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Intrinsic and Extrinsic Motivation in Technology Education

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Abstract: The purpose of this study was to determine the elements motivating comprehensive school students to study technology. The research was carried out as a qualitative case study and the material was collected through individual theme interviews. Each test participant represented a different case of motivation towards technology education. In choosing individuals for the study the main criteria were gender, negative or positive motivation and competence in the field of technology. This study found that the artifact to be made in school and the student's freedom of choice had significant effect on motivation in all test participants. Instead, curiosity and intellectual challenge seemed to be the main elements among technological talents. Although, we must be careful with final conclusions as the research group was relatively small, we can conclude that there were more signs of intrinsic motivation among students with high technological competence whereas extrinsic motivation was emphasized in the other students.

Keywords: Technology education, Intrinsic motivation, Extrinsic motivation, Technological talent

Introduction

The term motivation is derived from the Latin verb movere (to move). The idea of movement reflected in such commonsense ideas about motivation as something that gets us going, keeps us moving, and helps us complete tasks (Pintrich & Schunk, 2002). Since the formal beginnings of education (Dewey, 1913), motivation has been viewed as the primary determinant of student learning and school success. Research consistently reveals that motivation is critical not only to current academic functioning, but also to students beliefs in their future success as students and in their expectation of having positive school experiences (Shernoff, Csikszentmiahlyi, Schneider, & Shernoff, 2003). Furthermore, motivation is one lens with which to investigate factors that contribute to students´ interest, engagement and persistence in learning activities (Gilman & Anderman, 2006).

Most contemporary theories tend to emphasize one or more aspects that facilitate this process (Roeser, Strobel, & Quihuis, 2002). Gottfried (1990) used the term academic intrinsic motivation in a broad sense to depict a special kind of motivation for school learning. Academic intrinsic motivation involves the enjoyment of school learning and is characterized by a mastery orientation; involving curiosity, persistence and the learning of challenging, difficult and novel tasks.

Motivation involves goals that provide impetus for and direction to action. Cognitive views of motivation are united in their emphasis on the importance of goals. Goals may not be well formulated and may change with experience, but the point is that individuals have something in mind that they are trying to attain or avoid. Motivation requires activity – physical or mental. Physical activity entails effort, persistence, and other overt actions. Mental activity includes such cognitive actions as planning, rehearsing, organizing, monitoring, making decisions, solving problems, and assessing progress. Finally motivated activity is instigated and sustained. Starting toward a goal is important and often difficult because it involves making a commitment to change and taking the first step. But motivational processes are critically important to sustain action. Many major goals are long-term such as to get good grades to be accepted into college or saving money for retirement (Pintrich & Schunk, 2002).

Deci and Ryan (1985) were interested in whether individuals engage in academic tasks for the intrinsic benefits associated with the task, or in order to receive some type of extrinsic reward. Self-determination theory (SDT)

focuses on the degree to which an individual's behavior is self-motivated and self-determined. SDT posits the existence of three major types of motivational constructs namely intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation refers to engaging in activities for themselves, out of pleasure, fun, and enjoyment. On the other hand, extrinsic motivation refers to engaging in activities for outcomes that are separate from the activity. According to Deci and Ryan (2002) four forms of extrinsic motivation have been proposed.

1. External regulation involves engaging in an activity to obtain rewards or avoid punishment. In this level, students would not be intrinsically motivated or show high interest, but they would tend to behave well and try to do work to obtain rewards or avoid punishment.
2. Introjected regulation refers to behaviors performed to avoid guilt and internal pressure and entails the internalization of past external controls. In this level, students are not doing work solely for the rewards or to avoid punishment. The feeling of guilt is actually internal to the person, but the source is still somewhat external.
3. Identified regulation individuals engage out of choice in the activity that is not interesting per se. In this case, students want to do the tasks because it is important for them, even if it is more of utilitarian reasons, rather than intrinsic interest in the task.
4. Integrated regulation deals with behaviors that while not emitted out of fun, are nevertheless fully internalized in the individuals self and value system. The final level is still instrumental, rather than autotelic as in intrinsic motivation, but represents a form of self-determination and autonomy.

