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STUDENTS' SELF-REGULATION AND TEACHERS' REGULATING APPROACHES IN SCIENCE: RESULTS FROM A NORWEGIAN STUDY

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Abstract. *In Norway, the curriculum reform known as 'Knowledge Promotion' emphasizes that teachers should have high ambitions for their students and provide more so-called 'learning pressure' (or academic pressure) in the classroom. This school reform initiated in 2006 puts particular focus on schools' responsibilities for fostering strategies that benefit student learning. This paper reports an empirical study of Norwegian high school students' motivation, learning strategy use and self-regulation in science. It focuses on how students respond to teachers' regulating approaches. The results show that in science classes the goal of teacher mastery seems to have a more positive effect on boys, while girls respond more positively to teachers' academic pressure. Furthermore, ethnic majority students respond more positively to the mastery approach, while the academic pressure approach seems to be more important for ethnic minority students in the science classroom. In conclusion, we argue against the assumption in theoretical literature that academic pressure gives a somewhat one-sided negative effect. This assumption about academic pressure needs to be more nuanced.*

Key words: *self-regulated learning, teacher regulating approaches.*

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Introduction

In 2006 Norwegian education authorities launched a new curriculum reform (officially translated as 'Knowledge Promotion'). The central aim of this reform is to strengthen the learning outcomes of Norwegian students in compulsory education. Part of the background for this reform is the rather low and mediocre Norwegian results in large-scale international comparative studies such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS). In 'Knowledge Promotion', schools are instructed 'to stimulate the students to develop their own learning strategies' (KD, 2006). Furthermore, the teachers should provide more so-called 'learning pressure' or academic pressure (in Norwegian: 'læringstrykk') in the classes and base their teaching on higher ambitions for student learning (White Paper 30, 2003–2004). In particular, The Ministry has developed an action plan to strengthen students' interest in science and mathematics (UFD, 2005).

Against this background, it is of particular interest to study the relationship between teachers' regulating approaches and the responses of students in science. Extensive research has been done on student self-regulation in science from an individualistic perspective, while teacher–student interactions have not been dealt with to the same degree. Furthermore, it is also important to study differential effects on diverse groups of students. This paper addresses gender and ethnic minority/ majority differences in student responses to teachers' regulating approaches in science, based on an empirical investigation conducted in Norwegian high schools.

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Theoretical Framework and Research Questions

The central aspect of self-regulated learning is how the student can master his or her own learning processes (Pintrich, 2000). Self-regulated learning can be seen as a function of learning strategies, motivation, volition and meta-cognition (Wolters, 2003). 'Learning strategies' refers to cognitive processing performed by the student at the time of learning that is intended to improve learning. Motivation, which we define later for the purposes of this article, depends on the student's interaction with the specific content. There exists a clear distinction between motivation and volition (Corno, 2001). During the last few years, volition (or self-discipline) has been the focus of the research literature. Duckworth & Seligman (2006) document that, in grade 8, US girls are more self-disciplined than boys. Self-discipline is even more important for learning if the teacher's control function is reduced. When the teacher's control function is weaker, the students' abilities to regulate their own learning behaviours are even more important to ensure high learning intensity. High learning outcomes in a subject like science are to a large extent dependent on the effort of students and their focused work. Self-discipline has also been shown to be a better predictor of performance than intelligence (Duckworth & Seligman, 2005). Many Norwegian schools now use long term individual work plans for students.

