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Education for technological literacy in modern society

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Every citizen deals with technology on a daily basis. Those who are unable to manage and master technology are often helpless in modern society, where the ability to control, create and utilise technology is now seen as a basic skill. It follows that all citizens should receive education in technology, starting from childhood. Technological literacy is the umbrella concept for technology education. Children should understand that technology is the result of human activity. The ability to design and make use of technology in the context of technological literacy does not mean the acquisition of specific vocational skills, but namely the will and the self-confidence to approach simple technical tasks. A technologically literate person is able to evaluate critically, to reflect and to learn new things in the field of technology.

Technological activities provide a natural broadening of children's experience. They include many educational elements that stimulate all the facets of children's development, and help children understand that knowledge, skills, tools and materials can improve their environment (Dunn and Larson, 1991; Idle, 1991).

Technology education in the Finnish kindergarten

Technology education is not a totally new field in Finnish early childhood education. Activities such as handicrafts, building with construction toys, using computers, and developing familiarity with technological toys and their functions have traditionally been a part of early education. The national guidelines for curriculum planning in pre-school education encourage the teaching of technological activities (Stakes, 1994). According to these, children should become familiar with different materials, tools and techniques as well as developing their knowledge, skills and attitudes for daily living. Based on the guidelines, every municipality develops individual curricula which include technological activities such as logical thinking, problem solving and inventing (Lapsi Oppimassa, 1996).

Finnish kindergarten teachers have increasingly recognised the need for developing classroom activities related to technology education. This focus has especially been on pupils from ages five to six, although now there is an increasing interest in children as young as three and four. Recent discussion among kindergarten teachers, researchers and teacher educators shows how previously, technological activity in kindergarten has been regarded as trivial work rather than organised learning: the value of nailing, hammering and knitting was not recognised. However, these kinds of activities should be viewed as meaningful technological learning tasks.

Two types of staff, with different positions and educational backgrounds, work with children in Finnish kindergartens: kindergarten teachers focus more on instruction, while day care workers focus more on supervision and social development. Kinos (1997) has shown how the educational background of both groups has changed following revisions in educational programmes, requirements and laws.

The division of labour between the two types of staff has undergone significant modification, moving more towards co-operation, and is not as clear as it was twenty years ago. Although there are variations between kindergartens, kindergarten teachers usually plan the instruction, but often both kindergarten teachers and day care workers carry out the other activities.

A first degree in education is now required for kindergarten teachers. This must be obtained from either the Kindergarten Teacher education program or the Social Worker education program. Day care work requires a two or three year vocational degree in social work and day care. This degree includes studies in technological education, but they are generally a small part of the program.

An early start to technological activity

Technology is a familiar word to many, but the concept is often misunderstood. The meaning which is generally accepted among social scientists is the study of the human created world (Blandow, 1994; Goldman, 1984; Dugger & Yung, 1995; Mitcham, 1994). Technology encompasses the making and using of artifacts: it is the practice or activity of humanity working to accomplish its goals and needs. In the technological process, man converts natural resources to products or objects. Technology can also refer to information-based processes. Technology is associated with diverse human behaviours (Mitcham, 1994). This is why craft, inventing and designing are defined as parts of technology: historically craft is a central part of technological development, and as an instructional tool for technological education it still has an important role,

Technology education provides an opportunity for pupils to learn about technological information and processes. It promotes the development of thinking and psychomotor skills, creativity and innovation, and problem solving. Furthermore, it develops pupils' abilities through hands-on activities (Dugger & Yung, 1995; Eggleston, 1994; Layton, 1994; Kolehmainen, 1998). It is directly concerned with the use of tools, materials and processes: pupils are required to solve practical problems and to design and create products. Through the process of creating, they discover how humans create their technological world. This creative process develops their human potential and stimulates their cognitive, affective and psychomotor abilities, all of which are needed for effective learning. During the process one learns to understand, use, produce, and control technology in a meaningful way.

Parikka and Rasinen (1993) suggest that technology education has three main goals. The first is the development of the child's positive self-concept, which is the most important goal in early childhood education (Brotherus, Helimäki, & Hytönen, 1994). The second goal to is develop an understanding of the technological functions of the home, and the third to develop an understanding of the technological systems of society. Many other researchers have presented similar goals (Dugger & Yung, 1995; Idle, 1991). Early childhood education needs to give attention to the development of children's affective and psychomotor abilities as well as to their cognitive abilities, through technology education. Technology education during early childhood is different from technology education for older pupils, which puts greater emphasis on cognitive development.

Technology education as a part of early childhood education

Technology is part of a child's environment, from the home to the satellites that circle the Earth. Soon after birth, a child becomes familiar with different technology (Dunn and Larson, 1991). Children typically start to change their environment in different ways, such as by using toys to make snow forts and sand sculptures. Play often involves technological problem-solving; for example, when a child determines how to build a playhouse so that the blanket used for the roof will not crash down and the walls will not collapse. Such activity is so common that it often may not be considered as related to technology. However, through such activities children are developing many concepts and beliefs about technological matters that will have a strong effect in future learning situations.

