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"I Just Want The Credit!" – Perceived Instrumentality as the Main Characteristic of Boys' Motivation in a Grade 11 Science Course

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Abstract This case study examines the motivational structure of a group of male students ($n=10$) in a grade 11 General Science class at an independent single-sex school. We approach the concept of motivation through the integration of three different theoretical approaches: sociocultural theory, future time perspective and achievement goal theory. This framework allows us to stress the dialectical interdependence of motivation, as expressed through individual goals, and the socially and culturally influenced origins of these goals. Our results suggest that the boys internalised the administrative description of the course as meeting a diploma requirement, which they expressed in their perception of the course as being for "non-science" people who "just need a credit." However, we also found situational changes in students' motivational structure towards more intrinsic orientations when they were engaged in topics with personal everyday and future relevance. These situational changes in students' goal structures illustrate that our participants did not internalise classroom and school goal messages wholly and, instead, selectively and constructively transformed these goal messages depending on their own motivational structure and beliefs. These results stress the importance of teachers scaffolding not only for conceptual learning but also for student motivation in science classes, especially those that purposefully teach towards scientific literacy.

Key words interest and motivation in science · sociocultural approach on motivation · future time perspective · goals · perceived instrumentality

Science educators and official educational documents, such as the Pan-Canadian Framework (Council of Ministers of Education, Canada, 1997), the Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993), and the National Science Education Standards (National Research Council, 1996), emphasise general scientific literacy and science for all as important and desirable goals for science

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education. Although there are no agreed-upon definitions of scientific literacy or clear instructions for achieving it (DeBoer, 2000), various approaches to teaching and learning science are seen as more significant in encouraging scientific literacy than others. These approaches include student-centered learning (e.g., Von Secker, 2002) and STS education (e.g., Hughes, 2000). In addition, student interest and motivation to learn science are often stressed as important factors in achieving a scientifically literate citizenry (e.g., Häußler & Hoffmann, 2002; Nolen, 2003; Stake & Mares, 2005). Lack of motivation and interest are often blamed when schools or nations are perceived as falling behind in the pursuit of scientific literacy for all (e.g., Riess, 2000).

Despite the obvious importance of motivation in science learning, research on factors influencing motivation seems less favorable among science educators and it is addressed only occasionally (see for example, Lee & Brophy, 1996; Strike & Posner, 1992). This may be a result of a general perception of motivation as an individual psychological characteristic or of the difficulty of assessing motivation. Whatever the reason, responsibility for researching students' motivation to learn science seems to have fallen to educational psychologists (see for example, Anderman & Young, 1994; Pintrich, Marx, & Boyle, 1993) rather than science educators.

We question this approach and thus, in this study, investigate the factors influencing students' motivation in a grade 11 Science class and explore how motivation changes over the course of one school year. We approach this study from the perspective of science educators knowledgeable in educational psychology. A deeper understanding of the factors influencing motivation in learning science has the potential to shed light on students' learning processes and help us as science educators to develop more concrete teaching strategies facilitating student learning. Thus, this study will enrich the discussion on how to achieve scientific literacy in today's science classes through making motivation more transparent for science educators.

Theoretical Framework

As a review of the literature reveals, motivation is a complex phenomenon that is explained through diverse approaches and theories. For example, trait theory views motivation as the sum of trait-like characteristics, such as the need to achieve, that are held by individuals (e.g., McClelland, 1951) while context-specific theories, such as goal theory (e.g., Ames, 1992), concentrate on intrinsic motivation or immediate goals in present tasks or achievement situations. Future time perspective theories focus on the instrumental relevance of goals for the near or distant future (Phalet, Andriessen, & Lens, 2004), and sociocultural approaches (Hickey, 1997, 2003) explain individual motivation as emerging from social practices.

This study combines three theoretical approach on motivation: sociocultural approach, future time perspective theories and achievement goal theory. Each of these perspectives emphasises different aspects of motivation, and it is only in relation to each other that they provide a holistic theoretical framework in which students' motivational structure can be interpreted. This framework allows us to stress the dialectical interdependence of motivation, as expressed through multiple individual goals, and the socially and culturally influenced origins of these goals.

In deciding which theoretical approaches to use, trait theory was not considered an appropriate approach because it assumes that motivation is stable (e.g., McClelland, 1951). Achievement goal theory is addressed because, while it identifies students' immediate goals, it also allows looking at possible changes of goals over time. It is, however, not an ideal approach on its own because it often neglects the instrumental value of goals for the near or distant future (Phalet et al., 2004). Particularly in school learning contexts, students focus not only on the present task but also on their personal future (e.g., getting good grades in order to attend university, or enrolling in particular classes because of future career aspirations). A future time perspective was therefore considered appropriate for this study; however, it still neglects the sociocultural influences on motivation and learning. Sociocultural approaches of motivation (Hickey, 1997, 2003) explain individual motivation as emerging from social practices. Several studies using a sociocultural framework have demonstrated that instructional policies and practices on the school and classroom level affect students' personal goals and achievement (e.g., Ames, 1992; Urdan, 2004; Urdan, Midgley, & Anderman, 1998.) It is, however, far from clear which goal-related messages students filter into their own motivational structure and which ones they ignore.

Sociocultural Approach to Motivation

A sociocultural approach to student motivation recognises students as being embedded in and constituted by social and contextual processes. Tobin and McRobbie (1996) suggest that, in social situations such as the classroom, "participants know how to act in given situations because they have lived their lives in a cultural milieu and have adapted their practices to the cultural myths that constrain what happens" (p. 225.) Thus, in learning contexts, students' motivational structure is influenced by classroom and school goal structures, which are represented by for example, administrative policies, school mission statements and teachers' beliefs about teaching and learning. From this perspective, Tobin and McRobbie describe four cultural myths of the science classroom that are espoused by the teacher and reflected in the students' motivation and perceptions of the course.

Walker, Pressick-Kilborn, Arnold, and Sainsbury (2004) take this approach further by implying that while students are "enculturated" into social and academic practices, the enculturation process is not merely an absorptive one. Instead, enculturation occurs through the transformative internalisation of sociocultural values, such as goal structures that are transmitted through the teacher's pedagogical practices. This means that students do not internalise classroom goal structures wholly. Instead, it is suggested that during the internalisation process students selectively and constructively transform the teacher's goal structures. These are then subsequently externalised as their own motivational goal structure (Lawrence & Valsiner, 1993).

Urdan (2004) suggests that, when internalised, teachers' classroom goal messages are filtered through students' existing motivational orientations, and through their prior beliefs and feelings about themselves, their teachers and their school. In practice, studies recently published in a special issue of The Elementary School Journal (2006) indicate that teachers and administrators can have a positive effect on students' learning and motivation, in particular, when they are aware of the social context of their classroom, of discrepancies between their perception of the social context and the perceptions of their students (Summer & Davis, 2006). Other studies conducted in Finland (Järvelä & Salovaara, 2004; Veermans & Järvelä, 2004) demonstrated that students internalise context-specific motivational goals when confronted with pedagogical practices that are more student-centered and involve low levels of teacher authority.

Based on this research, several questions arise: Are goals and goal messages discussed in the classroom? How do different students in the same classroom perceive goal messages? If students in the same classroom perceive goal messages differently, does this then result in differences in their individual goals? We will address these questions in our study by exploring students' achievement and instrumental goals and the roots of these goals in the school and classroom culture.

Future Time Perspective Theories

Various studies support the notion of a positive influence of future goals in learning contexts (e.g., DeVolder & Lens, 1982; Eccles & Wigfield, 1995; Miller, Debacker, & Greene, 1999; Miller, Greene, Montalvo, Ravindran, & Nichols, 1996; Simons, Dewitte, & Lens, 2000). Being future-oriented or demonstrating a *future time perspective* means that the present task is seen as instrumental in reaching various anticipated future goals (Husman & Lens, 1999). DeVolder and Lens (1982) differentiate between a cognitive and dynamic aspect of a person's future time perspective. The dynamic aspect of future time perspective is a person's disposition to attribute a high priority to goals that can only be reached in the distant future, while the cognitive component of future time perspective is viewed as a person's disposition to see the immediate effect of a potential action in the present as well as its long-term consequences. The latter is operationalised in the literature as *perceived instrumentality*. In this study, we will focus on the cognitive aspect of future time perspective, thus looking at students' perceived instrumentality in science. An example of such a perceived instrumentality is a student's attempts for high grades in biology because she wants to study medicine.