In addition to intrinsic and extrinsic motivation, a third motivational construct is amotivation, which occurs when amotivated individuals do not perceive contingencies between their actions and subsequent outcomes. Amotivation can be seen as the relative lack of motivation to engage in a certain behavior (Vallerand, 1997). Amotivation has been found to typically yield negative outcomes: e.g., anxiety, distraction, dropping out, and negative affect (McDonough & Crocker, 2007; Pelletier, Fortier, Vallerand, & Briere, 2001).

Furthermore, Deci and Ryan (2002) assume that according to basic needs theory (BNT), there are three main intrinsic needs involved in self-determination. The three psychological needs motivate the self to initiate behavior and specify nutriments that are essential for psychological health and wellbeing of an individual. These needs include the need for competence, need for autonomy and the need for relatedness. These needs are seen as universal necessities that are innate not learned and seen in humanity across time, gender and culture (Chirkov, Ryan, Kim, & Kaplan, 2003)

Competence concerns an individual´s need to feel a sense of mastery through effective interaction within their environment. The inherent need for autonomy is fulfilled when people perceive that they are the origin of their choices and decisions, and that they are acting in accord with their integrated sense of themselves. The third need for relatedness, corresponds to feeling securely attached to and being respected by significant others.

Table 1. Simplified descriptions of a behavior in amotivation, extrinsic- and intrinsic motivation

AMOTIVATION *non regulation*	*EXTRINSIC MOTIVATION* *external-, introjected-, identified-, integrated regulation*	*INTRINSIC MOTIVATION* *intrinsic regulation*
COMPETECE		
Do not feel at all competent and experience no success	Feel a little competent in certain environments, but is not able to control possible outcomes	Feel very competent in all environments, is able to control outcomes and experiences success
AUTONOMY		
No autonomy: No sense of having chosen to do the behavior	Very little autonomy: The reason for doing the behaviour is to please friends, parents, teacher etc.	Very high autonomy: Would definitely choose to engage in this behavior anytime
RELATEDNESS		
No relatedness: Do not feel connected to others in context of behavior. Possible feel even unwelcome	Very little or negative relatedness: Do not feel connected to others or feel pressure from friends, parents and society to be in the context	High relatedness: Feel meaningfully connected to others in context

In this study, the elements motivating comprehensive school students to study technology education were classified according to the basic need theory (BNT). After the interviews with test participants, the elements

motivating the test subjects were classified into themes. First theme - need for competence was formed from needs, interest, character, physical abilities, technological talent and personal hobbies. Need for autonomy incorporated for example products to be made in lessons, freedom of choice in materials and techniques, student's internal feedback, and evaluation. Need for relatedness incorporated for example teacher, and teacher – student interaction, classroom atmosphere, parents, and friends.

Methodology

The aim of this research was to examine comprehensive school students´ motivation in technology education and to determine interaction of the elements motivating comprehensive school students to study technology education. In addition, we tried to find out if there was a difference between intrinsic and extrinsic motivation. The main research questions were:

1. What are the main elements motivating comprehensive school students to study technology?
2. What is the main difference in building intrinsic and extrinsic motivation?

The research was carried out as a qualitative case study (Merriam, 1988) and the data was collected from individual theme interviews. The interviews were first tape-recorded and transcribed. Themes were identified and the portraits of each subject established (Lightfoot, 1983). Later the data was analyzed using the content analysis methodology. The analysis was carried out through determining out the interesting and essential elements motivating students in technology education. These findings were later classified by the themes and finally reported in the conclusions.

Case study research excels at bringing us to an understanding about a complex issue or object and can extend experience or add strength to what is already known through previous research. Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships (Stake, 1995). It is correct that the case study is a detailed examination of a single example, but it is not true that a case study cannot provide reliable information about the broader class (Flyvbjerg, 2006).