Learning and education processes in Finnish early childhood education settings differ from those found in traditional schools. Huttunen (1989) notes that young children's ways of learning differ notably from that of older pupils and adults. Children may learn without organised teaching situations and subject content. The goal of teaching in early childhood education is to use a child-centred approach (Brotherus, Helimäki Hytönen, 1994; Huttunen 1989), and the curriculum advocates cross-curricular methods and the integration of all activities. For effective learning to take place in early technological education, children should determine their own learning environment (Dewey, 1916; Shapiro, 1994) where self-made technological projects are connected to real life, so that they can familiarise themselves with their environment and learn about the surrounding economic, technological and social culture and its importance both for the individual and society. Links need to be made between children's thinking and their environment. Makiya and Rogers (1992) and Richards (1994) point out that hands-on learning provides good opportunities to extend daily topics into technological learning tasks.

Technology education includes many activities such as making things from wood, using construction kits, utilising computers, experimenting with electrical toys and their functions, and working with low current batteries and lamps (see Dunn and Larson, 1991; Idle, 1991; Richards, 1990). Raat (1993) explains that children like to make things that can be used.

It is especially important that both boys and girls equally receive technological instruction. Ross and Browne (1993) point out that already in early childhood girls and boys start to focus on different activities. According to Browne and Ross (1991), this division into boys' and girls' activities begins at a young age. Raat (1993) claims that on the average, girls have a less positive attitude toward technology.

Children's readiness for technological teaching

Anderson, Reder and Simon (1996) argue that most modern information-processing theories in cognitive psychology are 'learning-by-doing' theories, which imply that learning takes place best with a combination of abstract instruction and concrete examples. They claim that numerous experiments show that such a combination is better than either one by itself. However, we need to consider if this kind of instruction can be applied in early childhood education. Although young children already have numerous experiences, are they able to learn through abstract instruction? When we teach technology in the early years, we should consider the children's ability to think, especially at an abstract level. Teachers need to be aware of the children's cognitive development,

their fundamental representational capacity and ability to understand relationships (Carey, 1990).

Children's cognitive growth has been seen as a developmental process which progresses from simple concrete observation to complex abstract thinking (Inhelder & Piaget, 1958). According to Siegler (1991), children's ability to reach the abstract level of thinking is dependent upon their interests. A boy interested in cars and a girl interested in a doll's house can achieve a higher level of thinking than other children because most of their action is focused on their area of interest. Teachers need to observe children's abilities in order to identify the content and goals of teaching.

Technology education should be relevant to children and needs to correspond to their abilities and experiences. Children's learning depends significantly on their intellectual experiences. Therefore, the teacher's role in technological instruction is to build upon the children's abilities and introduce them to a variety of new techniques and skills that will extend and widen their experience (Makiya and Rogers, 1992). Deloache and Brown (1987) have found that some of the best evidence of self-motivated and self-directed learning comes from situations in which children spontaneously operate on a problem with no external pressure or instruction.

Discussion

Technology education in early childhood is a way to develop more positive attitudes towards the field of technology. The use of technological tasks should be promoted because we live in a technological society: it is through these tasks that children's readiness for technological understanding develops. They begin to acquire an ability to make conscious decisions which will lead to the ability to function as wise consumers and users of technology and to make well-founded decisions in this area. Because the perceptions about technology depend on attitudes it is also important that technological equality between boys and girls develops. This influences later behaviour in new learning situations that will arise within a technological environment.

Technology education includes other goals which focus on the positive development of children. Activities such as the making and using of products involve a natural broadening of the children's experience and their learning. Technological hands-on activities include many educational elements which stimulate a balanced development in all facets of children's personal growth (Dunn and Larson, 1991; Idle, 1991; Parikka and Rasinen 1993). These are conducive to the development of children's creativity, logical thinking, psychomotor and problem-solving skills, and self-image.

One way to develop technology education would be to create more books of ideas and learning materials. There are computers in some kindergartens and the internet is also becoming more common: this makes it easier to obtain new teaching materials. Most software in this field has been designed for elementary education, but some of it can be also used for six-year-olds.

The departments, institutes, and schools that educate kindergarten teachers and day care workers, however, have the most important role in developing technology education. More attention needs to be paid to basic education in the training of teachers and day care workers. We should educate teachers to have basic skills in technology, teaching, and work safety and to understand children's thinking. During their period of student teaching,

students should be provided with the opportunity to become familiar with teaching technological activities. Technology education needs to become a more significant part of student teaching training as well as of the basic education in kindergarten teaching programmes and in the vocational schools where day care workers are educated.

Children should have a chance to become familiar with the technological environment and the making of products. If play and other activities do not include enough technology, learning possibilities should be organised according to children's interests. Although technological activities are not as familiar as music or drawing to kindergarten teachers and day care workers, there should be an organised effort to provide opportunities for children to engage in them. Technological activity demands learning new practices. We need to remember that positive successful childhood experiences form a basis for later learning situations and attitudes in the field of technological activity.

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