



International Conference on Education & Educational Psychology 2013 (ICEEPSY 2013)

TECHNO-school for Technologically Talented Underachieving Students

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Abstract

Finland has been one of the world's leading countries already for years when the pupils' school achievements are measured. On the other hand, we know about the basis of earlier studies that the pupils of the Finnish comprehensive school react relatively negatively to their school attendance. For this study, an essential point is that so-called traditional troublemakers or pupils' with intellectual disabilities are not the target group in this research. Instead, this study is focusing on young people whose learning difficulties are due to the inability to adjust and benefit fully of more traditional school education without practical connection. Previous study indicates that young people with special technological talent have limited social abilities and in this study the main target is to find out how many technological talents can be found in a group of pupils with need for special support in their basic education. Based on our study 30 % of pupils with the need for special support have better than average technological competence and 10 % achieve excellent results in the technological area.

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Selection and peer-review under responsibility of Cognitive-counselling, research and conference services (c-crcs).

Keywords: Techno school, Technological competence, special education, prevention, educational exclusion

1. Introduction

Finland has been one of the world's leading countries already for years when the pupils' school achievements are measured (OECD, 2001; OECD, 2010.) On the other hand, we know about the basis of earlier studies that the pupils of the Finnish comprehensive school react relatively negatively to their school attendance. According to Health Behaviour in School-aged Children (HBSC), Finland was among the last ones in the inquiry of school enjoyment of 35 different countries. Only a few of the pupils were especially satisfied with school and the large part experienced fairly much pressure in regard to the assignments (Samdal, Dur & Freeman, 2004). We can state with good reason that even though the academic school achievements are excellent in our country, the pupils' comprehensive welfare can still be improved. In regard to the school enjoyment, attention has already been paid to the pupils who need special support in their teaching arrangements. The model of Flexible Basic

Education (FBF) project was launched in January 2006. The aim of the FBF is to support the pupils who are in danger of educational exclusion. Several different ways of action and teaching methods were developed for the basic education to take care of pupils' different needs. Different practical learning environments and learning by the work were emphasized. This way an attempt was made to develop school enjoyment and prevent educational exclusion. In Iceland, "Techno School" that operates partly according to the same principles is being planned. This is based on assumption, that practical learning which emphasizes pupils' own strengths is the best method for these pupils to take responsibility of their own school attendance. What's more, later on to make commitments with the whole society.

For this study, an essential point is so-called traditional troublemakers or students' with intellectual disabilities are not the target group in this research. Instead, this study is focusing on young people whose learning difficulties are due to the inability to adjust and benefit fully of more traditional school education without practical connection. Previous study (Autio, 2011) indicates that often young people with special technological talent have limited social abilities which are not helping them to deal with teachers and other pupils in difficult social environments. Even more, quite many teachers don't even notice technological talent and cannot give any support to them. As shown in a study by Järvinen and Autio (2008) over 70 % of teacher training students think, that technological subjects are their weakest point among all school subjects. An essential element in this research is to find out these talents and give them more practical based education to support their talent instead of pointing out all of their problems in other subjects.

The research question in this study was: *how many technological talents can be found among a group of pupils with need for special support in two medium size cities in southern Finland?* Later on, the main objective is to find out practical solutions to support the learning of these students with special need for support by arranging technological based learning environments and finally to prevent the educational exclusion.

2. Technological competence

Technological competence is fundamental to human existence (Burke & Ornstein, 1995; White, 1962). At each stage within the cycle of life, humans continuously strive to acquire new skills or to refine existing ones in the hope that productivity and quality of life will be enhanced. Despite the fact that skilled behavior underlies nearly every human activity, our understanding about the factors that contribute to the attainment of expertise in technology education is far from complete. However some attempts to define technological competence. have been made. For example, based on Dyrenfurth's (1990) and Layton's (1994) work, Autio and Hansen (2002) defined technological competence as an interrelationship between technical abilities in psychomotor, cognitive, and affective areas.

Defining and measuring technological competence as a construct was achieved by extending the work of Dyrenfurth (1990) and Layton (1994). They identified three components that correspond with what the authors considered to be the dimensions of technological competence. The first is technological knowledge. Citizens in a democratic society, according to Dyrenfurth, know something about technological concepts, principles, and connections, as well as the nature and history of technology. This kind of knowing is often referred to in the educational sciences literature as the cognitive domain. Common examples include troubleshooting and understanding a circuit diagram.