Being future-oriented or perceiving the instrumentality of a present task for future goals or tasks is seen as enhancing students' persistence and performance in present learning contexts. For example, Van Calster, Lens, and Nuttin (1987) found, in their study with grade 11 and 12 students, that students who perceived their schoolwork as important for the future were more motivated than students who perceived schoolwork as less important. Simons et al. (2000) found, in studies with adults and grade 12 students, that when the individual future consequences of a task were stressed, participants were more oriented towards learning than towards performance. Thus, an instrumental relationship between the learning task and a future goal, for example attending university or entering a specific career, has been identified as having an important influence on students' engagement in an activity, their beliefs about their abilities for the task, and their valuing of the task (Miller et al., 1996; Montalvo, Krows, & Miller, 1996).

Perceptions of instrumentality and utility are not, however, always sufficient to maintain interest in school subjects as Creten et al. (1998, cited in Husman & Lens, 1999) demonstrated in a study investigating the motivational function of perceived instrumentality and utility for Belgian students in a low-level vocational school. The study asked whether students who recognised a future relevance (utility value) for learning French were more motivated for the French course than for their practical vocational courses. Students knew that in Belgium, where French is one of the official languages, speaking French is important for life in general and for their future professional careers. Therefore, it is not surprising that they attached a high utility value to this course. Despite this high utility value, students showed more motivation for their practical vocational courses then for their French course or for any of the other "theoretical courses" such as mathematics. Students explained this difference by complaining that the French course content and the way in which it was taught were not motivating. Although we do not know more details about this study, from a sociocultural approach this example potentially demonstrates the importance of the teacher's pedagogical practice on students' expressed motivation. Furthermore, merging a future time perspective with a sociocultural approach, suggests several questions surrounding why students attribute different values to the practical vocational courses and theoretical courses. Do for example, the school and the teachers transmit this message in their classes? How does this lack of motivation influence students' achievement motivation? While we cannot answer these questions for Creten and colleagues' study, they are important questions for our study of grade 11 science students' motivational orientations and will be addressed in this study.

Achievement Goal Theory

During the last 20 years, motivational researchers have developed a deep understanding of motivational behavior in achievement situations, although a variety of models exist to describe such behavior. In this study, we adopt achievement goal theory, in which goals are defined as "cognitive representations that guide behavior in a particular direction" (Elliot & Thrash, 2001, p. 144). Achievement goal theory distinguishes two different types of goals: performance goals and mastery goals. A student shows *performance goals* when he strives to perform better or attain greater skills or knowledge than his peers, thus demonstrating his competence and ability. These goals are often associated with extrinsic motivation, while intrinsic motivation is associated with *mastery goals*, which are related to a student's competence to master a task or a skill, thus to develop and improve her competence (Ames, 1992; Dweck, 1986, Dweck & Leggett, 1988). Various studies have shown that students who hold mastery goals often show greater cognitive engagement and persistence in achievement situations and tasks than those who indicate that they are oriented primarily toward performance goals (Ames & Archer, 1988; Greene & Miller, 1996; Nolen & Haladyna, 1990; Pintrich & DeGroot, 1990).

Numerous researchers (e.g., Elliot & McGregor, 2001; Pintrich, 2000) have extended this classical mastery-performance goal approach with two dimensions of competence. The first dimension describes how competence is defined. This refers to the referent or the standard that students use in performance evaluation. This can be a normative standard (the performance of others), an absolute standard (the requirement of the task itself) or an intrapersonal standard (the student's own past achievement or maximum potential achievement) (Elliot & McGregor, 2001). The second dimension of competence is valence, which refers to the notion that competence is either interpreted in terms of a positive or a desirable possibility (i.e., approaching success) or a negative, undesirable possibility (i.e., avoiding failure) (Elliot & McGregor, 2001). Based on this extension four goals or goal orientation[1] emerge: A *mastery-approach* oriented student is attempting to master or improve at a task or skill; while a student who is *performance-approach* oriented is striving to do better than other students. A student who we would describe as a perfectionist is quite likely oriented towards *mastery-avoidance* goals, thus striving not to fall short of mastering the task or not to lose her skills, abilities, or knowledge. In contrast, the *performance-avoidance* oriented student is attempting not to do worse than others (Elliot & Thrash, 2001).

Studies addressing achievement goal orientation often assume that mathematics and science classrooms are more performance-oriented than for example, English or history classes. Thus, science classes are viewed as focusing on high achievement and performance-oriented tasks resulting in higher performance orientation in students (Pintrich, 2000; Simons et al., 2000). But do students enrolled in science classes adopt these performance goal orientations and if so, to which degree?

[1] The terms goal and goal orientation are used interchangeable in this study, although some researchers distinguish between both based on their theoretical approach.

Synthesis: Research Questions

The achievement goal theory and the future time perspective theory assume that human behavior is shaped by goals. Although we do not question this assumption, we additionally assume that the goals that students adopt are forged by an interaction of personal attributes and environmental factors of the learning context such as the predominant achievement atmosphere, the school climate and the messages that the teacher transmits through her pedagogical practices. Based on this synthesis of theoretical approaches our study is guided by the following research questions:

1. What kind of goals do students adopt in a science class that is promoted as meeting students' need for a senior science credit?
2. Are students' goals influenced by goal messages discussed in the classroom and/or transported through the general school climate and school mission? If so, which goal messages do they integrate into their own goal structure and to which degree do they integrate them?

These questions are investigated using a qualitative case study approach in which various data sources are triangulated in order to ensure the study's credibility.

Methodology

Participants

The study was conducted at Smith Academy, an urban all boys' independent school[2] in Southern Ontario, Canada in a grade 11 General Science course over the duration of one school year. The study was introduced at the beginning of the school year, and all 20 students who were enrolled in the class were invited to participate. We emphasised that participation in the study was voluntary, and only possible with parental consent, which resulted in 13 boys agreeing to participate with parental consent. In the end, however, only 10 boys participated throughout the full school year.

Most of the participating boys were of European descent (8 out of 10); one was Asian and one was Middle Eastern. This reflected, in general, the racial and ethnic distribution at Smith Academy. The boys involved in this study will likely all go to university, and most of them come from high income and upper middle-class families.

Amanda, the teacher of the grade 11 science course, is a biology and geography teacher with more than 8 years of teaching experience in various private schools (a co-educational private school overseas and an all girls' independent school in Canada) prior to working at Smith Academy. During her first year at the school, she volunteered to be part of a joint project between an education department at a Southern Ontario university and Smith Academy exploring boys' learning habits. When we introduced the study at the school, Amanda showed immediate interest. After an initial meeting, she enthusiastically agreed to participate in the project.

[2] In order to guarantee anonymity, the course calendar and other official documents of Smith Academy are not noted in the list of references. Individuals interested in these sources may contact the first author.

Course Design

We developed a curriculum plan for the course in co-operation with the teacher during the summer prior to the start of the course. Based on Amanda's intentions to make students aware "of the importance of science in everyday life" (June, 2004) and the Ministry of Education guidelines for the grade 11 science course (Ministry of Education, 2000), we developed a curriculum that can best be described as taking a student-centered, guided-inquiry approach (Martin-Hansen, 2002). This curriculum emphasised the role of science and technology in daily life and in relation to social and environmental issues. The course units included: nutrition, waste management, space and microgravity, and technologies in everyday life. These topics were taught with a focus on ethical, environmental, and economic issues that involve various societal viewpoints. During these units, Amanda assigned frequent student projects for which she generally chose the topics and the questions. She supplemented student work time with occasional short lectures providing students with information necessary for completing the projects.