Gender differences in students' learning have been researched for several decades (Meece, Glienke & Burg, 2006). However, there is no agreement about gender differences in the use of learning strategies in science (Meece & Jones, 1996; Ridley & Novak, 1983). One trend in this research, that is also associated with a general motivation for learning, is that when gender differences can be found, they have a tendency to be small in terms of size and cannot be counted as a strong predictor of behavioural response (Meece et al., 2006). Pajares & Valiante (2001) can find no significant differences between girls and boys when it comes to self-efficacy and mastery motivation. However, certain motivational differences can be related to age level, different school subjects, different themes within the same subject, or types of exercises. Anderman & Young (1994) show that girls in general are more learning-focused and less ability-focused in science than boys, in spite of the fact that the selected girls report that they have lower self-efficacy than the boys. There may be complex gender differences in motivation and interest, self-discipline and focus, in addition to the use of learning strategies. Furthermore, studies have also shown that minority students in Norway report higher motivation and more extensive use of learning strategies than majority Norwegian students (Elstad & Turmo, 2007). On the other hand, the minority students tend to receive higher grades than expected, when their, on average, lower socio-economic background is taken into account.

In recent years, Norwegian education authorities have emphasized that teachers should use more learning pressure or academic pressure (in Norwegian: 'læringstrykk') in teaching, and have higher professional ambitions as a basis for teaching. In political documents concerning education in Norway in the 1990s through to 2002, the emphasis was on the teacher as a supervisor or guide. These documents stressed that the student's own desire to learn was the most important part of the learning process. In 2001 the top civil servants in the Ministry of Education declared that the teachers should be 'more like supervisors than lecturers' and that students should 'work independently and in groups with topics they develop themselves' (Kluge, 2001). Similar citations are found in manifold white papers and documents from committees in the Parliament. Current policy documents (White Paper 31, 2007–2008) and research-based literature (Cochran-Smith & Zeichner, 2005) emphasize what behaviour by the teacher ensures the smooth delivery of academic content and allows for effective student academic work.

In this paper our aim is to give a professional contribution to understanding how teachers' regulating approaches in science can influence students' learning intensity and habits. The frequently used words 'learning pressure' (White Paper 30, 2003–2004) are used here without negative connotations. The purpose of learning pressure is to affect the student's choice in a positive manner via the teachers' strategic behaviours. The teacher may compel the student to higher academic ambitions and higher learning intensity. Learning pressure works through persuasion and demands. We want to examine the empirical connections between teacher learning pressure and student motivation, the use of learning strategies and self-regulation in science. We also want to study the significance of the teacher's emphasis on the mastery of a goal in science teaching, and if teachers' regulating approaches influences the study orientations of ethnic minority and majority students differently.

In this paper, a distinction has been made between intrinsic and extrinsic motivation. Intrinsic motivation has no special purpose, in the sense that the activity is carried out for the activity itself, while extrinsic motivation is an instrumental activity in order to reach a goal set by one self or others. Since the 1970s, researchers have claimed that extrinsic motivation undermines internal motivation (Condry, 1977). If the teacher uses external regulation and this regulation is accompanied by the reduction of student self-determination, this will lead to an external orientation and less interest in the subject (Boggiano et al., 1992). A parallel can be found in education policy documents in Norway from the 1990s, where students were 'responsible for their own learning' and where one of the goals was to create 'equality between student and teacher in the democratic learning organization where the students are both creating the terms and contributing'. However, newer documents state that the school must not 'put more responsibility on the students than they can handle' (White Paper 30, 2003–2004:55).

'Learning pressure' is not a term used in research literature, although the term 'academic pressure' is used in Midgley et al. 2000. The term 'pressure' is associated with teachers' regulating behaviour (Lens & Rand, 1997). Rigby et al. (1992) have established distinctions between terms in a continuum between 'external regulation' (characterized by 'pressure and deadlines') and 'integrated regulation'. Somewhere in-between these two extremities are the categories of 'introjected regulation' and 'identified regulation'. 'Introjected regulation' involves an external regulation having been partially internalized, but not in a deep sense; the actions are still controlled by the regulator and have therefore an external perceived locus of causality (Rigby et al. 1992). Regulation through identification is a more self-determined form of extrinsic motivation (the learner identifies with the underlying value of the activity), while 'integrated regulation' involves identifications of the external regulation which is brought into congruence with the student's endorsed values. According to this categorization, if one understands the term 'pressure' in the sense of the teacher being controlling and demanding, it would be an instance of external regulation or 'introjected regulation' (if the student acknowledges the importance of the regulation). These aspects of influence are advantageous only in their anticipation by students. Without committed academic standards that are persuasively communicated, academic pressure lacks potency and credibility. 'Potency' here refers to the teachers' ability to carry out the pressure on a scale sufficient to persuade students. 'Credibility' refers to the students' believing that the teachers' conditioning will be carried out. Lee & Smith (1999) reported that when social support by teachers was present, higher levels of academic pressure nurtured greater learning. We hypothesize that teachers who challenge their students in a positive manner will likely have students who feel that their educators are interested in them.