The second dimension of technological competence is skill. Technical and technological skills are part of most human activity and are essential for the survival of humankind. These skills are often labeled by psychologists as psychomotor skills and are an important component of technological competence. They involve tactile or kinesthetic ability as well as practical intelligence. Such skills include manual coordination and steadiness when using welding or soldering equipment, for example.

The third dimension is technological will, or being active and enterprising with regard to technology. Technology is determined and guided by human emotions, motivations, values, and personal qualities. Thus the development of technology in society is dependent on citizens' technological will to participate in, and have an

impact on, technological decisions (individual and/or societal). This is the affective or emotional aspect of technological competence. Technological competence, in short, involves a balance between knowledge, skill, and emotional engagement. In its fullest sense it is the act of using human ingenuity or, being ingenious (Hansen, 2007).

In the present study technological competence was defined as an aggregate of the three abovementioned measurements: knowledge, skill, and emotional engagement. This definition has been criticized because it seems to be too simple for defining the complex interrelationship between psychomotor, cognitive, and affective areas. It is also true that in every psychomotor action a certain amount of cognitive thinking and emotional engagement is involved; in addition, every cognitive action always includes an affective element. Simplified definition of technological competence is presented in Figure 1.

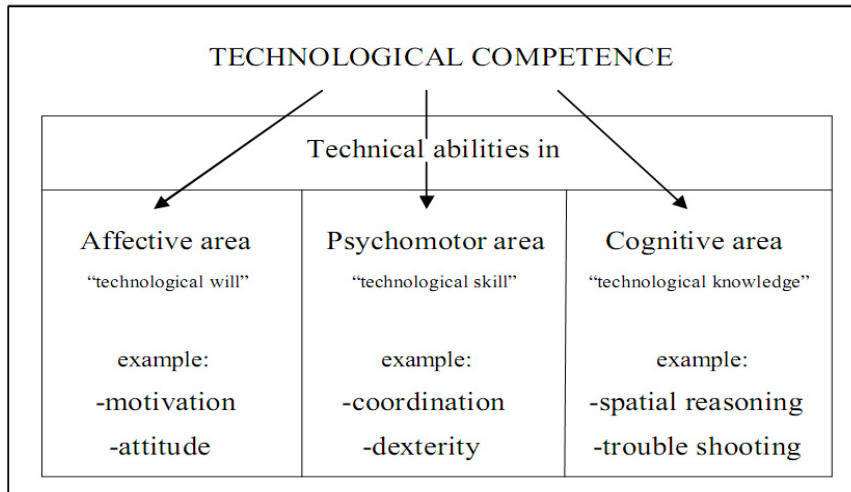


Figure 1. Technological competence (Autio, 2011)

3. Empirical Research

The aim of the empirical aspect of the research was to answer the question: *how many technological talents can be found among a group of pupils with need for special support?*

The main problem from the conception stage of the study was - how is technological competence to be defined and how can it be measured in a way that would be simple, easy to use with large groups, and still be reliable and valid enough to be generalized to other student populations. Furthermore, the test instrument needed to cover all three dimensions (affective, psychomotor and cognitive) of human personality, which are considered outcomes of technology education. However it is almost impossible to separate the dimensions, because in every psychomotor exercise there is a lot of cognitive thinking involved and in every cognitive act the affective domain is prominent.

In this study we used three different test instruments which were developed to measure a) attitudes towards technology, b) technological skill and c) technological thinking. Attitudes towards technology were measured with a questionnaire based on the PATT standards (Pupils Attitudes Towards Technology), which were designed and validated by Raat & de Vries (1986) and van de Velde (1992). Questionnaire was devised, consisting of 14 questions. For each Likert-type item, there were five options, from ‘Strongly Disagree’ (= 1) to ‘Strongly Agree’ (= 5). The questionnaire also featured some questions about students’ backgrounds, in addition to questions that attempted to gauge students’ motivation and success, in terms of craft and technology education classes. Several similar studies in attitudes towards technology can be found in Raat & de Vries, (1985); Boser, Palmer and Daugherty (1998); Bame, Dugger, de Vries, and McBee (1993); and Smail & Kelly (2002). The test

of technological skill was called X-boxes and it was based on the theory of Powell, Katzko and Royce (1978). In the test of motor skills all the elements of bodily orchestration, precision, motor reactivity and dynamism are involved. The aim was to construct as many items as possible in five minutes (final score: the amount of constructed items). The test of technological knowledge consisted of 28 questions related to physical laws in simple machines (final score: the amount of right answers). More information of the test instruments, and other data from previous studies is available in Autio (1997), Autio and Hansen (2002) and Autio (2011).

