GOAL REGULATION: NEEDS, BELIEFS, AND EMOTIONS

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Using the theoretical framework of self-regulated learning as a starting point, this article will elaborate students' self-regulation of goals. Three aspects of goal regulation will be discussed within the context of mathematics classrooms. 1) Goals are seen as elements of a needs-goals structure, and goal choices may be derived from needs values. 2) Self-efficacy beliefs are interpreted as beliefs about accessibility of goals. Goal accessibility belief is seen as a necessary, but not sufficient condition for adoption of a new goal. 3) Automated emotional reactions are seen as a possible inertia force. Some qualitative data of a three-year longitudinal study will be presented to illustrate the presented conclusions.

INTRODUCTION

To understand student behaviour we need to know their motivations. In the literature (e.g. Ryan & Deci, 2000) one important approach to motivation has been to distinguish between intrinsic and extrinsic motivation. Another approach to motivation has been to distinguish three motivational orientations in educational settings: learning (or mastery) goals, performance (or self-enhancing) goals, and ego defensive (avoidance) goals (e.g. Linnenbring & Pintrich, 2000; Lemos, 1999). When further elaborated, motivation can be conceptualised through a structure of needs, goals and means (Shah & Kruglanski, 2000). Such construct of goals and goal structures is an important part of the theory of self-regulated learning (SRL) (e.g. Boekaerts, 1999).

The importance of human needs as motivator for mathematical behaviour has been addressed, for example, by Vinner (2000) and Lerman (1998, p. 69). However, in a sample of five PME proceedings, there were surprisingly few papers explicitly on motivation or goals. Yates (1998, 2000) uses motivation (operationalised as task involvement and ego orientation goals) as one variable in a longitudinal survey, and Bikner-Ahsbahs (2001) and Moyer (1999) write about intrinsic motivation (interest) towards mathematics.

This paper will focus on students' goal regulation in mathematics and we shall discuss three aspects that influence students' goal choices. The first aspect is the students' needs. Students' different goal choices can be derived from different needs. The second aspect is students' beliefs – more specifically beliefs about accessibility of different goals. The third aspect is emotions that may function as inertia forces that restrict goal choice changes. Some data of a three-year longitudinal qualitative study will be presented to illustrate the theory.

The main theoretical framework for this paper is self-regulated learning. Boekaerts (1999) presented a three-layer model of self-regulated learning (SRL). Inner layers include choice of cognitive strategies, and use of metacognitive knowledge and skills

to direct one's learning. The focus of this report is in the outermost layer, which includes choice of goals and choice of resources. This least developed area of SRL is essential in understanding student behaviour in classrooms:

> information about ... the goals [students] set for themselves ... provides an indication of *why* students are prepared to do what they do and *why* they are not inclined to do what is expected of them. (Boekaerts, 1999, p. 451)

Although SRL is the main theoretical framework for this paper, the standpoint needs to be specified. For example, Lemos (1999) writes about "internalisation of goals", "non-goal oriented behaviour", and that "strengths of self-directed behaviour lie in its flexibility". Instead of perceiving self-regulation as an advanced learning style, it is seen as a general psychological process that is part of every action. Thus, present approach assumes that student behaviour in classroom is always goal-directed and self-regulated. Students' goals are always self-chosen and internal, and behaviour is always goal oriented. However, the goals may differ from the learning goals set by the teacher and some students may be more flexible in their goal directed behaviour than others. Furthermore, it should be noted that present approach assumes that a lot of self-regulation is automatic and not conscious.

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Goals are part of a structure of needs, goals and means. The structure is personal and dynamic in time. There are individual differences in structure dynamics: some may pursue multiple goals simultaneously and elegantly navigate between them, while others put their goals in serial position and pursue one goal at a time. Students may also decide not to pursue learning goals when they feel that one or more of their psychological needs (autonomy, competence, social belonging) are thwarted. (Boekaerts, 1999)

For the purposes of the present paper we shall distinguish within mathematical behaviour two individualistic needs (autonomy and competence) and two social needs (belonging and status). Autonomy is the need to have a control over own actions and to feel self-determining. Competence is the need to be able to comprehend and influence own environment. Social belonging is the need to be part of a social group, and social status is a social equivalence for competence – a need to have influence within a social group.

As a starting point for goals we take the three motivational orientations: learning, performance, and avoidance. However, we do not regard them as alternative orientations, but as goals that may be pursued simultaneously (the case study below will illustrate this). Thus, when a student is given a mathematical task, he or she might adopt a goal to master the topic, to demonstrate high ability, and/or to avoid public failure. Furthermore, we can use the empirical results by Lemos (1999), who observed and interviewed Portugese sixth grade students. She concluded that students' activities in class could be classified under following goals: working goals, evaluation goals, learning goals, complying goals, interpersonal relationship goals,

enjoyment goals, and discipline goals (in order of decreasing frequency). Some of these goals are on a more specific level, but evaluation goal roughly equals performance goal and learning goal equals mastery goal. Enjoyment, however, should not be accepted as a goal. Emotions regulate goal directed behaviour, and enjoyment is a general reaction that may be related to a variety of different goals (for further elaboration, see Hannula, in print).