The test participants consisted of four different students each having a different background in motivation towards technology education. In the choice of individuals to be tested the main consideration was given to gender, technological talent and to negative and positive motivation in technology education.

Three boys and one girl took part in the study. Three of them studied in Helsinki area and one of them in a rural village, which lies about 150 kilometers from Helsinki. In the school curriculums there was nothing different compared with normal Finnish comprehensive schools. At the primary level (grades 1-6) pupils are 7 to 13 years old, at the secondary level (grades 7-9) pupils are 14 to 16 years old and in the upper secondary school pupils are 17 to 19 years old. In grades 1-7, craft and technology education is a compulsory subject, about 2-3 hours a week, even though in grades 1-2 subject contents are closer to hobby crafts. In grades 8-9 and in upper secondary school there is no compulsory technology education, but pupils can take elective studies for about 2-4 hours per week. Since the background of each test subject was somewhat different we named them characteristically as follows:

Subject 1 - rebel
Subject 3 - academic theoretician
Subject 5 - academic multi talent
Subject 6 - non academic technology talent

Result

Since each participant had different experiences in technology education, in the following section we describe each test participant's educational history and the main elements accounting their motivation.

The themes accounting for motivation are described in tables, which show the elements that had the greatest effect (identified with bold and underlined text) as well as elements that had less meaning for the participants' motivation (shown in bold or normal text). The elements may have had negative or positive effects on a participant's motivation. The direction can be interpreted from the context. Besides, the elements with negative effect are marked * in the tables. The significance of the elements is based on the participants' direct comments, which were documented during the interviews.

Subject 1 – Rebel

The first test participant represented a girl who had chosen technology lessons in secondary school. She lives with her mother and older brother. Her mother works in the library and her father is a production manager.

Subject 1 considers technology education important because it is a necessary counterbalance to the theoretical subjects. Her first role model was her grandfather, and she has been interested in technology since childhood. The first noticeable increase in motivation was found when craft and technology classes started in primary school, and she learned something valuable about technology education. Later, there was some reduction in motivation because the new teacher was too domineering and demanding. Yet especially in secondary school the motivation again increased because Subject 1 liked to work with large machines, and there were more materials and interesting projects to choose from. The highest point in her motivation came when she had completed building her electric guitar and took it home. After finishing secondary school, Subject 1 thinks that her activity in technology education will decrease, but that her attitude towards technology in general will remain positive, but diminished.

From the interview we can conclude that Subject 1's motivation in her early childhood was based on external or introjected regulation and her grandfather was a highly valued role model. In the continuum of her motivation sensation seeking seemed to be an interesting element. According to Zuckerman (1994), sensation seeking is a personality feature that shows up in attempts to engage in new, varying, complicated, and intensive experience. In seeking this kind of experience, the person is willing to take physical, social, and financial risks. This kind of behavior is a typical sign of intrinsic motivation among some persons. Building an electric guitar demonstrated such behavior in Subject 1's career in technology education.

Subject 1 remembers the work of making the guitar as the most agreeable project of all. The impressive and valuable product that she had made for her own use motivates her significantly, but also increases her interest in other products. Other main elements in her motivation were classroom environment and the atmosphere of the classes, which was usually relaxed, and the group was smaller than in other subjects. The effect of the school curriculum had also been important because the school has offered a sufficient number of alternatives. Wood-, metal-, and electrical work all belong to the curriculum. In making the electric guitar, for instance, several different skills and materials were combined.

The themes accounting for Subject 1's motivation are described in table 2, which show the elements that had the greatest effect (identified with bold and underlined text) as well as elements that had less meaning for the participants' motivation (shown in bold or normal text).