Mastery goals are those that drive the learner to master and understand a topic. Research has shown that mastery goals are associated with effort and the effective use of learning strategies (Midgley et al., 2001). The influence of teachers on the goal orientations of students can foster mastery of the subject matter. Teacher mastery goal orientation refers to the students' perceptions of a teacher emphasizing the engagement in academic work in order to develop learning and understanding. Teachers that focus on learning and understanding science tend to have students who possess mastery goals (Ames, 1992). The empirical relation between teacher mastery goal orientation and teacher academic pressure orientation is unclear, but it is likely to have a positive association. Many teachers will have a repertoire of different orientations in their teaching.

We know very little about connections between different teachers' regulating approaches and study orientations within ethnic minority or majority groups and genders. For instance, it is possible that teacher academic pressure in science will work differently for girls and boys. It is also possible that teacher academic pressure will work differently among ethnic groups. These types of issues will be discussed and explored in the following sections. Two main research questions are studied in this paper: 1) what relationships can be found between different teacher regulating approaches and aspects of students' study orientation in science? and 2) are there gender differences regarding the above-mentioned relationships; are there differences between minority and majority students?

The purpose of this study is to investigate these research questions and to provide quantitative

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evidence to further the discussion on the influence of teacher regulating approaches. Two different teacher approaches in science are studied: 1) Teacher mastery goal orientation, and 2) Teacher academic pressure orientation. Furthermore, four categories of aspects related to student study orientation in science are included: 1) Student motivation and interest, 2) Student learning strategies, 3) Student self-discipline and focus and 4) Student–teacher interactions. The operational definitions of the concepts will be elaborated in the next section.

Methodology of Research

Empirical data was collected in five high schools in Oslo, Norway in the autumn of 2006. In total, 20 science classes in grade 11 (16- to 17-year-olds) participated. The students were attending a compulsory broad general science course as part of the first year of the academic specialization programme. In this paper, we define minority students by language spoken at home most of the time, as given by the students in the questionnaire. Swedish and Danish languages are very similar to Norwegian, almost like dialects. In the following, we therefore define a minority student as a student speaking a language other than Norwegian, Swedish or Danish at home most of the time. There were 441 majority students and 87 minority students in the sample.

Instruments were developed that aimed to capture as many aspects of student study orientations as possible (both motivational aspects, learning strategies and aspects of student self-discipline). We used three items related to teacher mastery goal orientation. We intended to tap as many aspects of 'learning pressure' (used in White paper 30, 2003-2004) as possible, and nine items related to teacher academic pressure were developed. Several of the items were derived from existing instruments which were translated into the Norwegian language and adapted to the science context (Duncan & McKeachie, 2005; Midgley et al. 2000; Tangney, Baumeister & Boone, 2004). Other items were new developments.

Table 1 shows the reliability of the constructs reported in this paper. The reliabilities are measured using Cronbach's alpha (Crocker & Algina, 1986). In the table, the constructs are sorted into five thematic categories. All the constructs are measured by sets of single items with the same response format: a five point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree). In the table, one example item is given for each construct to illustrate the construct content. The construct values has been generated by assigning the five alternatives numeric values from 1 to 5 (1=Strongly Disagree to 5=Strongly Agree), and then calculating the mean of the single items included in each construct at student level.

Table 1. Reliability of constructs measured by Cronbach's alpha (Crocker & Algina, 1986).

