

INTRINSIC AND EXTRINSIC MOTIVATION VERSUS SOCIAL AND INSTRUMENTAL RATIONALE FOR LEARNING MATHEMATICS

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This paper presents and discusses the relation between two different concepts of motivation for learning mathematics: intrinsic and extrinsic motivation as defined in Self Determination Theory and Mellin-Olsen's concept of rationale for learning mathematics. When presenting the two frameworks the author gives examples from her own study in mathematics education. Within Self Determination Theory one suggests that extrinsic motivation varies considerably in its relative autonomy and thus can either reflect external control or true self-regulation. Their detailed description of different forms of motivation makes it possible to discuss the I- and S-rationale for learning mathematics in relation to extrinsic and intrinsic motivation.

INTRODUCTION

Theories of motivation are created to help us explain, predict and influence behaviour. Within psychology, the research field of motivation is enormous. One important approach to motivation has been to distinguish between intrinsic and extrinsic motivation (Deci & Ryan, 1985). In mathematics education there has not been done much work on motivation to date (See Evans & Wedege, 2004; Hannula, 2004b), and only a few researchers have distinguished between intrinsic and extrinsic motivation. Holden (2003) makes a distinction between intrinsic, extrinsic and contextual motivation. She suggests that the students' motivation always is governed by some kind of "rewards". According to her, students who are extrinsically motivated engage in tasks to obtain extrinsic rewards, such as praise and positive feedback from the teacher. The students' intrinsic motivation is governed by intrinsic rewards, which concern developing understanding, feeling powerful and enjoying the task. Students who are contextually motivated are doing something to obtain contextual rewards, such as acknowledgement from peer students, working with challenging tasks and seeing the usefulness of the task. Goodchild (2001) relates extrinsic and intrinsic motivation with ego and task orientation and with performance and learning goals. According to him a student is extrinsically motivated when he is doing something because it leads to an outcome external to the task, such as gaining approval or proving self-worth. A student is intrinsically motivated when he considers the task to have a value for its own sake; he is engaging in the task in order to understand. Evans and Wedege (2004) consider people's motivation and resistance to learn mathematics as interrelated phenomena. They present and discuss a number of meanings of these two terms as used in mathematics education and adult

education. In Middleton and Spanias' (1999) review of research in the area of motivation in mathematics education, intrinsic motivation is defined as the student's desire to engage in learning for its own sake. According to them extrinsically motivated students are doing something to obtain rewards, such as good grades or approval, or to avoid punishment. In Hannula's dissertation his approach to motivation involves needs and goals, rather than intrinsic and extrinsic motivation (Hannula, 2004a).

My aim in this paper is to discuss and make conclusions about the relation between the concepts of intrinsic and extrinsic motivation as defined by Self Determination Theory and rationales for learning mathematics as defined by Mellin-Olsen. First I will give a short presentation of the self-determination view of intrinsic motivation. This perspective is one of the most comprehensive and empirically supported theories of motivation available today (Pintrich & Schunk, 2002, p. 257). Second I describe in detail their model of differing types of extrinsic motivation. Third I present Mellin-Olsen's (1987) concept of rationale for learning mathematics. When presenting the theories I will give examples from my own study in mathematics education (upper secondary level). Finally I will discuss if the concepts of intrinsic and extrinsic motivation as defined in Self Determination Theory can be directly translated to Mellin-Olsen's S- and I-rationale as is usually done in Norway.

MOTIVATION IN SELF DETERMINATION THEORY

Most contemporary theories of motivation assume that people engage in activities to the extent that they believe the behaviours will lead to desired goals or outcomes (Deci & Ryan, 2000). Within Self-determination one is concerned about the goals of the behaviour and what energizes this behaviour. Self Determination Theory (SDT) is founded on three assumptions. The first assumption is that human beings have an innate tendency to integrate. *Integrating* means to forge interconnections among aspects of one owns psyches as well as with other individuals and groups in one's social world:

...all individuals have natural, innate, and constructive tendencies to develop an even more elaborated and unified sense of self. (Ryan & Deci, 2002, p. 5)

Individual's tendency to integrating involves both inner organisation and holistic self-regulation and integration of oneself with others. This assumption of active, integrative tendencies in development is not unique to SDT. However, specific to this theory is that this evolved integrative tendency cannot be taken for granted. The second assumption in SDT is that social-contextual factors may facilitate and enable the integration tendency, or they may undermine this fundamental process of the human nature:

...SDT posits that there are clear and specifiable social-contextual factors that support this innate tendency, and that there are other specifiable factors that thwart or hinder this fundamental process of the human nature. (Ryan & Deci, 2002, p. 5)

In other words, according to SDT, there is a dialectic relationship between an active organism and a dynamic environment (social context), such that the environment acts on the individual, and is shaped by the individual. Within SDT this is called an *organismic dialectic*. The third assumption is that human beings have three basic psychological needs, the need for competence, autonomy and relatedness. According to SDT, the three basic needs provide the basis to categorizing social-contextual factors as supportive versus antagonistic to the integrative process (Deci & Ryan, 2000; Ryan & Deci, 2000a, 2002). Within Self Determination Theory, competence autonomy and relatedness are defined in the following way:

Competence refers to feeling effective in one's ongoing interactions with the social environment and experiencing opportunities to exercise and express one's capacities. (Ryan & Deci, 2002, p. 7, *my italic*)

Relatedness refers to feeling connected to others, to caring for and being cared for by others, to having a sense of belongingness both with other individuals and with one's community. (Ryan & Deci, 2002, p. 7, *my italic*)

Autonomy refers to being the perceived origin or source of one's own behaviour. (Ryan & Deci, 2002, p. 8, *my italic*)

According to this definition, competence is not an attained skill, but it is a felt sense of confidence and effectiveness (effectance) in action. Relatedness reflects the human tendency to connect with and be integral to others. It is a felt sense of being with others in secure communion or unity. When individuals are autonomous they experience themselves as volitional initiators of their own actions. According to SDT, the students' motivation will be maximized within social contexts that provide the students the opportunity to satisfy their basic psychological needs for competence, autonomy and relatedness (Ryan & Deci, 2002).

Internal and external perceived locus of causality are two other important concepts within SDT, and they relate to the need for autonomy. If people perceive themselves as the origin of the behaviour, they have an internal perceived locus of causality. If people believe they are engaging in behaviour to achieve rewards, or because of external constraints they have an external perceived locus of causality (Deci, 1975).

Intrinsic motivation in Self Determination Theory

Self Determination Theory, as many other motivational theories, distinguishes between intrinsic and extrinsic motivation. A person is intrinsically motivated if he is doing an activity because it is inherently interesting or enjoyable. If a person is doing something because it leads to a separable outcome, he is extrinsically motivated (Ryan & Deci, 2000a). Within SDT, *intrinsic motivation* is defined in the following way:

Intrinsic motivation is defined as the doing of an activity for its inherent satisfactions rather than for some separable consequence. (Ryan & Deci, 2000a, p. 56)

Intrinsic motivation reflects the inherent tendency of human nature to engage in activities that are novel and challenging and results in learning and development.

From birth onward, humans, in their healthiest states, are active, inquisitive, curious, and playful creatures, displaying a ubiquitous readiness to learn and explore, and they do not require extraneous incentives to do so. This natural motivational tendency is a critical element in cognitive, social, and physical development because it is through acting on one's inherent interests that one grows in knowledge and skills. (Ryan & Deci, 2000a, p. 56)

According to SDT, if active engagement or intrinsically motivated behaviours are to be maintained, they require satisfaction of the needs for competence, autonomy and relatedness. Research studies within SDT indicate strong links between intrinsic motivation and satisfaction of the needs for competence and autonomy. Results from studies further indicate that relatedness typically plays a more distant role in relation to intrinsic motivation than do competence and autonomy (Ryan & Deci, 2000b, 2002).

Different types of extrinsic motivation

As mentioned earlier, extrinsic motivation refers to the performance of an activity in order to maintain some separable outcome. According to Self Determination Theory, extrinsic motivation can vary greatly in its relative autonomy. *Internalisation* and *integration* are important concepts in describing the different types of extrinsic motivation, and they are defined in the following way:

Internalisation is the process of taking in a value or regulation, and integration is the process by which the individuals more fully transform the regulation into their own so that it will emanate from their sense of self. (Ryan & Deci, 2000a, p. 60)

According to SDT, internalisation is a natural process where the individual tries to transform social practices, values or regulations into personally endorsed values and self-regulation (Deci & Ryan, 2000; Ryan & Deci, 2000a). I interpret regulation to be what regulates, orients or determines behaviour, or in other words, what causes behaviour. SDT assumes the following:

...if external prompts are used by significant others or salient reference groups to encourage people to do an uninteresting activity – an activity for which they are not intrinsically motivated – the individuals will tend to internalize the activity's initially external regulation. That is, people will tend to take in the regulation and integrate it with their sense of self. (Ryan & Deci, 2002, p. 15)

When the internalisation process functions optimally, the individual will fully accept the regulations as his or her own. The regulations will be fully integrated in the self, and through this process the individual will become both self-regulated and socially integrated. However, when the internalisation process is forestalled, the regulations may remain external or be only partially internalised (Deci & Ryan, 2000). In SDT internalisation is seen as a continuum. It describes how people's motivation varies

from amotivation to self-regulated motivation. How autonomous an individual is when acting depends on what extent the regulation of the extrinsically motivated behaviour is internalised. Regulations that are internalised to a small extent provide basis for more controlled forms of motivation. Regulations that are more fully internalised provide basis for more autonomous forms of motivation. SDT have identified four types of extrinsic motivation; external regulation, introjected regulation, identified regulation and integrated regulation (Deci & Ryan, 2000; Ryan & Deci, 2000a, 2002). The four types of motivation are organised in a taxonomy which reflects their differing degree of autonomy. Figure 1 shows the different types of motivation, arranged from left to right in terms of the extent to which the motivation is autonomous or self-determined.

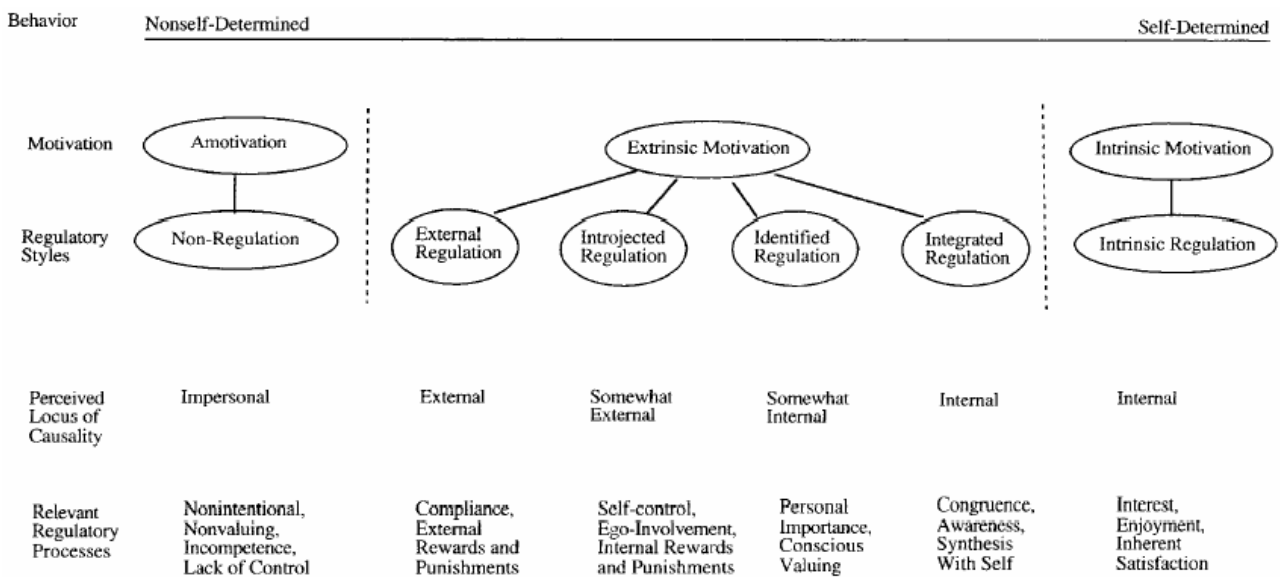


Figure 1: The self-determination continuum showing types of motivation with their regulatory styles, loci of causality, and corresponding processes (Ryan & Deci, 2000b, p. 72).

At the left end of the continuum in figure 1 is *amotivation*. When people are amotivated they lack an intention to act, and either they do not act at all or they act passively. This happens when they are not valuing the activity or the outcomes it would yield, or when they are not feeling competent to do it (Ryan & Deci, 2000a, 2000b, 2002). At the right end of the continuum is intrinsic motivation. Intrinsically motivated behaviours are the prototype of autonomous or self-determined behaviour, because these behaviours are interesting and enjoyable and are performed volitionally.