An example of a student-guided inquiry task is the assignment "Designing a Game or Website," which was intended to help the students review the content they had learned in the "Body Input and Body Function" unit. Students either in pairs or individually could choose to design a model, visual display, board game or website that would illustrate their knowledge of the composition of food, factors that affect body function, personal health strategies (e.g., dieting, exercise, nutrition), and the social and economic costs and benefits of food processing and preservation. Students' games/websites were formally evaluated on originality, design, instructions or rules of play, and used as a teaching tool for their peers. Another activity, "Design Your Ideal Car," was designed to help the boys learn about some of the causes of air pollution and ways that air pollution can be controlled. This assignment had three different components. First, students were asked to answer a series of questions about the causes of air pollution, air pollution issues throughout the world, technology that exists to reduce pollution, and consumer wants versus consumer needs. In the context of their answers to these questions they were then instructed to design their ideal car, which they then compared to a car currently on the market that uses an alternative form of energy. Finally, based on this comparison, they had the opportunity to redesign their "ideal car" and discuss how the new design changed from the original design. Students shared their designs and their ideas in a teacher-led discussion. Student participation in the class discussion and completion of the activity was recorded but the teacher did not conduct a formal evaluation of the assignment. The activity "Waste Disposal Debate" had the objective of creating awareness about waste disposal issues in the students' local community. Students were given a role to play (e.g., representing a resident, local interest group, environmental organisation, business or industry within the City of Toronto); expected to place themselves in the mindset of the individual or group they were representing; and asked to propose solutions to Toronto's waste production and disposal problems after individual research about this issue. The teacher provided appropriate websites for her students on which they could find the information they needed. In a simulated debate at a town council meeting, students presented their views and solutions. The teacher assessed the students on their arguments, preparedness for the debate, and understanding of the issues of waste management in a large urban center.

Methodological Design

In order to answer the research questions, we chose a qualitative case study research design. Conducting this study in the actual classroom instead of following an experimental approach allows for a holistic and naturalistic inquiry. While an experimental approach has the benefits of focusing only on a few variables, in a naturalistic inquiry the phenomenon and the context are not always distinguishable, resulting in many more variables of interest than actual data points. A case study inquiry allows researchers to cope with such issues because it relies on multiple sources of evidence, which are triangulated to increase credibility, and because prior developed theoretical propositions guide the data collection and analysis (Yin, 2003). Thus, this case study design allows us to develop an understanding of individual students' goals and what influences the adoption of these specific goals. In addition, following a group of students throughout one school year permits us to explore whether and why the emphasis of single goals might change throughout the school year.

Data Collection and Analysis

In order to ensure credibility of this study, data from three different sources were collected and triangulated (Yin, 2003). First, a sequence of semi-structured interviews with the teacher and the students were conducted at three different time points in the school year: at the beginning of the school year (initial interview), at the end of the first semester (mid-interview), and at the end of the school year (follow-up interview). Second, the first author conducted classroom observations on average once per week during 75 min class periods. The observations concentrated on teacher's pedagogical strategies and students' verbal and behavioral responses to these strategies. Finally, official school documents such as the Course Calendar and the Academy's website were analyzed focusing on the school's missions and goals. Using interviews as one method of data collection results in fine-grained contextual information that can then be complemented by the other two types of data.

The student interviews focused on: goal orientations (including achievement goals and perceived instrumentality), interest in the course, and perceptions of the course. Mid- and follow-up interviews explored these areas with regard to the classes and teaching units experienced since the last interview. Some of the students' answers from the previous interview were also read to them. This was done either to ask them to expand on a previous statement if we felt that it was incomplete or unclear, or to explore contradictions or changes in opinion since the last interview. This procedure resulted in rich and comprehensive data collection and in students' on-going reflection on their answers. Examples of student interview questions are listed in Table 1.

The teacher's semi-structured interviews followed a procedure similar to the student interviews: asking a core of questions throughout the school year and building on answers from previous interviews. Examples of teacher interview questions can be found in Table 2.

Both, the student and teacher interviews were audio-taped and then fully transcribed. These transcripts were reviewed line by line. From this detailed reading, sections of text were descriptively coded (Miles & Huberman, 1994). For the student interviews, these first level codes were descriptive statements that often emerged from the boys' own words (e.g. "not motivated because not interested"). From this first level coding, a matrix was created to organise the descriptive codes and representative interview excerpts from each student. The codes were placed into three categories relating to the research questions: goal messages as expressed in students' perceptions of the course, students' perceptions of the utility of the course and its content, and students' goals as indicator for their motivation. Within this matrix, student responses were also organised chronologically (by initial interview, mid-interview, and follow-up interview) so that changes in perceptions and motivation over time could be explored. From this initial descriptive matrix, the selected

Table 1 Examples of student interview questions

Student interview questions
Why did you choose this course?
How do you like your science class?
What do you like the most/dislike the most about your science class, and why?
What would you change in the science class so that it (or the topics are) more interesting?
How are you doing in your science class? Are you satisfied with your current achievement? Why/why not?
What does your teacher/what do your parents think how you are doing in the class? Do you think they are satisfied with your current achievement? Why/why not?
Would you say that you work hard in the science class? Why/why not?
Would you consider a career in science or in a science-related field?

interview excerpts were pattern coded to identify emergent themes related to the research questions (Miles & Huberman, 1994). Through this process, several descriptive codes were subsumed under each pattern code. Both researchers discussed these pattern codes until consensus was reached regarding the descriptive codes that should be included under each pattern code and the relationship of each pattern code to the research questions. From the five pattern codes that emerged, a final matrix was created relating the themes to student motivation.

This analysis was based on Simons et al. (2000) three different types of instrumentality, which combine two different dimensions. The first dimension describes the relationship between a present task and a future task or goal, and the second dimension focuses on the kind of conditions that regulate present behavior in the classroom. Behavior can be regulated externally or internally (Deci & Ryan, 1985). For example, if a student's motive to enroll in the science class is based on the promise of a reward, the motives inducing the behavior are originated outside of the student (externally regulated behavior). In contrast, if a student has enrolled in the science course because she wants to deepen her scientific knowledge, her motives reside within her (internally regulated behavior). Simons et al. argue further that a present task and a future goal can belong to the same motivational category. For example, the student who enrolls in science because she wants to deepen her scientific knowledge is interested in her personal development (internally regulated behavior), and the present classroom task (e.g., ethical discussion of stem cell research) is related to this goal (intrinsic motivation). Simons et al. label this as an *Intrinsic–Internal (I–I) orientation*. Another student who is enrolled in a biology class wants to go to Medical School and needs the course as a prerequisite for this future goal (externally regulated behavior). Although he participates regularly in the course tasks, which are necessary for

Table 2 Examples of teacher interview questions

Teacher interview questions
What are your objectives and goals for this grade 11 science course?
Did your objectives and goals change throughout the course?
Did you experience a discrepancy between your intended teaching strategies and your actual practiced strategies? If so, how did you handle this?
How do you think that the boys perceive your teaching approach?
What would you change if you teach this course again, and how would you accomplish these changes?
How would you describe your relationship to the boys?
How do you see yourself as a science teacher?

achieving the credit, the tasks themselves are not seen as meaningful in relation to the goal (extrinsic motivation). This is labeled as an *Extrinsic–External (E–E) orientation*. The third type of instrumentality encompasses a future goal that motivates extrinsically and regulates present behavior internally (*Extrinsic–Internal or E–I*). For example, a student is enrolled in the science course because she wants to deepen her scientific knowledge (internally regulated behavior). She participates in the course but does not perceive the present classroom tasks (e.g., developing scientific skills) as related to this goal (externally motivated). All interview data were analyzed with respect to these three types of instrumentality.

The teacher interviews were coded in a manner similar to the student interviews with a two-level process involving descriptive and pattern coding. This process concentrated first on the teacher's goal messages as expressed in her own perceptions of the course. These results were then compared with themes emerging from the student interviews.

The data from the teacher and student interviews were then triangulated with the classroom observations and the official school documents emphasising the school's mission and objectives.