Within the goal structure we can distinguish two kinds of relations (Fig.1). Firstly, there are personal beliefs about how goals are related to other goals and different needs. One may perceive a single goal to satisfy multiple needs and a need to be satisfied through multiple goals. Goals may also be seen as contradictory in a sense that reaching one goal might prevent achieving another goal. For example, it is not possible to show high performance without taking a risk of failure. Another kind of relations are the values of needs and goals (seen as comparative evaluations). Needs values are relatively stable characteristics of the personality although when a need is fulfilled at a moment it may be temporarily given lower priority. Goal values are partly derived from respective needs values and partly from the beliefs about how reaching a particular goal will affect different needs and other goals. In the given example (which shall be further elaborated later) the student gives higher value for social status compared to competence. In classroom context this leads to lower derived value for understanding (learning goal) compared to performance and failure avoidance goals.

A second aspect behind goal choices are beliefs about accessibility of goals. This aspect is usually discussed under the term 'self-efficacy beliefs' (e.g. Philippou & Christou, 1999, Risnes, 1998). Here, I only stress the importance of goals in relationship with beliefs. Beliefs as obstacles for an educational change have been discussed by Pehkonen (1999). Furthermore, Lemos (1999, p. 482) pointed that "in the absence of valued personal goals, individual's beliefs do not seem to play a helping role in overcoming stressful situations." It seems, that in order for change to take place two conditions must be met. Firstly, there needs to be a goal that motivates the change and, secondly, one's beliefs must support the change.

Earlier at PME (Hannula, 1998a) the author has reported a case study of a radical change in student beliefs and behaviour that includes these two aspects. Using the present terminology of goals, we may say that the case student had self-defensive goals dominating her behaviour in the beginning ('You don't need math in life'). However, this was later replaced by performance goals ('I will raise my math number'). Behind this change there was a new awareness of the importance of school success in general (change in goal values) together with more positive self-efficacy beliefs (success is possible).

The third aspect to be discussed here are automated emotional reactions as an inertia force to students' goal choices. There are two fundamentally different ways how emotional state may be changed (Power & Dalgleish, 1997). One way is the

(possibly unconscious) cognitive analysis of the situation with respect to one's goals. Another

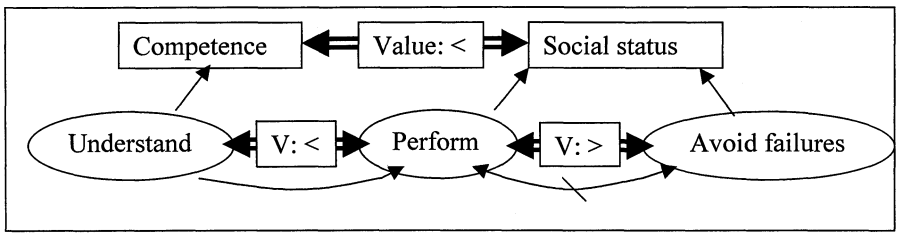

Figure 1. A part of a needs-goals structure. In top row are two needs and their relative value (competence is more important). In bottom row are goals and their values. Thin arrows represent beliefs about the relationships between goals and need.

route to change emotional state is through association to one element of the situation. Emotional associations are learned via classical conditioning and they are the core of attitude as an emotional disposition (Hannula, submitted). Although they allow shorter reaction times to possible threats, they lack flexibility and are an inertia force of behavioural changes. Once formed, these associations are difficult to change. During school years students usually develop some emotional disposition to different mathematical actions and goals. Therefore emotional associations may function as an inertia force against change, even when change would be 'rational'.

METHODOLOGY

There is a serious methodological problem with research on such mental constructs as beliefs and goals. We can't directly access student's all beliefs and goals. Some of the goals and beliefs are always hidden even to the student him/herself and they need to be reconstructed through interpretation of the observable. Even if we succeed in explaining all the utterances and actions of the student, we have constructed only one possible mental configuration behind the observable.

In present study the solution to overcome these methodological problems has been to collect a large and varied data (classroom observations, individual and group interviews, interviewing parents and teachers) on a small number of students. The study was longitudinal (three years) and the researcher interacted a lot with the students as their teacher and thus gained tacit knowledge that has guided the interpretations. Furthermore, the use of multiple frameworks to analyse students' beliefs and attitudes has enriched the understanding of students (Hannula, 1998a; 1998b; 2001; submitted). However, using a broad spectrum of analytical frameworks has its inevitable cost in lack of depth.