Constructs	Example	Cronbach's alpha
Student motivation and interest		
Mastery motivation in science	It is important for me to learn as much as possible in science this school year.	0.88
Performance motivation in science in relation to other students	One of my goals is to show the other students that the science tasks are easy.	0.78
Interest in science	I think the things we learn in science are important to learn.	0.73
Student learning strategies		
Memorization strategies in science	I try to memorize key words to remember important science concepts.	0.67

Constructs	Example	Cronbach's alpha
Elaboration strategies in science	I try to see connections between what I learn and my previous knowledge in science.	0.65
Critical thinking in science	I often reflect on whether the things I read in the science textbook fit my own views.	0.71
Student self-discipline and focus		
General self-discipline	I often do funny things that are not good for me in the long run (reversed).	0.72
Distraction by ICT	When I work alone on a PC at school, I sometimes do things other than what I should be doing.	0.82
Focus when learning science	I often miss important points in science classes because I think about other things (reversed).	0.68
Teacher regulating approaches		
Teacher mastery goal orientation	My science teacher wants us to understand the science content, not only memorize facts.	0.84
Teacher academic pressure orientation	My science teacher tells the students to work a lot.	0.76
Student–teacher interactions		
Student learning pressure approach	When the science teacher demands a lot from me, I pull myself together.	0.72
Student learning pressure avoidance	When the science teacher demands a lot from me, I become stressed.	0.73
Student preference for teacher academic pressure	The science teacher should tell the students to work a lot.	0.71
Student academic self-handicapping	Some students do the school work in the last minute. If they get a low mark, they say that they did not have time to prepare. How true is this for you?	0.71
Student classroom performance avoidance	In our science class, it is important to avoid not knowing the answers to questions that are asked.	0.65

Results of Research

Table 2 shows the relationships between teacher mastery goal orientation and aspects of students' study orientations in science. The analyses have been conducted for all the constructs in Table 1, but only significant findings ($p<0.01$) are reported in Table 2. The results show that teacher mastery goal orientation is positively related to student mastery motivation and interest in science. There are also positive relationships between this approach and students' use of learning strategies. Regarding the student–teacher interaction constructs, there are only significant relationships for the boys. Boys reporting high levels of teacher mastery approach tend to respond more positively to learning pressure and also have stronger preferences for learning pressure.

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Table 2. Teacher mastery goal orientation. Correlations with constructs related to aspects of student self-regulation in science. Only statistically significant correlations are shown (p<0.01), n=528.

Construct	Correlations - girls	Correlations -boys
Student motivation and interest		
Mastery motivation in science	0.19	0.21
Interest in science	0.35	0.35
Student learning strategies		
Memorization strategies in science	-	0.22
Elaboration strategies in science	0.19	0.34
Critical thinking in science	0.17	-
Student self-discipline and focus in science		
General self-discipline	0.30	0.20
Focus when learning science	0.34	0.28
Student–teacher interactions		
Student learning pressure approach	-	0.42
Student learning pressure avoidance	-	-0.23
Student preference for teacher academic pressure	-	0.22

The overall picture regarding *teacher academic pressure* is that there are fewer significant relationships compared to the findings for teacher mastery orientation. For the girls, the academic pressure is positively associated with critical thinking in science (correlation 0.23). For both genders, this approach is related to greater student learning pressure avoidance (correlations 0.23 for girls, 0.19 for boys).

Table 3 compares the relationships between the two teacher orientations and the self-regulated learning constructs for the minority and the majority students. Only constructs where the correlations are larger than 0.20 for one or both groups are included. Significant correlations (p<0.05) are highlighted. The results show more positive relationships in the majority group for teacher mastery goal orientation, while there are more significant relationships in the minority group for the academic pressure orientation.

Table 3. Relationships between teacher approaches and aspects of student self-regulated learning. Significant correlations highlighted (p<0.05).