Results and Discussion

All data were analyzed with reference to both research questions, and the results of this analysis are presented in the following order: First, we describe Smith Academy's general mission and objectives as presented in official school documents and the official description of the General Science course. This description sets the stage for the presentation of students' perceptions of the course, which are then related to the school's goal messages. This gives an impression of which goal messages students have internalised and externalised in the form of particular motivational goals (Research Question 1). Then, we present the analyses of data collected through the series of teacher interviews and classroom observations describing the teacher's perceptions of the course and thus, her implicitly and explicitly articulated goal messages (Research Question 2). Finally, all results are triangulated resulting in a holistic picture of students' motivational goals and their origins in this particular grade 11 General Science course.

Smith Academy's Mission and Objectives

Smith Academy is a university preparatory school that was founded in 1961 originally as an Anglican Choir School. The school quickly established a strong academic reputation resulting in growth of enrolment and the building of a modern classroom wing complete with science laboratories, library and full-sized gymnasium. The Academy emphasises that a student body of 430 boys from grades 3 to 12 promotes a family-like supportive community and makes personalised courses of study possible. Its mission is to provide "a stimulating and supportive environment, grounded in Christian values" and to instill "in boys the knowledge, skills and adaptability to live a balanced, purposeful and happy life."[3]

Students are expected to continue their formal education after leaving the school and to attend major universities in Canada and the US. For this purpose, the school offers regular university information sessions throughout each school year and invites representatives

[3] Independent schools in Ontario are governed by the Ministry of Education and charge tuition fees. The school's name as well as all students' names and the teacher's name are pseudonyms.

from over 30 Canadian and US universities to speak with the students prior to their university application due dates.

Smith Academy maintains high academic standards and a strong commitment to reinforcing learning behaviors that are necessary for post-secondary studies. For example, in their most recent school course calendar, the school stresses as one of their aims “to develop in students the power of independent reasoning, the discipline of hard work, and the life-long pursuit of knowledge.” The school stresses the importance of self-esteem as a major key to the healthy development of students and strives for this through small class sizes “that give opportunities for the respect and recognition of student achievement.” It places a strong emphasis on the use of computers (each student has a laptop which is used daily in each class) and assists students in developing the ability to evaluate and synthesise information through the research process. The latter is reflected in the variety of research projects that students conduct in their courses and that go beyond the provincial guidelines of one independent study per school year and per course. Based on this philosophy, all senior courses are offered only at the university preparation level and as advanced placement courses. Finally, the school aims to ensure that the boys have “sufficient time to develop academically, athletically, spiritually, and socially.” Besides the provincial high school diploma the school offers a special Smith Academy Diploma that acknowledges a level of achievement that exceeds provincial standards. Additionally, the school recognises academic achievements throughout the school year with events such as “academic breakfasts” for parents and students who are ranked in the top ten based on their overall average on the November or March report cards, or listing of top ten students on either the “Top Ten Board” or “AP Scholar Board.” Although these recognitions of academic achievements are quite common in many high schools, the school climate is saturated with competition in academic and athletic fields. Each student and teacher is affiliated with one of four houses; house teams compete academically, athletically, musically and in drama throughout the school year.

The grade 11 Science General course that is the subject of this case study was being offered at the school for the first time. It was intended to meet the students’ need for a senior science credit while providing an alternative to the typical university preparation courses in physics, chemistry, and biology. Although the science course meets the standards of an academic course, it is not accepted as a prerequisite for studying science at the university level and thus was chosen by students not planning to pursue a career in science. The Ministry of Education (2000) guidelines underline this intention in the first sentence of the course description: “The course enables students, including those who do not intend to pursue science-related programs at the postsecondary level, to increase their understanding of science and its technological applications” (p. 125). This aim was mentioned explicitly to the boys during their course selection process at the end of grade 10. The course was also profiled as an environmental science course with an implicit and probably unintended emphasis on its lower status in contrast to the discipline-oriented science courses. The following analysis of students’ perceptions demonstrates which aspects of the course’ perceptions the boys internalised and how they are transformed and externalised in individual motivational goals.

Students Perceptions and Motivational Goals

The analysis of the series of students’ interviews revealed five major perceptions of the course, which did not change throughout the school year. These major themes were: “Dead-end," "just a credit," "for non-science people," "not a real science course," and "everyday knowledge accumulation" (see Table 3).

The qualitative analysis showed that individual boys did not hold one or two clearly distinguished perceptions; instead they had multiple perceptions in parallel. Based on this result we did not conduct individual analyses; thus, all results reflect the perceptions of the group of participants. Individual student quotes must therefore be seen as particularly expressive examples of the group's perceptions. However, when we found a small number of students who expressed a particular perception that was not shared by the majority of the participants, then we highlighted its specific character appropriately.

Dead-end Course

A large majority of students held the perception of the course as a "dead-end" course, which was close to reality as this course does not count as a prerequisite for any further senior science courses or as a science credit for entrance into university science programs. For this reason, the course itself did not hold any value to the students. They felt that the course itself would not bring them any further to their future goals; however, getting the course credit was important. In describing the course the students said: "It really is a dead-end course" (Leroy, Oct. 17, 2004); "It doesn't lead into anything else next year" (Kalen, Oct. 15, 2003).

This impression appears to have influenced their level of motivation in the course. Students expressed a general desire to achieve respectable grades ("You want a good mark because what's the point of going to school if you don't care about anything, right?" Leroy,

Table 3 Major themes in students' perceptions of the course

Student perceptions of the course	Example	Effect on motivation
Dead-end	"It really is a dead-end course." Leroy (Oct. 17, 2003) "It doesn't lead into anything else next year." Kalen (Oct. 15, 2003)	"Because this course isn't really going anywhere, I don't have much motivation to do well in this course." Leroy (Oct. 17, 2003)
Just a credit	"This is just a way to get my third science course." Leo (Oct. 2, 2003)	"As long as I pass, that's all that matters." Mark (June 1, 2004)
For "non-science" people	"Science is not my strong point. That's why I'm in this science." Kalen (May 28, 2004)	"I have not the determination or drive to pursue anything even closely related to science." Alan (Oct. 15, 2003)
Not a "real" science course	"I guess it's science but it's environmental science. It's not biology, chemistry, or physics, which is 'science–science'." Alan (Feb. 24, 2004)	"I heard some other kids talking about how it would have just been better to take an actual, like a chemistry class or a physics class because it's not-like at the end of the year, what do you have? You have a grade 11 Environmental Science and...you don't get much back from it all." Leroy (May 27, 2004)
Everyday knowledge accumulation	"It's informative. You learn about real life stuff that you need...I didn't know anything about global warming until we studied it, which I used, which I can relate to." Fayad (Feb. 17, 2004)	"I need to be interested in the subject to get the drive to learn about it and then I actually do the work – something that is beneficial for me later on in life." Alan (Oct. 15, 2003)

May 27, 2004), and at the same time reported very low levels of motivation specific to this course because of its dead-end nature:

> Because this course isn't really going anywhere, I don't have much motivation to do well in this course. (Leroy, Oct. 17, 2004)
> I want to get a good mark because obviously a good mark says something but basically I don't care for the course, I care for the mark. (Fayad, Oct. 14, 2003)
> Because I don't need it [for the future], I'm not interested in it...I'm more focused on other courses, this is the least one. (Fayad, Feb. 17, 2004)

As these statements illustrate, the fact that this course led nowhere in terms of their ambitions and interests made it a low priority in students' time management. It also led those students who did express higher levels of motivation to approach the course with a performance goal orientation – achieving good marks but only for the sake of those marks.

Getting a good mark that would improve their grade point average was the primary utility that students attached to the course: "I do care [about the course] but it doesn't matter to me really because I just want to bring my average up" (Fayad, Oct. 14, 2003). Despite the boys' concerns for getting a good mark, this did not result in a performance-approach or avoidance orientation. Although probed during the interview, none of the students expressed striving to do better than their peers or not to do worse than their peers. It seems that this was not part of their goal structure. Students' perception and labeling of the course as a "dead-end" course also underlines the low academic value they associate with it, and gives a first insight into students' internalisation (and externalisation during the interviews) of the school's goal message of academic standard.