Table 2. Main elements behind the motivation of Subject 1

NEED FOR AUTONOMY	COMPETENCE	RELATEDNESS / SOCIAL RELATIONS
- **Product /artefact**	- **Needs**	- **Classroom atmosphere**
- **Freedom of choice**	- **Interest**	- **Grandfather**
- **Internal feedback**	- **Physical abilities**	- Parents
- **Evaluation**		- New teacher

Subject 2 – Academic theoretician

The second test subject represents a boy who has not chosen any technology education lessons in secondary school. He lives with his mother and elder brother. Both parents are lawyers and Subject 2 is willing to pursue the same career.

Subject 2 did not have any interest in technology education in early childhood because he was not familiar with it at all. The first remarkable increase in interest and motivation came when technology education started in primary school, and for the first time he learned some valuable technical skills. Later the motivation increased again when he could concentrate more on his own interests. In secondary school, he encountered some difficulties in his work because his skills were limited and the motivation decreased. After finishing school, Subject 2 thinks that he will not have any activities in technology education because he will be concentrating on his academic career. So his motivation to engage in technology education may well reduce close to zero after his school years.

In the continuum of Subject 2's motivation, we can see that he could move from amotivation to identified regulation where individuals engage out of choice in the activity that is not interesting per se. The product to be made and freedom of choice in products and materials seemed to be the main elements in his motivation. Unfortunately, these elements had only a short-term effect on his behavior.

According to Subject 2, technology education is not a significant matter in his life. Indeed, he considers it to be merely the hobby of a small minority of people. At home academic values are also appreciated to a considerably higher degree than vocational education. Subject 2´s thoughts regarding technology education reflect those values and attitudes that come from home. He places value neither on the craft nor on vocational education in the field of technology.

During his first school years, however, Subject 2 liked technology education. Then the product and the freedom of choice were some of his most significant sources of motivation. When he proceeded to more difficult and challenging work, his skills and abilities were no longer enough and his general interest gradually came to an end. The themes accounting for Subject 2´s motivation are described in table 3.

Table 3. Main elements behind the motivation of Subject 2

NEED FOR AUTONOMY	COMPETENCE	RELATEDNESS / SOCIAL RELATIONS
- **Product /artefact**	- **Character** *	- **Parents** *
- **Freedom of choice**	- **Needs** *	- **Friends** *
- Evaluation *	- **Interest** *	
	- Physical abilities *	

* Amotivation

Subject 3 - Academic multi talent

The third test participant spent his first school years in a normal primary school, but at secondary and upper secondary level he studied in Helsinki University Training School, which is one of the highest ranked upper secondary schools in Finland. He lives with his father and mother and one younger brother. Both parents are Masters of Science in technology and they both work in State Technical Research Centre. Also quite many of his older relatives have studied in the University of Technology. So, in this case, the technological talent may have been in genes for a longer time.

Subject 3 became familiar with technology education already in early childhood while he played with Lego and worked with radio controlled (RC) cars. The whole family was very competent in technology and especially mother was very supportive and fixed toys with the children. Subject 3's motivation was based on child's curiosity and he always wanted to know how toys work. Though in primary school he was not especially interested in technology education and he did not think that he learned much valuable skills. At the secondary school level there was more freedom of choice in projects and working was in general more challenging. The whole classroom in technology education was well organized. There were plenty of different materials and machines and tools were in good order. The teacher was also very competent and could create inspiring and open atmosphere, but still the working was based on a rational process with planning, investigation, implementation, and evaluation. It was easy to talk with the teacher and feedback from the teacher was rewarding and developed skills and technical thinking further.

In upper secondary school, he had to concentrate more on academic subjects and he was not at all sure that he will choose a technology related profession in the future. He was interested in physics, chemistry and mathematics, but still he wanted to find a counterbalance between theory and practice. Computers gave him a new change to develop his technological competence without being too theoretical. The themes accounting for Subject 3´s motivation are described in table 4.