During years 2012-2013, 357 students took part in the survey. The age of the student-respondents was 12 to 13 years and they studied in Grade 6-7. The students with special need for support were compared to “ordinary” Finnish students in the area of technological competence. The group of students with special need for support was collected from two Finnish middle size towns. The criterion for these techno school applicants was that they had some kind of learning difficulties but no physical handicap. “Ordinary” students were selected from normal Finnish schools about 70% from Helsinki city area and 30% from countryside.

4. Results

When comparing the arithmetic averages in the results of techno school applicants and Finnish “ordinary” students, there is a difference in all items of technological competence. Difference in averages is the biggest and statistically the most significant in case of technological skill and technological knowledge. The average result in the measurement of technological skill was among techno school applicants 3.21 and among “ordinary” students 3.57. In the measurement of technological knowledge the average amount of right answers was among techno school applicants 13.72 and “ordinary” students 15.70. Instead, no statistical difference was found in the measurement of technological will. The average response in our Likert-style (1-5) questionnaire to all 14 items was among techno school applicants 3.71 and “ordinary” students 3.68.

Based on the standard deviations we can conclude that there was more variation in each item of technological competence among techno school applicants. It seems that this is due to the fact that in the group of techno school applicants, some students who have need for special support are not just underachieving but about 30% of them have real learning difficulties due to some intellectual disabilities. Instead, about 30% of techno school applicants performed better than average results in the measurements of technological skill and – knowledge. What is more, about 10 % of techno school applicants performed excellent results when compared to their “ordinary” peers. It seems that especially these students are underachieving in most of the school subjects, which is due to their limited social abilities which are not helping them to deal with teachers and other pupils in difficult social environments.

Hence, the main point in these results is that there was no statistical difference between students with special need for support and “ordinary” students in attitudes towards technology. This means that different practical learning environments and learning by the work would be helpful and motivational for the whole group.

The averages and standard deviation of techno school applicants and “ordinary” students, in terms of the measurement of technological competence are listed in the table 1 below.

<i>Measurement in Technological competence</i>	<i>Techno school applicants 6.-7.grade average (sd)</i>	<i>Finnish “ordinary” school students 6.-7. grade average(sd)</i>	<i>Techno school applicants over Finnish average</i>
Technological will	3,71 (0,60)	3,68 (0,52)	56%
Technological skill	3,21 (2,05)	3,57 (1,82)	32%
Technological knowledge	13,72 (4,12)	15,70 (3,90)	30%

Table 1: Average and standard deviation among techno school applicants and Finnish normal school children, with regard to the measurement of students’ technological competence

5. Conclusion and Discussion

The first step of the study was the quantitative measurement of students' technological competence. The measurement contained three items: the technological will, the technological skill and the technological knowledge as defined in Figure 1. The research question in the empirical part was: how many technological talents can be found among a group of pupils with need for special support in two medium size cities in southern Finland? Based on our results we can assume that 30 % of pupils with the need for special support have better than average technological competence and 10 % achieve excellent results in the technological area. An essential element in this research is to find out these talents and give them more practical based education to support their talent instead of pointing out all of their problems in other subjects.

The theoretical background of the Techno School study is relatively simple. The idea of using Flexible Basic Education content for underachieving pupils is supported by the idea that in that kind of alternative context we can take account the strengths of these pupils. It is a question of a focused intervention in terms of the observed special talent of the target group. On more societal level, this is also an attempt to prevent educational exclusion by using the pupils' own interests and skills in building up the more suitable, alternative learning environment (e.g. Jahnukainen, 2011).

Technology education which was originated over 140 years ago in Finland could provide a good starting point for Techno School. In the beginning, the subject largely focused on students copying artefacts, using a variety of handicraft tools: the purpose of this was to improve their' manual skills, rather than their thinking skills. Since then, the subjects have moved away from craft towards technology, with the aim to increase students' technological literacy. Today, the focus is also on developing students' thinking skills, which enables them to work through various handicraft processes (from initial ideas to the final products). This work is based on the idea generation of students and is thus expected to increase their self-esteem and ingenuity.

Actually, similar ideas as Techno School are been introduced already in the beginning of 1900s when John Dewey introduced his idea of "learning by doing". So far, we are just in the beginning. We are quite sure that we can find enough technologically talented underachievers whose problem is not their academic skills. Instead, their learning difficulties are due to the inability to adjust and benefit fully of more traditional school education. To develop Techno School further and fully benefit from practical learning environments we still need support from school administrators, parents and understanding from the whole society.

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