	Teacher mastery goal orientation		Teacher academic pressure orientation	
	Maj.	Min.	Maj.	Min.
Student motivation and interest				
Mastery motivation in science	0.20	0.12		
Interest in science	0.33	0.30	0.05	0.30
Student learning strategies				
Elaboration strategies in science	0.25	0.24		

	Teacher mastery goal orientation		Teacher academic pressure orientation	
	Maj.	Min.	Maj.	Min.
Student self-discipline and focus in science				
General self-discipline	0.27	0.18		
Focus when learning science	0.32	0.29		
Student–teacher interactions				
Student learning pressure approach	0.26	0.09		
Student learning pressure avoidance	-0.21	0.03	0.22	0.04
Student preference for teacher academic pressure			0.05	0.27

Discussion and Conclusions

Much of the research on extrinsic motivation in school has dealt with the less fortunate effects of the extrinsic motivation (e.g. Boggiano et al., 1992); the stimulation of students' intrinsic motivation has been considered equally important (McGraw & Cullers, 1979). This somewhat one-sided negative consideration of external regulation (which promotes low-quality learning) is in the process of changing among education researchers (see for instance Harackiewcz et al., 2002). We would argue that we must not end up with conclusions incompatible with the development of flexible and appropriate motivational patterns that can drive forward both short term and long term actions and learning progress. Our empirical findings support the assumption that there are potential positive relations between teachers' regulating approaches and an interest in science. Ethnic minority students seem to respond more positively to instrumental motivation and learning pressure than Norwegian majority students. Furthermore, the study has shown a significant empirical connection between the teacher's emphasis on interest and understanding in science teaching and the students' interest in science, as expected. These are empirical regularities that require follow-up attention in research. We need a finer distinction between the terms covering teacher academic pressure in order to conceptualize students' mental processes. Not every form of extrinsic motivation leads to a situation in which the learning of new material becomes more difficult, as certain writers claim (e.g. McGraw & Cullers, 1979). However, an increase in teacher academic pressure is not entirely positive either. What is needed here is more research to investigate the relationship between academic pressure and motivational aspects and learning results.

In the opinion of some scholars, the degree of self-determination is significant in relation to how 'pressure' can work positively, for instance if regulation is accepted and in harmony with self-beliefs (Rigby et al., 1992), and if it supports autonomy (Vansteenkiste et al., 2006). In our material, positive connections can be found for both boys and girls between the teacher's emphasis on understanding and interest in science on the one hand, and the students' general mastery motivation in science on the other. There are no grounds for claiming that teacher conduct contributes to gender differences in our empirical material, but other studies document gender-specific patterns in classroom interactions (Sabbe and Aelterman, 2007). If we are to find out more about this, we need studies that are more context sensitive.

We have identified a difference between the genders with regard to how girls and boys respond to academic pressure in their schooling. It is very interesting that girls reporting about high teacher academic pressure also make use of critical thinking to a greater degree when learning science. Statistical explanations of this kind have to rely on intuitions about plausible causal mechanisms. Future research is needed to follow up this study to investigate causal explanations and to identify the conditions in which pressure can work positively and negatively on learning progress in science.

This study gives empirical grounds for claiming that students do not perceive every form of academic pressure negatively. Related conclusions are found in Ibanez et al., 2004. One possible interpretation is

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that academic pressure by a teacher influences the attitude of the students; the students recognize the need for a person to push them towards higher achievements and that the students acknowledge that they may benefit from being constrained in their options. This volitional explanation is based on a model of intrapersonal bargaining between a wayward self and a proper self (Elstad, 2008). The assumption in theoretical literature that there is a somewhat one-sided negative effect because of academic pressure has to be more nuanced. The challenge is therefore to try to better understand under what conditions teacher academic pressure works positively and negatively. Teachers who challenge their students may have students who feel that their teachers are interested in them and are therefore nurtured to achieve beyond their comfort zone. An opposite mechanism is possible, for instance, if students are exposed to excessive expectations a sense of uncertainty and vulnerability might be triggered. If the student has a positive attitude towards the teacher exerting the pressure, the student will be able to overcome more easily any negative feelings. Relational trust can be understood as a prerequisite if the teacher wants to exert academic pressure on students to promote greater academic achievement. 'The presence of relational trust … moderates the sense of uncertainty and vulnerability that individuals feel as they confront … demands' (Bryk & Schneider, 2002). This moderation via relational trust is a mechanism, a possible causal pattern, that is triggered (Elster, 2007). Future research should concentrate on identifying and defining prerequisites for pressure to work positively for a diversified student population. Furthermore, knowledge about how pressure can work positively has implications for teachers' professional work in school. What is needed is a better research-based foundation for pedagogical practice.