Table 4. Main elements behind the motivation of Subject 3

NEED FOR AUTONOMY	COMPETENCE	RELATEDNESS / SOCIAL RELATIONS
-**Curiosity** - **Freedom of choice** **- Process (planning, investigation, implementation, evaluation)**	- **Talent** **- Hobbies (Lego, RC, Computers)** - Interest	- **Teacher** **- Technically oriented and supportive family** - Friends with common interest - Feedback from the teacher

Subject 4 – Nonacademic technology talent

The last test subject studied technology education in primary and secondary school in a relatively small school about 150 kilometers from Helsinki. He lives with his mother and father and had two elder brothers and two sisters. His father works as a taxi driver, but is a main owner of a local bus company. His mother works as a bank officer.

Subject 4 became familiar with technology education already in early childhood while he built with Lego and followed his elder brothers. There were plenty of inspiring stimuli at home. Father had good facilities to work with cars and had different tools of all kind and machines available. Thus the school was the first identifiable element to affect his skills, there was any special increase in his motivation in primary school level. In secondary school, especially electronics gave him some more challenge and in general he felt much better when he had more freedom and his choices were respected, because this was not the case in several other school subjects. According to him, there was always a sufficient supply of materials. Also tools and machines were in good condition in classrooms where technology education was taught. The teacher was also a significant element. He could create an open, intellectually challenging atmosphere.

Subject 4 was gifted with his hands and so he could concretely see his development from his products and he felt comfortable in technology education classes, but still he thinks that his competence and motivation developed even more with his hobbies than in school. When, he was older and more skilful his two elder brothers accepted him to repair cars with them. So his competence developed further and affected his motivation positive.

According to Ryan and Deci (2000) competence concerns an individual´s need to feel a sense of mastery through effective interaction within their environment. Subject 4 is a good example of a student, who usually chooses and prefers subjects and tasks in which they are good and can show their competence (Byman, 2002). Subject 4's motivation in other school subjects was quite low, but in technology education he developed to a level where behavior was internalized in the individual´s self and value system. Research supports this hypothesis in a variety of life contexts (Vallerand, 1997). The themes accounting for Subject 4´s motivation are described in table 5.

Table 5. Main elements behind the motivation of Subject 4

NEED FOR AUTONOMY	COMPETENCE	RELATEDNESS / SOCIAL RELATIONS
- **Product** **- Freedom of choice** - Internal feedback -Working process	-**Talent** -**Interest** **-Needs** - **Hobbies (Lego, cars)**	- **Teacher** **- Atmosphere in technology education lessons** **- Parents and brothers** -Challenging and inspiring working atmosphere

Discussion

Of all the elements in motivation, the freedom of choice and the artefact to be made seemed to have the most remarkable effect on motivation which for its part would have emphasized the external motivation or situational

interest. Nevertheless, it seems that among some students these elements have affected even intrinsic motivation by expanding the amount of internal feedback. Hence, among technological talents, curiosity and intellectual challenge seemed to be the main elements in motivation. According to Deci and Ryan (1985), one way to achieve intrinsic motivation is to expand the feeling of autonomy among students. That is what happens when there is freedom of choice in materials, techniques, and in products to be made. The feeling of autonomy is especially important for older students who want and need more autonomy in their decisions. Some research in other life contexts such as education in general has also shown that high levels of autonomous motivation toward education lead to high academic performance (Burton, Lydon, D´Alessandro, & Koestner, 2006; Gottfried, Fleming, & Gottfried, 1994).

Need for competence: talent, students´ own needs, interests, and technology-related hobbies were definitely more important elements in technology education among technology talents. Instead, these elements may have had a negative effect in motivation among less talented test participants. According to Byman (2002), students usually choose and prefer subjects and tasks in which they are good and can show their competence. It seems that if we ask students to do too difficult tasks in technology education with limited competence, the motivation is based only on extrinsic forms.