Just a Credit

Related to the perception of the course as dead-end, the students also viewed it as just a way to get a required credit (the instrumental value of the course). The students acknowledged that they needed this senior science course in order to graduate: "This is just a way to get my third science course" (Leo, Oct. 2, 2003). The science course was advertised as an environmental course providing the third science credit without the perceived level of stress and high workload associated with the discipline-oriented and university preparation science courses such as chemistry, physics, and biology. Some students internalised these perceptions and this was revealed clearly in their descriptions of the course:

> It's a remedial science class for kids who don't want to pursue science and who need that science credit. And you want them to learn something but you don't want them to kill themselves over something they're not going to pursue later. (William, May 28, 2004)
> I took a science that I don't really need to hurt my brain with. (Daniel, Oct. 17, 2003)
> It's easier than all the other three topics [chemistry, physics, biology]. (William, Feb. 26, 2004)

This "just a credit" perception was related to students' low levels of motivation; it made the course something for the students to just get through: "As long as I pass, that's all that matters" (Mark, June 1, 2004). This perception was also supported in some parents' feelings towards the course as reported by the students. One student described his parents' attitudes by saying, "They know I'm not really into science so they're just like 'Okay, whatever, just get this over with and get good marks in the rest of your classes' " (Daniel, Oct. 17, 2003).

A Course for Non-science People

The students also perceived the science class as a course designed specifically for students who will not continue in science, which conforms to the school's official motive to offer the course instead of assigning students to any of the discipline-oriented university preparation science courses. However, our data reveal that this motive was accompanied by a particular perception: In taking this course, the boys saw themselves as "non-science" people and as such as people who did not want to or were not capable of taking the discipline-oriented science courses. They expressed this by saying:

> Science is not my strong point. That's why I'm in this science. (Kalen, May 28, 2004)
> I recommend this class if you don't like science. (Alan, May 28, 2004)
> We suck at science so we're doing this class. (William, Feb. 26, 2004)
> I think the reason why most people are taking this course is because they're not interested in scientific stuff. (Leroy, May 27, 2004)

These comments indicate that students' disinterest in science was associated with a perception of themselves as not being able to achieve well in science (low self-efficacy), which in return influenced their motivation to participate in the class:

> I have not the determination or drive to pursue anything even closely related to science. (Alan, Oct. 15, 2003)
> I'm taking this course because I don't care.... The main reason why students take this course is that they don't care. (Fayad, June 3, 2004)

Not a Real Science Course

Another theme that derived from students' interviews was their perception of the course as being "not a real science course" because it did not present the rigor or the challenge of a real science course:

> I guess it's science but it's not biology, chemistry, or physics, which is 'science-science.' (Alan, Feb. 24, 2004)
> We haven't been as strict as every other course. It hasn't been so strict on us. There's not a lot of pressure on us because it's not a necessary course. (Mark, Oct. 21, 2003)
> I don't really think of this as a science class. I see this class as just exploring the way things work like landfills and the way the human body works but not as a science class that is building up your skills to go somewhere else because this class goes nowhere. So this is basically a pretty simple science class. (Leroy, Feb. 13, 2004)
> It's more of a compensating course. (William, May 28, 2004)

The boys' perception of the course as being not a real science course was also deduced from their understanding that it would not prepare them for future studies in science; one student (Mark) even felt that scientists would have little regard for this course.

> In [chemistry, physics, or biology] you kind of learn more if you want to take a further course in science in university. You'd learn more ...like about chemicals and different types of equations and that type of stuff that concerns scientists or anything else along those lines. Whereas in this class, you don't really need to learn that. (Daniel, Feb. 24, 2004)
> Scientists are men in lab coats and...they don't think too highly of this course. (Mark, Oct. 21, 2003)

This perception reveals a negative or inverse instrumental value of the course. The boys felt that they did not get anything out of the work that they put into the course and that it did not bring them the benefits that a "real" discipline-oriented science course would bring:

> I heard some other kids talking about how it would have just been better to take an actual, like a chemistry class or a physics class because ... at the end of the year, what do you have? You have a grade 11 Environmental Science and...you don't get much back from it all. (Leroy, May 27, 2004)

Everyday Knowledge Accumulation

The final major perception that students expressed is closely related to their understanding of the course as being a "not real science course." This perception is a kind of paradox. On the one side, students viewed the course as having low status, as being not a real science course, and for non-science people who are less able to learn science. This was reflected in the course topics, which they perceived as "everyday" and "practical," thus not academic: "Compared to what science was last year, it's not science. It's just like common knowledge I guess" (Alan, May 28, 2004). On the other side, students developed a strong interest in these everyday and practical topics:

> It's basically stuff we can use in our life and not garbage that I don't need to know. (Fayad, Oct. 14, 2003)
>
> This gives us more of a lifelike situation for us that don't really want to go into science. It kind of gives us a bit of what's going on right now and maybe we can do something to help. (Daniel, Feb. 24, 2004)
>
> It's mostly important for me. Some of the things, like to do with sports nutrition or how the body works. So if you get injured you're not doing something that will aggravate it or nutrition so you're eating properly when you're doing an activity. (Darren, Feb. 24, 2004)

Thus, the boys' achievement goal orientation changed from a performance to a "situational" mastery goal orientation. When they felt that a certain topic had relevance for their future lives, then they were interested in it and also wanted to develop competent knowledge in it. In addition, a couple of students highlighted the importance of gaining knowledge in particular topics for use in their future lives as lawyers, businessmen, and informed citizens indicating a strong future utility value:

> For business, that I might go into, it would be a lot more useful [than chemistry, physics, and biology] for general talk with anybody. (Daniel, Feb. 24, 2004)
>
> I think it's important because you want to have some sort of knowledge and background of what makes the earth do this. You don't want to be watching the news and not know what they're talking about when they're relating environmental issues. You want to actually know what's going on so you can have an opinion. (William, Feb. 26, 2004)

The perception of the course as a way to develop everyday knowledge increased the boys' motivation and generated situational interest in areas such as nutrition and pollution:

> I need to be interested in the subject to get the drive to learn about it and then I actually do the work. [It has to be] something that is beneficial for me later on in life. (Alan, Oct. 15, 2003)

But when specific topics were not perceived as useful or interesting (low utility value), motivation decreased.

> I'm not really into the whole sci-fi thing so I probably won't have an interest in [the space unit]. And because of that I won't do my homework and I'll probably get a bad mark in it. (Alan, Oct. 15, 2003)

These comments illustrate a close relation between situational interest as an interest that is topic related (Ainley, Hidi, & Berndorff, 2002) and extrinsic motivation.

For other students, the perception of the course as accumulation of everyday knowledge reinforced ideas of it as an easy course.

> It's more general knowledge which is easier to think about than doing all these equations and memorizing a whole bunch of stuff. It's a lot easier on my brain. (Daniel, Feb. 24, 2004)

But for some of these students, the perception of ease was associated with decreased motivation because they felt like they did not need to try.

> It's kind of hard to do a good job because it's so easy to just do a bad job. You can just go right through it. – I think everybody understands it. Since they understand it right away, they don't spend much time on it and then they just forget it because it's easy. (Leroy, Feb. 13, 2004)

Students' Perceptions in the Context of a Sociocultural Approach of Motivation

The various themes of the boys' perceptions ("dead-end," "just a credit," "for 'non-science' people," and "not a real science course") emphasise how deeply they internalised the official perceptions of the course up from the start of the school year. At the same time, the boys used these perceptions as a justification for why they put only a minimum of effort into it. The course does not count as a prerequisite for any of the subjects that they want to study at university, it "only" gets them there; so why put more then the minimum of work into it? This pragmatic approach is also linked to another perception: the idea of not being able to do the real science. If they were capable of doing science, then they would not have enrolled in this "not a real science course" or "course for non-science people," instead they would have enrolled in any of the discipline-oriented courses. This perception reflects how deeply students internalised the school's mission of high academic standards, which values only university-preparation courses such as the science discipline-oriented courses, positively and views them as the standard of imparting academic knowledge. Yet, students' perception does not only reflect the Smith Academy's official mission or the Ministry of Education course description, it also reflects two socioculturally determined public views: First, of science as a subject for only smart people (Bell & Lederman, 2003) and second, that an understanding of environmental or socio-scientific issues (Sadler & Zeidler, 2005) such as global climate change, land-use decisions, cloning or stem cell research as not being real science. However, it was these topics that sparked the students' interests and motivated them to develop an understanding about topics that had relevance for their future lives, which then resulted in a *situational change* of their goal structure. This situational change did not, however, result in a change of the boys' general motivational goal structure. Instead, their perception of these topics as easy and everyday, their internalised socioculturally determined view of science, and their internalised school mission were more powerful messages and were incorporated into the students' motivational goal structure.