As our study has shown, students' approval and acceptance of teacher academic pressure can be grouped under categories such as gender and ethnic minority and majority. As has been the case before, these empirical results shed light on some of the complexity in gender-specific attitudes and behaviour, and call for more research that could contribute to a better understanding of the dynamics of student–teacher interaction, and cultural and gender factors.

References

Ames, C. (1992). Classrooms: Goals, structures and student motivation. *Journal of Educational Psychology,* 84, 261-271.

Anderman, E.M. & Young, A.J. (1994). Motivation and strategy use in science: Individual differences and classroom effects. *Journal of Research in Science Teaching*, 31(8), 811-831.

Boggiano, A.K., Shileds, A., Barrat, M., Kellam, T., Thompson, E., Simons, J. & Katz, P. (1992). Helplessness deficits in students: The role of motivational orientation. *Motivation and Emotion,* 16, 271-295.

Bryk, A.S. & Schneider, B. (2002). *Thrust in Schools. A Core Resource for Improvement*. New York: Russel Sage Foundation.

Cochran-Smith, M. & Zeichner, K.M. (2005). Executive summary. In M. Cochran-Smith, & K.M. Zeichner (Ed.) *Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education*. Wahwah, New Jersey: Lawrence Erlbaum associates.

Condry, J. (1977). Enemies of exploration: Self-initiated versus other-initiated learning. *Journal of Personality and Social Psychology*, 35*,* 459-477.

Corno, L. (2001). Volitional aspects of self-regulated learning. In B. J. Zimmerman & D. Schunk (Eds.) *Self-regulated Learning and Academic Achievement: Theoretical Perspectives* (pp. 126–191). Mahwah, New Jersey, Lawrence Erlbaum.

Crocker, L. & Algina, J. (1986). *Introduction to Classical and Modern Test Theory*. Fort Worth, Texas, Harcourt Brace Jovanovich College Publishers.

Duckworth, A.L. & Seligman, M.E.P. (2005). Self-discipline outdoes IQ predicting academic performance in adolescents. *Psychological Science,* 16, 939-944.

Duckworth, A.L. & Seligman, M.E.P (2006). Self-discipline gives girls the edge: Gender in self-discipline, grades and achievement test scores. *Journal of Educational Psychology* 98(1), 198-208.

Duncan, T.G. & McKeachie, W.J. (2005). The making of the motivated strategies for learning questionnaire. *Educational Psychologist*, 40(2), 117-128.

Eccles, J.S., Adler, T.F., Futterman, R., Goff, S.B., Kaczala, C.M. & Meece, J.L. (1983). Expectancies, values and academic behaviors. In J.T. Spence (Ed.) *Achievement and Achievement Motives* (pp. 75–146). San Francisco, Freeman.

Elstad, E. (2007). Building self-discipline to promote learning: students' volitional strategies to navigate the demands of schooling. Learning Inquiry, 2: 53-71.

Elstad, E. & Turmo, A. (2007). Strategibruk, motivasjon og interesse for naturfag: forskjeller mellom minoritets- og majoritetselever *Tidsskrift for ungdomsforskning,* 7(2), 23-44.

Elster. J. (2007). *Explaining Social Behavior. More Nuts and Bolts for the Social Sciences*. New York: Cambridge University Press.