External regulation

External regulation is the least autonomous type of motivation. It is the classic case of extrinsic motivation in which people’s behaviour is externally regulated by, for example, tangible rewards or threats about punishment. According to SDT, these regulations are considered controlling, and they have an external perceived locus of

causality (Deci & Ryan, 2000; Ryan & Deci, 2000a, 2002). Edith, in my study, is working well in the mathematics lessons, but she is not feeling very competent in mathematics. Her behaviour is externally regulated because her main focus is to get a good grade in mathematics.

Introjected regulation

Another type of extrinsic motivation is introjected regulation. The regulation is partially internalised by the individual but not accepted as one's own. These behaviours are performed with a sense of pressure to avoid guilt and shame and to attain a feeling of pride or worth. According to SDT, the behaviours are considered quite controlling, and they have an external perceived locus of causality (Deci & Ryan, 2000; Ryan & Deci, 2000a, 2002). A classical form of introjection is ego-involvement (Ryan & Deci, 2000a). A student is regulated by introjects if he gets to mathematics class on time to avoid feeling like a bad person.

Identified regulation

Identified regulation is a more autonomous or self-regulated type of extrinsic motivation. If a regulation or goal is personally valued by the individual, and is consciously accepted as one's own goal, the regulation is identified. According to SDT, identified regulation has an internal perceived locus of causality (Deci & Ryan, 2000; Ryan & Deci, 2000a, 2002). Nicole, in my study is working hard with mathematics because she believes it is important for continuing to succeed at mathematics, rather because it is interesting. She believes that mathematics is important for future studies. The regulation for her behaviour is identified because she is doing it for personal reasons.

Integrated regulation

Integrated regulation is the most autonomous type of extrinsic motivation. It does not only involve identifying with the importance of the behaviour, but the regulation is evaluated and brought into harmony with the individuals own personally values, goals, and needs that are already a part of the self (Ryan & Deci, 2002, p. 18). The regulation is fully accepted by the individual. The external regulation is completely internalised to self-regulating, and the result is self-determined extrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2002). According to SDT, integrated regulation has many of the same qualities as intrinsic motivation, but there is one essential difference. When people's behaviour is governed by integrated regulations, they are performed volitionally to attain personally important outcomes, rather than because the activity is inherently interesting or enjoyable. The behaviours are performed to attain a separate outcome where the value of the outcome is well integrated with the self. According to SDT, integrated regulation has an internal perceived locus of causality (Deci & Ryan, 2000; Ryan & Deci, 2000a, 2002). Jennifer, in my study, is very clever in mathematics. Doing well in mathematics is personally important to her. She is working hard with mathematics and focuses on conceptual understanding. The

regulation is integrated and her behaviour is self-regulated, but she is not intrinsically motivated for mathematics. She does not think mathematics is enjoyable or interesting.

The continuum illustrated in figure 1 is purely descriptive. According to SDT, the individual does not need to progress through each stage of internalisation. Internalisation of a new regulation of behaviour may happen at any point along this continuum (Deci & Ryan, 2000; Ryan & Deci, 2002).

ACTIVITY THEORY AND RATIONALITY FOR LEARNING

In the book “The politics of mathematics education”, Mellin-Olsen developed his Activity theory, which is a social theory of learning mathematics. Mellin Olsen argues that if students are going to learn mathematics, they must approach their activity with a rationale for learning. He identifies two rationales for learning mathematics in school; an S-rationale (Social rationale) and an I-rationale (Instrumental rationale). In this section I first present the concepts of Generalised others and Ideology. These concepts are important in understanding Mellin-Olsen’s definition of the rationales for learning mathematics. Second I present the I- and S-rationale for learning Mathematics.

Activity Theory

Within Activity Theory the individual and society are considered a unity. The individual is acting on his society at the same time as he is being socialised to it (Mellin-Olsen, 1987, p. 33). The individual is considered a political individual of the society, and that means that the individual is permitted responsibility for his own life situation and for the society. Activity belongs to the individual and is a way of describing the complete life of an individual:

In the broad sense Activity is the way Man acts in his world, transforms it, and is being transformed himself in a variety of ways. Such transformation takes place in environments which are primarily social. (Mellin-Olsen, 1987, p. 38)

Within Activity Theory, the individual experiences himself through others. Mellin-Olsen (1987) operates with the concept “*the Generalised Other, (GO)*” about all the social groups in the environment that have influence on one owns life. It includes the common attitudes, expectations and reactions as experienced by the individual and which function as a referent for his actions. Usually the individual has a system of generalised others, for example, friends, family, neighbours and school. According to Mellin-Olsen the individual may be exposed to various GOs at the same time, and the GOs may communicate different views. Mellin-Olsen further introduces the concept of *ideology*:

In my use of ideology I relate this construct to the individual, in particular the pupil, as a carrier of ideas developed by him in his social relationships, i.e. the attitudes he has adopted from his GOs. (Mellin-Olsen, 1987, p. 155)

A student's ideology is the ideas the student has developed in his social relationships. Ideology is a dialectical concept. It is a result of the influence by his GOs and his own Activities.