Need for relatedness / social relations – for example teacher, teacher–student interaction, classroom atmosphere, and parents were also found to be important elements in all test participants, but not as essential as those elements in need for autonomy and competence. It seems, that classroom atmosphere and teacher-student interaction were more important in making the whole environment suitable than in directly influencing motivation. Reeve, Bolt and Cai (1999) have shown that teachers who support students´ freedom of choice and autonomy in decisions create more intrinsic motivation than those who are willing to control their students. Autonomy support is evident when an authority figure respects and takes the subordinate's perspective promotes choices and encourages decision-making (Ratelle, Larose, Guay, & Senecal, 2005).

In addition, an additional theme that is not directly included in the basic need theory seemed to have an important effect on motivation. The entire classroom environment with available tools and machines appeared to be important for motivation among all test participants. According to the test participants, the classroom in technology education should have enough space for everybody, enough materials, and tools in good order. Deci and Ryan (1985) argue that informal learning environments which offer optimal challenge, plenty of different stimuli, and a chance to feel autonomy achieves effective motivation. According to Stipek (1996), it is even more important to pay attention to provide an optimal and suitable learning environment than to concentrate on students' personal problems in terms of motivation.

Suitable learning environment and atmosphere are seen as typical features of a positive affect. Positive affect for its part facilitates flexible thinking and problem solving, and enhances performance, even where the tasks to be done are complex, difficult and important (Isen & Reeve, 2005). Furthermore, Isen and Reeve (2005) indicate that positive affect does foster intrinsic motivation, and enjoyment and performance of enjoyable tasks, but not at the expense of responsible work behavior in uninteresting tasks that must be done.

Other special elements in motivation – for example values in society, nursery school, grandparents, friends, and group size in the lessons had some effect on motivation among test participants, but proved to be less important in the formation of motivation in technology education in this study. In figure1 the interaction between the main elements of motivation based on the empirical data from the test participants' interviews is presented. The interaction is not self-evident and we must be careful with final conclusions as the research group was relatively small. However, from the test subjects' interviews we can conclude that there were more signs of intrinsic motivation in technological talents test group and extrinsic motivation was emphasized in others.

We can assume that both intrinsic and extrinsic motivation are at first step based on environment which includes: parents, supportive family and tools and machines at school and home. In long term, the most remarkable difference between intrinsic and extrinsic motivation seems to be in interest, curiosity and intelectual challenge. These elements affected hobbies and freedom of choice in several different learning situations at home and in school and finally generated intrinsic motivation. Although, the freedom of choice is important in generating the feeling of autonomy, it is possible that it will lead to situations where the product to be made is the most important element in motivation. In case just the product to be made is more important than interest and intellectual challenge, this will lead to extrinsic motivation. Hidi and McLaren (1990), states that individual interest develops slowly and tends to have long-lasting effects on a person's knowledge and values, whereas situational interest is an emotional state that is evoked suddenly by something in the immediate environment and may have only a short-term effect on an individual's knowledge and values.

Talent, physical abilities, competence and interest were definitely important elements in technology education. However, these elements may have had a negative effect in motivation among less talented test participants. According to Byman (2002), students usually choose tasks in which they are good at. It seems that if we ask students to do too difficult tasks in technology education with limited competence, the motivation is based only on extrinsic forms.