SOME DATA

Laura, performance through mastery

Laura was the student whose goal structure was used as an example above (Fig 1). She had been a successful student in elementary school. There she never had needed to prepare for mathematics tests, and it took some time (and unsuccessful tests) before she realised that in secondary school she needed to start working. She thought that studying mathematics was boring at times, but that it was nice in the class when she was able.

One ground to claim that performance goal was more important to Laura than learning goal was that understanding alone was not enough for her. She also wanted to get praises for her good performance.

> "If you have been thinking yourself crazy and if you have got them right, so that makes you feel real good except, if ... you have been thinking really hard, and ... the teacher does not say 'Good!' either."

Furthermore, her best memories in mathematics were when she could outperform the others at school.

> [The nicest thing in elementary school in math was to] "learn addition the first day ... because I could do them all and it was real fun."

There was consistent evidence that the social status was an important need for her. In classroom context she did not get to a leading position and the conclusion adds up from minor events, as a tacit knowledge gained through three years of observation. More explicitly, she expressed her pride and happiness for gaining a leading position in her hobby and her relationship with her younger brother also reflects an enjoyment of having power over others.

> "Maria asked, the other day, advice for what to tell her younger brother, who always is depressing her somehow, saying things like 'I'm better in math than you'. And Maria asks what she can do. I told her to grab him by his shirt tightly and yell: 'I am you elder sister!' [] Maria maybe has not enough charisma to influence him."

Although Laura's main goal was performance, she also had a mastery goal to really understand mathematics, and this goal she approached often with her father.

> ... all the interesting discussions that I have with my father, that why 4*(-4) is not, for example, + 16 instead of -16. And about what is to power of zero, such really interesting issues that I do not comprehend."

In this context she could achieve both need of competence and need of social belonging. This example illustrates how goal choices depend on context and situation.

Above, I have only presented a selected sample of Laura's interviews. That data alone would, of course, be open to several different interpretations. However, the

interpretation that I have presented is supported by further data that can't be presented due to space limitations.

Maria, competence through performance

Maria was another student in the same class, who was mentioned by Laura above. She was a high achiever, and she wanted to be perfect in everything. At primary school she had felt that it had been difficult to keep up the fast tempo that some of her classmates had kept. She also had felt that it had been difficult to avoid mistakes, even though she had understood what to do. She had been bored by calculating long lists of routine tasks, and preferred doing word problems. At grade six she had started to understand mathematics better, had achieved higher, and had started to like mathematics more.

Maria had clearly a performance goal in mathematics, as she admitted in an interview:

> "But usually I like tests, I have always liked. ... Some say that I am the kind of person who likes so much to compete. ... Usually it's nice to show it, when you are good at something."

She did not like group work, because she felt that the others didn't work as hard as she did. Furthermore, when she worked alone, she would get all honour for the result herself. However, Maria did not boast with her success in the class.

Maria had also a mastery goal. She was challenged by more difficult problems even when nobody would know about her performance. She was driven by a will to overcome the challenges and she enjoyed especially tasks where she could see their applicability.

> "I do not know if that is allowed, but I do sometimes look the more difficult tasks" [while others check homework]"

> "[If a task is not solved] I can not go peacefully to sleep, because you still think how it would go."

> "I like [equations], because it feels natural and purposeful when, for example, with world problems you need to think and apply, so it is not only that you move figures, but there is a purpose. Such problem could exist in real life and so it is not just calculations."

My understanding of Maria is that she was, deep inside, uncertain of herself. Therefore she had a strong need to feel competent. Her goal in the math class was to learn and convince to herself that she is intelligent and competent. As a sub-goal she wanted to monitor her own success. Tests and challenging tasks were her way to convince herself that she is doing well enough.

SOME CONCLUSIONS

Altogether eight students' goal structures have been analysed. As a general finding it should be noted that there is great variation in goal structures and they do not

provide easy means for classifying students. As it became evident in cases of Laura and Maria, performance and mastery are not contradictory goals. There also seems to be a developmental trend towards mastery goals. However, we do not know if this is a general developmental trend or due to teacher's efforts to promote such orientation. This development towards mastery goals seems to co-evolve with a view of mathematics as a sense-making activity. As an unsurprising finding we see that avoidance goals occur together with a belief of self as untalented in mathematics.

Three aspects of goal regulation were specified in the theory: deriving goals from needs, the influence of goal accessibility beliefs, and emotions as an inertia force. Within the empirical data it was possible to identify examples of all three aspects. The cases of Laura and Maria were presented as examples of the first aspect.

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