Rationality for learning

To understand why students act like they do, Mellin-Olsen introduces the concept of *rationality for learning*:

The individual's rationale belongs to the individual. It is the way he "chooses" to act in his world under the material and social conditions under which he lives. (Mellin-Olsen, 1987, p. 156)

The rationale of behaviour is the result of the individual's ideology. According to the definition above, the individual's rationale is a dialectical concept. The rationale belongs to the individual, but it is a product of the individual's relations to his system of GOs. Mellin-Olsen claims that several rationales may be present for behaviour. He further emphasizes that the individual is not always acting out of a set of rationales, because the individual is considered to be able to evaluate the effects of his behaviour. Mellin-Olsen identified two important rationales for learning mathematics in school. One of the rationales is called an *instrumental rationale (I-rationale)*, because it works as an instrument for the students. This rationale is related to the school's influence of the students' future, by the contribution of formal qualifications to further studies or professions.

In its purest form the I-rationale will tell the pupil that he has to learn, because it will pay out in terms of marks, exams, certificates and so forth (Mellin-Olsen, 1987, p. 157)

The second rationale, which is called *social-rationale (S-rationale)* is saying that knowledge has a value beyond exams and grades. This rationale includes everything that makes the knowledge so important and interesting for the students that they want to acquire it. The S indicates that the student evaluates knowledge through a reference to his GOs which go beyond the I-rationale. The I- and S-rationale work together, and the student's rationale for learning is considered a result of both rationales. The two rationales mutually influence each other, and the student's evaluation of I- and S-knowledge may change over time.

DISCUSSION

As a starting point for my discussion I will present an example presented by Mellin-Olsen :

Jarle is a son of a doctor. From aunts, uncles, neighbours and teachers Jarle understands at an early age that he most likely is going to study, a thought which he also makes his own. For this reason the S-rationale nevertheless works for Jarle, when the teacher presents equations and the class does not understand at all how this can be useful for them. He knows that some time he will meet equations again, maybe as a necessity to become a doctor. For this reason, Jarle has no difficulty with accepting equations and

how to solve them as a meaningful activity in school. (Mellin-Olsen, 1984, p. 39, my translation)

This example illustrates that the student S-rationale can work even though the student does not experience the activity as enjoyable, interesting or challenging. Jarle considers equations to be important in relation to future studies. A student who is acting from the S-rationale has considered the knowledge, through a reference to his generalised others, to be important and interesting. According to Self Determination Theory, a student will internalise the external regulation of a learning activity if significant other or salient reference groups encourage the student to do an uninteresting activity. Within SDT Jarle's type of motivation will be described as identified regulation. Jarle has recognised and accepted the underlying value of learning equations. He has identified with the value of the learning activity, and accepted it as his own. The behaviour is still extrinsically motivated, because he is not doing the activity for its own sake. Another type of extrinsic motivation that also falls under the S-rationale is integrated regulation, which is the most autonomous type of extrinsic motivation. When a student has integrated a regulation, the behaviour is performed to attain goals that are brought into harmony with the student's values, goals or needs. Both types of regulation have an internal perceived locus of causality. The two least autonomous types of motivation in SDT's model are external regulation and introjected regulation. I consider these two types of extrinsic motivation to be similar to the I-rationale, because in the former case the behaviours are regulated by rewards as grades and exams, and in the latter case to avoid guilt and shame and to attain a feeling of pride or worth. Both types of regulation have an external perceived locus of causality.

My aim with this paper is to be informative, clarifying, and critical. Self Determination Theory model of the different types of motivation makes it possible to place the rationales in relation to intrinsic and extrinsic motivation, and that is what I have done in this paper. The model also makes it possible to be critical to the direct translation from S-rationale and I-rationale to intrinsic and extrinsic motivation as for example Holden does (Holden, 2003). Further, the SDT model made it possible to discuss the relation between the frameworks of intrinsic and extrinsic motivation versus social and instrumental rationale for learning.

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