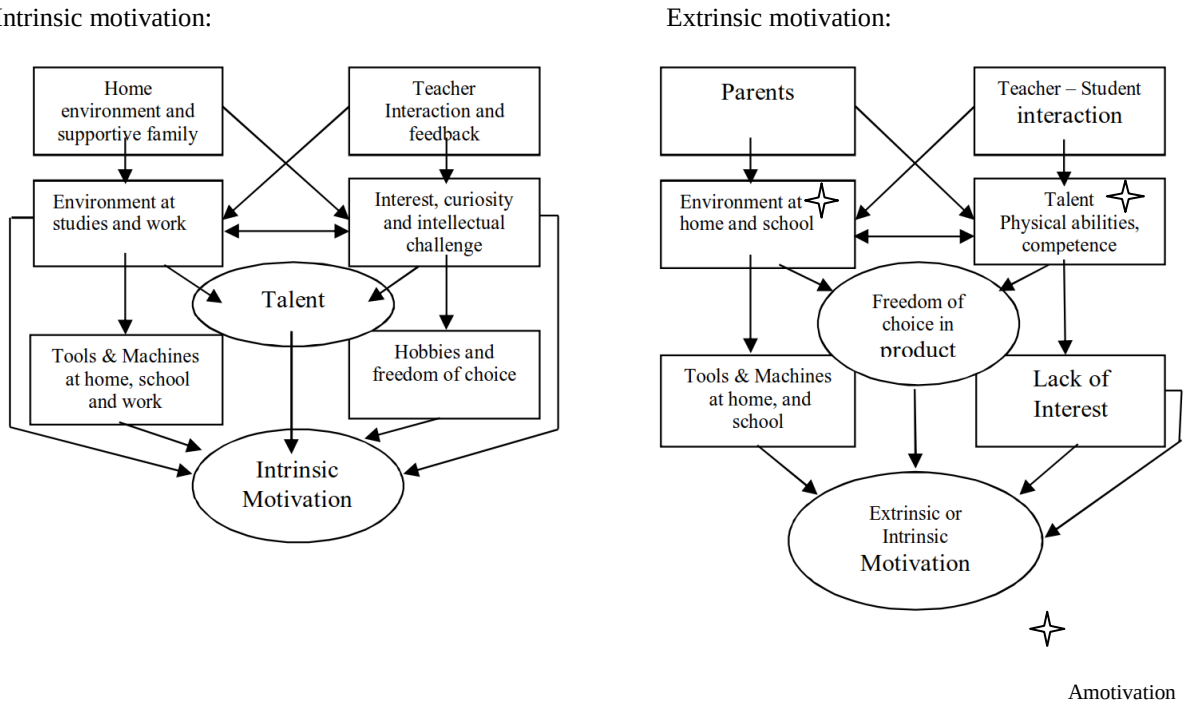

Figure 1. Interaction between the main elements behind intrinsic and extrinsic motivation

Conclusions

For a long time, motivation has been viewed as the primary determinant of students' learning and school success. Motivation is critical not only to current academic functioning, but also to students' beliefs in their future success as students. Although, our research group was numerically small, this fact was noticed in this study as well.

It is not surprising that both boys and girls are attracted to technology education because they enjoy working with their hands and like the independence and chance for creativity provided by these classes (Silverman & Pritchard, 1996). Students who typically enroll in technology education are attracted to the types of projects they will be engaged in (Weber & Custer, 2005). It seems that several other school subjects have more motivational problems than technology education. Additional studies, based on time sampling methods suggest that these negative perceptions are not limited to one or two of the hardest class subjects, but are pervasive across the entire school curriculum (Shernoff et al., 2003). We can assume that all subjects could use more practical methods, which give the students more independence, autonomy and the chance to use their own creativity.

In Finnish schools it appears to be the case that some students value neither crafts nor vocational education. Common opinion is that, the university is definitely a better and more respected place to in which to study than vocational school. Usually, these views of technology education reflect those values and attitudes that come from home, and these attitudes are adopted already at an early age (Autio, Hietenoro, & Ruismäki, 2009). Although an academic career is usually more valued than practical work, there should be a better balance between practical and academic subjects, at least in the lower grades and even at the high school level. On the other hand, motivation in technology education can be significantly improved by developing special programs (Mammes, 2004), where teachers are aware of the differing interests of both genders and consider ways of making the environment and the subject attractive to all (Silverman & Pritchard, 1996).

When teachers try to find ways to promote student's motivation during relatively uninteresting learning activities, they can successfully do so by promoting the value of the task. One way teachers can help students value what they may deem uninteresting is by providing a rationale that identifies the lesson's otherwise hidden value, helps students understand why the lesson is genuinely worth their effort (Jang, 2008).

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