Students' Motivational Goals in the Context of Future Time Perspective Theory

In the context of perceived instrumentality or future time perspective, our data revealed that the boys were, in general, extrinsically motivated and their motivation was externally controlled. Simons et al. (2000) describe this instrumental perspective as an E–E orientation (see Table 4). As seen in the boys' comments, they sought the course credit and a decent grade that would bring up their grade point average. These are purely extrinsic rewards. Our group of students was not driven by intrinsic reward; none of them saw the value of the course in developing his personal or professional life. The boys' motivation was, in general, also externally regulated. In the context of Simon and colleagues' framework, this means that the tasks that the boys completed to receive the reward were not related to the nature of the reward itself. In this sense, the tasks themselves are not motivating; they are merely a means to an end.

An important result of this study, however, is that during particular course topics the students temporarily shifted towards an I–I orientation (intrinsically motivated and internally regulated) or an E–I orientation (extrinsically motivated and internally regulated). The boys expressed an increased motivation during topics that seemed particularly interesting or useful in their everyday or future lives. During these topics, their motivation centered on their desire to learn and to understand the material (mastery orientation) rather than just to get through and to get the credit (performance orientation). The material itself was temporarily the reward rather than the course credit or the mark. In some cases, the students saw the activities that they were completing as being directly related to the reward of being an informed citizen, lawyer, or businessman (I–I). For example, when debating and discussing environmental issues with each other, they were acting in the same way that they hoped to act in the future. In other situations, the boys conducted activities that would led them to the desired knowledge but the activities themselves were not related to what they hoped to do with the knowledge in the future (E–I). This orientation was expressed particularly in relation to research activities that students completed on the Internet. The activities were seen as a way to build knowledge that they perceived to be useful but the activities were seen as merely a way to achieve that knowledge. This result is, as discussed previously, an apparent reflection of the boys' internalisation of one of the school's goal messages: the strong emphasis on "the use of computers to access, retrieve and manipulate

Table 4 Instrumentality types and their application to this course

Instrumentality types and their applications
E–E: Extrinsically Motivated and Externally Regulated
External rewards (e.g., credit, "decent" grade)
Consequences or goals not related to the task (e.g., the tasks necessary for getting a good grade or passing are not related to the actual achievement of a credit or a grade)
I–I: Intrinsically Motivated and Internally Regulated
Internal rewards: personal or professional development (e.g., becoming a knowledgeable citizen, lawyer, businessman, etc.)
Tasks related to the consequence or goals (i.e., the task itself is motivating) (e.g., discussing or researching topics in class is acting like a knowledgeable citizen)
E–I: Extrinsically Motivated and Internally Regulated
Internal rewards (same as above)
But achieving these rewards provides extrinsic motivation for completing tasks not directly related to the consequence or goal (e.g., the class activities are perceived as being different than acting like a knowledgeable citizen but skills developed will lead to becoming a knowledgeable citizen)

data" as described in Smith Academy's senior school course calendar. Although avid computer use seems normal for students of this age group and therefore has to be discussed with caution, it should be noted that, despite other less topic-oriented uses, the boys made particular use of their laptops and the internet as tools for information gathering.

It is important to note that this shift towards I–I and E–I orientations during certain topics did not change the dominant E–E orientation (extrinsically motivated and externally regulated) that the boys expressed throughout the course. However, even in a course that is presented to and perceived by students to be designed specifically for the purpose of achieving an external reward (a necessary credit), interest in topics that are perceived to be useful and valuable can have an effect on students' motivational goal structure. Our results do not confirm Simons et al. (2000) assumption that the instrumentality of an activity for a person's future makes an initially extrinsic reward internally rewarding in the long run resulting in a shift from performance orientation to learning orientation. But our results suggest that motivation in science can change temporally depending on the topic or learning situation, and thus seems to have a situational component.

Teacher's Perception of the Science Course

Similar to the students' perception of the course, the teacher's perception was stable throughout the school year. The series of interviews reveal one major theme with which Amanda struggled throughout the school year: her intended teaching approach and her actual practiced teaching approach. This struggle was a result of the boys' motivational pattern in the course, which in return was a result of their perception of the course as dead-end, just a credit course, a course for non-science people, not a real science course, and as accumulation of everyday knowledge. Thus, her teaching practice was closely related to how she perceived the boys' behavior and motivation, and at the same time it discloses her perceptions of the course. These perceptions were a reflection of the general Ministry of Education goal message of the course as fulfilling university requirements for students who do not intend to enroll in science or a science related field at the university. Amanda expressed this general goal of the course explicitly during our meetings in which we outlined the course prior to the start of the school year. Furthermore, this goal determined her perceptions of her future students as academically highly motivated but not interested in science. The latter resulted in her major objective of the course being to make the students aware "of the importance of science in everyday life" (June, 2004). Without the pressure of applying high academic standards to the course, Amanda was able to give the course her own direction within the scope of the official curriculum. This is particularly reflected in her intended teaching approach.

Actual Teaching Practice Versus Intended Teaching Approach

During the initial interview Amanda described her desired teaching practice as a student-centered and guided-inquiry approach:

> A classroom where instruction time is relatively short...a lot of group work where the kids get to talk about what they're doing...have time to talk about something and then bring it back together at the end. (Oct. 15, 2003)

The teacher's role in such an approach was to provide the students with a glossary of short definitions of major scientific terms either in a short lecture or through referring to various textbooks (the course did not have one specific textbook). Such "basic knowledge" as she labeled it, also included scientific concepts but without contextual embodiment. Students would then apply these definitions to inquiry projects in order to understand them, "to see how it works," and thus to put flesh to the context-free concepts and definitions in order to develop meaning. When probed further, Amanda gave an example of how this would look in describing a previously taught lesson sequence:

> Well, I guess, for instance when I did that car experiment they [the students] had a chart where they had to write down the textbook definition of the five principles that they would be used in the car...and then they had to think about how that applied to their actual car...and think about how it works. (Oct. 15, 2003)

She stressed that such an approach would help students to understand the definitions instead of memorizing them. This approach implies a mastery goal orientation. Amanda expects her students to take the initiative to develop their understanding through discussions and group activities and to contribute their knowledge to a debriefing at the end. It also requires that the students themselves share a mastery goal structure, and thus are engaged in learning in order to develop an understanding and not (only) to get a good mark.

Throughout the school year, however, Amanda struggled with her ideal teaching approach and the reality of the classroom. She realised that the students were not prepared for the open-ended nature of the tasks; they were used to guided, step-by-step approaches in their previous science classes, which do not require a mastery orientation. Amanda responded to this challenge by choosing the questions of students' investigations and facilitating the students more closely in their decisions on how to proceed with the investigation. This was not, however, enough guidance. The boys lacked skills and motivation: to search logically for information on the internet despite their high interest in searching on the Internet as was noted during the classroom observations, to summarise major aspects of an Internet site, and to structure their reports and oral presentations. She did not feel that they were completing these assignments with care and were therefore not developing their understanding in the way that she had hoped.

Furthermore, Amanda's original attempts to have boys work in groups were not successful because in the science class the boys had difficulty discussing the tasks and dividing responsibilities equally. The following episode noted during a classroom observation six weeks into the school year highlights students' lack of desire to learn independently and also describes how Amanda reacted to students' behavior. During this period, Amanda had given students a written task related to their ideal car project, in which they were supposed to describe five principles that they considered when building their ideal car, such as center balance and friction. They worked in groups of four for approximately 20 min when Amanda stopped the activity realising that none of the groups actually had done anything. She expressed her frustration with their work ethic and asked them why they were not able to finish the task. Most of the boys said that they did not know what they were supposed to do, that they were more engaged in other things, that the task was boring, that they wanted more hands-on activities and that they preferred to work in smaller groups. Amanda responded by saying:

> We cannot always build cars; we also have to cover material .... Today it didn't work for me, so I will think what to do and how; if you have ideas send me an email. (Classroom notes, October 17, 2003)

Amanda clearly invited students to participate in her choice of instructional practice but most students did not appear to be mature enough to do so and also were not interested. The unspoken question "why should we be engaged in a course in which we are only enrolled because we need the credit" was clearly in the room when students left the classroom.