Harackiewicz, J.M., Barron, K.E., Pintrich, P.R., Elliot, A.J., & Thrash, T. (2002). Revision of achievement goal theory: Necessary and illuminating. *Journal of Educational Psychology,* 94, 638-645.

Ibanez, G. E., Kuperminc, G. P., Jurkovic, G., & Perilla, J. (2004). Cultural attributes and adaptations linked to achievement motivation. *Journal of Youth & Adolescence,* 33, 559-568.

KD (2006). *Knowledge promotion-Kunnskapsløftet på engelsk*. Oslo, Ministry of Education and Research.

Kluge, L. (2001). Reformforsøk i 700 skoler. *Aftenposten*, 5, 7:4

Lee, V. E., & Smith, J. B. (1999). Social support and achievement for young adolescents in Chicago: The role of school academic press. *American Educational Research Journal,* 36, 907-945.

Lens, W. & Rand, P. (1997). Combining intrinsic goal orientations with professional instrumentality/utility in student motivation. *Polish Psychological Bulletin*, 28(2), 103-123.

McGraw, K.O. & Cullers, J.C. (1979). Evidence of detrimental effect of extrinsic incentives on breaking a mental set. *Journal of Experimental Social Psychology*, 15, 285-294.

Meece, J.L., Glienke, B.B. & Burg, S. (2006). Gender and motivation. *Journal of School Psychology*, 44(5), 351-373.

Meece, J.L. & Jones, M.G. (1996). Gender differences in motivation and strategy use in science: Are girls rote learners? *Journal of Research in Science Teaching*, 33(4), 393-406.

Midgley, C.,Maehr,M. L., Hruda, L. Z.,Anderman,E.,Anderman,L., Freeman, K. E., et al. (2000).*Manual for the Patterns of Adaptive Learning Scales (PALS).* Ann Arbor: University of Michigan Press.

Midgley, C., Kaplan, A. & Middleton, M. (2001). Performance-approach goals: Good for what, for whom, under what circumstances, and at what cost? *Journal of Educational Psychology*, 93, 77-86.

Pajares, F. & Valiante, G. (1997). Influence of self-efficacy on elementary students' writing, *Journal of Educational Research,* 90(6), 353-360.

Parsons, J.E., Meece, J.L., Adler T.F. & Kaczala, C.M. (1982). Sex differences in attributions and learned helplessness, *Sex Roles,* 8(4), 421-432.

Pintrich, P.R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P.R. Pintrich & M. Zeidner (Eds.), *Handbook of Self-regulation*. San Diego: Academic Press.

Ridley, D. R. & Novak, J. D. (1983). Sex-related differences in high school science and mathematics enrollments: Do they give males a critical headstart toward science- and math-related careers? *The Alberta Journal of Educational Research*, 29(4), 308-318.

Rigby, C.S., Deci, E.L., Patrick, B.C. & Ryan, R.M. (1992). Beyond the intrinsic-extrinsic dichotomy: Self-determination in motivation and learning. *Motivation and Emotion*, 16, 165-185.

Sabbe, E. and Aelterman, A. 2007. Gender in teaching: a literature review. *Teachers and Teaching*, 13 (5), 521-538.

Tangney, J.P., Baumeister, R.F. & Boone, A.L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality*, 72(2), 271-323.

UFD (2005).*"Realfag, naturligvis!" Strategi for styrking av realfagene 2002-2007.* Oslo, Ministry of Education and Research.

Vansteenkiste, M., Lens, W. & Deci, E.L. (2006). Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. *Educational Psychologist,* 41, 19-31.

White Paper 30 (2003–2004). Kultur for læring. Oslo, Norwegian Ministry of Education and Research.

White Paper 31 (2007–2008). Kvalitet i skolen. Oslo, Norwegian Ministry of Education

Wolters, C. (2003). Regulation of motivation: Evaluating an underemphasized aspect of self-regulated learning. Educational Psychologist, 38, 189-205.

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