden bucket and not used a plastic glue top—for our model of a draw well.”
Questioner: “How did the counterweight work?”
Markus: “The water in the bucket can be lifted by the counterweight.”

Maija
Maija: “We went to the wood shop and we used plastercine for the man sailing the boat, and we used wooden sticks for the boat and its oar.”

Interpretation for Category (4). The children were clearly able to identify appropriate materials for their model, as well as employ typical classroom skills in manufacturing. Their making was seen to happen through their use of chosen materials, tools, and construction techniques. For example, Mika used the term “construction” and used a drill in making his model. They all handled materials and used modeling skills to construct a model of something known to them that exhibited a real use for counterweight technology.

Discussion

Children demonstrated their acquired knowledge of the use of counterweight technology in their models in many ways, especially in how they drew from their direct experiences with actual tools and machines. Further information to aid their realization of a model was derived from class discussions involving the teacher, peers, and personal analysis. This also provided support for their development of the concept of counterweight technology. Thus, children synthesized their ideas about the usefulness of a technical principle, especially because it involved them in recalling and redefining their acquired experiences.

The study revealed that children’s solution-focused technological concepts were expressed through the force of their experiences and imaginations. These internally generated responses to designing and making, including knowing the usefulness of things, represent both their abilities to be creative technologically, as well as their meta-cognitive skills and processes in acquiring such abilities. Throughout, they used the everyday terms of balance and counterweight spontaneously as examples of their language and inculturalization (Panofsky et al, 1990; Parkinson, 1999).

Thus, children’s acquired analytical skills and ways of representing their understanding were intuitively based upon being able to define problems and to analyze how to make a model which used counterweight technology. They handled many variables and possibilities. The complexity of their work came

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from employing many skills and handling ideas, processes, and materials simultaneously. They also worked with incomplete information as they developed their model.

This study empirically revealed some of the key aspects of the characteristics of children acting technologically. It demonstrated how children make pragmatic decisions about their models with respect to their experience of making. These decisions included making adjustments and changes to their model so that it would work well. Together, these processes represent a synthesis of technological thinking in which children are constantly analyzing variables in order to form their version of a model.

Children were able to define their situation, analyze the requirements, and select a personally distinct model idea. When children evaluate a design idea, an approach to making, or a use of counterweight technology against other possibilities, they are then clearly engaged in analysis. Taking a design idea and making it work is technological analysis. Thus, the assertion concerning analytical skills revealed that children make spontaneous judgments to select and make a particular model.

The basic analytical skills outlined here reveal how children's design and technology work is founded upon how they are able to make meaningful links between what things are for and how they actually work, with respect to their design and manufacture. The data indicated that children understand through analysis how products 'afford' using counterweights (Norman, 1988). Thus, children exhibited the essential analytical skills typical of technological pursuits, based upon a synthesis of acquired experiences.

Existing knowledge, direct observations, and practical experience clearly guide analysis and are a part of their interaction with peers. Children's intuitive use of analysis and modeling in their application of counterweight technology demonstrated that there was some commonality in their experience.

Problems, issues, and decisions determine the nature of technological inquiry. The subject matter for technology can be found in many areas of human experience. The task of teachers is to reveal and make explicit the knowledge, skills, understanding, and values which comprise technology. There was support for maintaining the breadth of technological subject matter because technology is influenced more by issues and contexts rather than procedures, specific skills, or facts.

The authors advocate that children's understanding of technology can be best achieved by enabling them to work in the same spirit in which technologists work. This approach brings authenticity to classroom experiences for pupils. In technology education, it is essential that the pupils are encouraged to work and learn in a way that fosters creativity and discovery. This can be facilitated by providing an appropriate atmosphere for problem solving, one that is low in stress and allows concentration on the task at hand (Futschek, 1995). Technological problem solving is a form of reflective thinking in which the child interacts with many sources of knowledge in the process of solving a problem. The pupil's mind changes and develops through active participation. In

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turn, pupils are able to cause real changes in the world around them when the problems tackled are also real.

Technology is a multi-dimensional field of inquiry. It is a synthesis of many experiences and successful work draws upon a wide range of knowledge; it is not bound by subject boundaries. Thus, the authenticity of technological problems or issues demands a multi-disciplinary approach. None of these characteristics are particularly unique to technological activity, but authentic experiences for students in confronting problems and developing solutions to them are essential in its role as a player in education in general.

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