This classroom episode resulted in a change in Amanda's teaching approach that started halfway through the first semester and continued until the end of the school year. From this point on, assignments were mostly completed in pairs and the results presented orally to the class or in an interview setting with the teacher. A small percentage of lessons (approximately 20–25%) followed a teacher-centered approach. Amanda either gave short lectures (5–10 min per lecture) including notes on transparencies accompanied by student handouts, or used a questioning-answering approach to develop a new concept, or review a concept from the grade 10 science curriculum. In addition, approximately 20–25% of the assignments were individual structured-inquiry assignments (Martin-Hansen, 2002). Students were asked to come up with a specific end product following detailed teacher instructions.

In the follow-up interview at the end of the school year, Amanda expressed her frustration with the science course and the kind of approach that she actually put into practice:

> I've just never had that before...it's just been a difficult year in teaching and just not being able to accomplish things that you want to do. (June 9, 2004)

She interpreted the change of teaching approach as a reaction to students' instrumental goals (fulfilling their last science credit without the grade counting towards university) and the size of class, which was in her opinion too big for a guided-inquiry approach. When asked how she would change the course if she taught it again, she stressed the same ideas as at the beginning of the school year:

> Well I just think that more like, ...the things like the definitions and terminology, do that, do it fast. If they copy this kind of things it's not the end of the world but then work on more practical sides of it that you can tell if they've understood those definitions, ...give them a project where they have to then use it and apply it, I think [this] would be better for these guys. (June 9, 2004)

Amanda wanted to see her teaching approach put into practice but at the same time acknowledged that she had to give boys, in general and those who enrolled in the grade 11 science course in particular, more structure by providing them with detailed guidelines of how to work with Internet sites, how to summarise articles, and how to structure a report or oral presentation. She did not, however, address strategies for improving their motivation to complete these tasks.

From a motivational perspective, these results illustrate the tension between individual goals (Amanda's intended teaching approach towards mastery learning) and contextual goals (the students' expressed performance goals or the school's mission of achieving high academic standards) that are not fully internalised into one's own motivational goal structure. Amanda acknowledged and integrated the contextual goals only at a surface level by implementing a more guided and teacher-centered teaching approach aimed at teaching the major concepts. She continued, however, giving students projects that allowed for student-centered learning and required a mastery orientation. Students' continuing performance orientation can possibly be attributed to Amanda's lack of ability to solve this tension and to her rejection of accommodating particular sociocultural originated goals that clearly are in opposition to her motivational goal structure. A closer look into Amanda's perception of how her students' perceived the course will give further information of how to interpret this result.

Teacher's Perceptions Versus Students' Perceptions

Amanda's understandings of how the boys perceived the course were in most aspects coherent with the boys' perceptions of it as a dead-end but necessary credit course. She was aware of and stressed in each interview that these perceptions were fueled by the school administration, but she also pointed out that most boys were not interested in science:

> They're in a subject because they need the credit and I would say the majority... wouldn't have taken a science necessarily if they didn't have to. (Oct. 15, 2003)

She further assumed that most of the boys probably did not like science in general and found it boring. Amanda emphasised students' instrumental and utility goals throughout the school year and saw them being responsible for students' lack of interest and motivation in participating in the class. At the same time, she was aware of sparking students' interest in and enjoyment of different topics (e.g., nutrition or infectious diseases), through hands-on activities in general and through other specific assignments.

> The power point demonstrations we did that was the one they did for infectious diseases and I think they enjoyed that topic because it was gruesome and they...got to see some interesting things...they enjoyed making the presentation but then having to sit there and listen to other people's presentations that's where they weren't as motivated. (June 9, 2004)

Amanda explained in the mid-school year and in the follow-up interview at the end of the year that she recognised students' interest in a topic because of their different classroom behavior. For example, the boys reminded each other to be quiet and focused or they were more active, as seen in the lessons on ethical issues in disease treatment:

> They were interested in the material. They definitely liked [it] because they had come up with the questions and they were answering the questions...and last class they also asked factual questions they wanted to know about the diseases and yesterday they were answering those questions. So I hadn't made them up, they had made them up the questions they had to answer. (Feb. 4, 2004)

Amanda's realistic assumptions of the boys' perceptions were also evident in the follow-up interview. She emphasised that some of the students were interested in certain topics while others just did not care whatever topic or activity was done in class:

> I think individuals in the class may have enjoyed or might take something away than others cause it stood out for them, so I think definitely some of them would have something now to talk about. A couple of boys did say so like they said that they had enjoyed it and there were some topics, not all of them..., some of them just are not as interested...some of them just don't care, it's really it was just a course they had to pass and that was their only goal and...they didn't open up to anything else. (June 9, 2004)

When further probed about her thoughts on what the students learned in the course, she stressed that they accumulated everyday knowledge, which was also one of her goals for the course and guided her teaching approach. The mid-school year interview and classroom observations during this time revealed that Amanda integrated her own goal of making the boys aware of the importance of science in everyday life with the boys' perception of the course as a credit course:

> For these guys, my understanding of their goals for a course like this is to complete their science credit that they need to graduate. I think then knowing that and knowing that science is not something that they've chosen as a specific career; I think that they will experience science in their everyday life. And in almost every career, you can probably find some link to something we've done....It helps them in their voting.... I think it's the practical things that'll come out of this course. They may not look back and realise that it was from a science course like this but it will be a part of their knowledge that they will apply to something in their future. (Feb. 4, 2004)

This perception was also well reflected in some of the boys' comments about the utility value of the course in accumulating everyday knowledge as described above. In addition, Amanda had a strong future time perspective with respect to the course utility value and some of the students seemed to integrate this into their own goal structure as can be seen in Daniel's comments during the mid-school year and follow-up interviews:

> I think if you're are not going into science, if you're not going to think about having a career in science then things like physics, if you go into the business world, chemistry's not going to help you that much but if you know about the environment, you can still do stuff depending on your company. (Feb. 24, 2004)
> I think it's just a good thing to have no matter what you're going into. I think because you get a better knowledge of things that are going on. – ... it would be a lot more useful for general talk with anybody and just everyday life. (May 28, 2004)

In summary, we can say that Amanda was aware of the boys' perception of the course and was able to challenge their negative feelings towards science sporadically when a certain topic or activity "hit" students' interest. It seems that these sparks of interest kept up Amanda's on-going effort and motivation to find interesting activities and topics alive throughout the school year, although by the end her frustration with the course was clearly evident. Although in the long run, Amanda was not able to change the boys' underlying perceptions of science as well as their dominant E–E orientation (extrinsically motivated and externally regulated), we can conclude that Amanda interpreted the situational changes of students' motivation throughout the course as indicators of the effectiveness of her mastery learning oriented teaching approach. Thus, Amanda refused to accommodate the students' motivational goals that were shaped by sociocultural messages and that were in opposition to her own motivational goal structure.

Conclusions and Implications

The results of our study suggest that the boys' initial perceptions of the course and their reasons for taking it established their instrumentality and their overall instrumentality type (I–I, E–I, or E–E) from the beginning of the course until the end of the school year. These initial perceptions were triggered by the school's promotion of the course to meet the students' need for a senior science credit while providing an alternative to the typical university preparation courses in physics, chemistry, and biology and the official Ministry guidelines for this course as not being accepted as a prerequisite for studying science at the university level. Students internalised these goal messages resulting in the transformed perception of the course as being for "non-science" people who just need a credit. Interpreted in the context of goal theory, this immediately positioned the students for an E–E type of instrumentality (extrinsically motivated and externally regulated). Furthermore, throughout their schooling at Smith Academy, students had internalised the school's general goal message of striving towards high academic standards. This made the General Science course stand out even farther from their other experiences at the school. It was not a course that was geared towards academic excellence. It was a way to get the required credit more easily than in any of the discipline-oriented science courses.

Based on these goal messages, it does not seem surprising that the resulting motivation levels were very low and students were mostly performance oriented (focused on grades and achieving the credit). Our results are in a reciprocal way supported by other studies indicating that teachers and administrators can have a positive effect on students' learning and motivation (Summer & Davis, 2006). This means that, in order to avoid negative student perceptions, schools such as Smith Academy should be more careful in how they promote or frame new courses that are not coherent with the schools' general goal messages.

Our results also support Simons et al. (2000) findings that an E–E orientation (extrinsically motivated and externally regulated) is associated with performance goals rather than mastery (task) goals. But we also found that, although the boys' performance goal orientation was predominant, it was not strongly developed, and we also were not able to distinguish between performance-approach or performance-avoidance goals. This seems like a paradox in the context of the literature on future time perspective and goal theory because expressing a particular goal orientation is generally associated with holding those goals strongly. The reality of our science classroom does not seem to support this relationship. Instead, our results indicate the importance of sociocultural aspects influencing our students' motivation. Smith Academy's strong goal messages about this particular science course resulted in students' internalisation of these goal messages as stated in sociocultural approaches (e.g., Lawrence & Valsiner, 1993; Walker et al., 2004). However, the students' motivational goals were also influenced by stereotypical perceptions about science as being for smart people, which in turn, were reinforced by the school's and the teacher's goal message that this General Science course is less difficult then the discipline-specific science courses. This finding is very specific to science and to students' understanding of science as a discipline. For this reason, this finding suggests that motivation in science deserves to be studied in its own right and not merely as an example of general scholastic motivation.

Situational changes in the students' goal structures also illustrate that our participants did not internalise classroom and school goal messages totally and instead, selectively and constructively transformed these goal messages depending of their own motivational structure and beliefs (Lawrence & Valsiner, 1993; Urdan, 2004). While some studies indicate that teachers' goal messages, as transferred through their teaching approaches, have a positive influence on students' learning and motivation (Summer & Davis, 2006), our results do not confirm these studies. Instead, our results support Veermans and Järvelä's (2004) result that not only students' learning but also their motivational level needs to be scaffolded, in particular in learning contexts that promote student-centered learning and teaching. Our participants shifted their motivation from a performance orientation (desire to get through the course and get the credit) to a mastery orientation (desire to learn and to understand the material) when they viewed the task as an authentic and meaningful learning experience (e.g., debating and discussing environmental issues). Thus, it is important that the teacher sees the emotional and utility value of the learning task from the student perspective, for example its potential applications outside of the school context (Brophy, 1999).

The boys' predominant E–E orientation also had an effect on the teaching practices implemented in the course. Amanda's ideal student-centered teaching approach included problem-oriented tasks, socially shared activities and joint goals (Strijbos, Kirschner, & Martens, 2004), which the boys were less willing to follow. Järvelä and Salovaara (2004) emphasise that in such dynamic learning environments both students and teacher mutually influence each other in their interaction with the learning context. Amanda's efforts to implement her approach in the classroom were continually frustrated by the low levels of motivation and the students' mark- and credit-based focus, resulting in partial changes in her approach. As Järvelä and Salovaara illustrate: "The construction of motivational meanings reflects individuals' motivational beliefs, prior experiences, and subjective appraisals of the possibilities and constraints of the current learning context" (pp. 232–233). Amanda recognised the E–E orientation of her students and its relationship to the way the course was advertised, and she attributed much of the motivational difficulties that she encountered with the students to this orientation. She did not, however, express awareness of the underlying public perception of science (science is only for smart people and socio-scientific topics are not real scientific topics) that was also a dominant force in the boys' general perceptions and resulting motivational structure and goal orientations.

Despite students' strong overall E–E orientation, the results indicate temporary shifts towards I–I orientations (intrinsically motivated and internally regulated) and E–I orientations (extrinsically motivated and internally regulated) depending on the utility that students perceived in individual topics. Many expressed an interest in topics that held everyday value and possible future utility for them, and during these topics they shifted to a more internally regulated orientation: Their motives for engaging in the material became more personal as they recognised everyday or future utility in the topic. During these topics, the students also expressed stronger mastery orientation. They liked doing the work because it was interesting or because they wanted to learn about the topic. This shifted their attention away from the externally regulated goal of just getting the credit or a high mark. And although their motivation may have remained extrinsic (the task itself was still not the reward), moving to an internal regulation meant making the extrinsic motive more personally meaningful. This seemed to be associated with moving towards a mastery orientation and away from a performance orientation. This result supports Simons et al. (2000) proposal that "If one could induce type E–I (instead of E–E) by enhancing the interpretation that the consequences of the present task are relevant for one's personal or professional development, goal orientation may become more adaptive" (p. 348).

It is in this way that the teacher's perceptions of the course had a direct impact on the students. In recognizing that her students did not wish to continue in science, she highlighted the importance of them understanding the connections of science to everyday life. It was these connections that triggered the shifts from E–E to I–I and E–I in the students. This result suggests the importance of integrating more STS topics in our science curricula or, more radically, teaching scientific concepts through their immersion in STS topics.

Simons et al. (2000) suggest the possibility of a permanent shift away from an E–E orientation: "We assume that the instrumentality of an activity for one's own future makes the initially extrinsic rewards internally rewarding in the long run. In this way, uninteresting but important activities may become more interesting to do and easier to perform" (p. 348). But it is important to note that our results suggest only temporary shifts towards E–I and I–I in relation to very specific topics that students perceived to have instrumentality. These temporary shifts did little to affect the overall E–E orientation of our students and the course. Research on interest (Ainley et al., 2002; Hidi, 1990; Schiefele, 1998) has shown that interest is subject and topic-specific. Our result suggests that like interest, motivation and goal orientation have a topical or situational component. This means that we cannot necessarily assume a single orientation over an entire course. Our study indicates that motivation is not a global characteristic of a student; instead, student motivation can vary widely from course to course and even from topic to topic within a course. This finding could only have come from a study, such as this one, that follows a group of students through a full school cycle and all of the course topics. Further research of this type is required to more fully explore these relationships and their effects on classroom practice.

The aim of our study was to investigate factors influencing students' motivation from the perspective of science educators knowledgeable in educational psychology and was guided by the common assumption of the importance of motivation for learning. From a methodological standpoint, our study aimed at presenting detailed and fine-grained contextual data in case descriptions. Although the generalizability of case study research has aroused debates (see for example, Gomm, Hammersley, & Foster, 2000), our aim was not to generalise our results; we are quite aware of the limitations of our findings as they derived from a small group of students. Rather, the aim of our study was to stress the necessity for more research in motivation conducted by science educators. Our results hint towards a dialectical interdependence of students' individual goal structures and teacher's teaching approaches. Through integrating sociocultural approaches, future time perspective theories and achievement goal theory we were also able to develop an understanding of the origins of these goals. How can we use this knowledge in science education? Despite research on the effect of changing science curriculum content through integrating STS issues or socioscientific topics (e.g., Hughes, 2000), and debates and research about designing and implementing more student-centered teaching and learning methods (e.g., DeBoer, 2002; Hodson, 2003; Von Secker, 2002), school science remains almost unchanged and still focuses on confronting students with basic facts and theories (Eisenhart, Finkel, & Marion, 1996). Science's ways of knowing and everyday practices continue to privilege white middle-class males (Tobin, Seiler, & Walls, 1999), thus discourage many students, in particular, women and minorities to pursue science further than the required school courses. It seems that we, as science educators, have fallen short in transforming our research results into the science classroom, resulting in our students' continuing poor and incoherent scientifically knowledge and their ability to use that knowledge effectively and purposefully in everyday life. If our aim in science education is achieving a scientifically literate citizenry, then it is important to be aware of the dialectical interdependence of teaching approaches, school's goal messages and students' motivational structures and take these interdependences into consideration when developing curriculum materials.

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