The autonomy to choose – the case of ninth-grade mathematics students

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Abstract

In this study we explored the effects of providing ninth-grade students with the chance to take part in decision making concerning the mathematics level they would be assigned to in high school. Decisions concerned their self-competence regarding their mathematical abilities, their learning goals and the class atmosphere. The students were taught three mathematics topics during the ninth grade in two levels (regular and extended) and after each topic they were examined in the level they identified as appropriate for themselves. After each exam the students were asked to fill in a questionnaire in which they had to address issues referring to their choice. The results revealed that the students learnt how to better monitor their learning. The students’ learning goals were mainly performance and mastery goals and the class atmosphere changed completely and frustration and dissatisfaction were no longer expressed.

Keywords: autonomy, self-regulation, self-efficacy, mathematical competence.

1. Introduction

Mathematics acts as a gate-keeper for many students. Moreover, mathematics is one of the main subjects according to which students are grouped into learning levels. In the Israeli educational system tenth-grade (age 15) students are usually grouped into three main levels according to their past achievements in mathematics: high, medium and low. This process takes part between the seventh and the ninth grade, but the most
significant year is the ninth grade. Although the process of grouping is performed very cautiously and various factors are taken into consideration, many students are disappointed and have difficulties in accepting the learning level to which they are assigned. Informal talks with students over the years revealed that one of the reasons underlying this disappointment stems from their feeling that they have no influence on the decision-making process and do not get a genuine opportunity to improve their learning level during the ninth grade. As the grouping affects their future vocational opportunities it becomes even more significant. Some of the students feel that they would be able to achieve at a higher level than the one they have been grouped to. As a result, feelings of frustration are often reflected in ninth-grade students’ behaviour during mathematics lessons. The class atmosphere becomes unpleasant and the students’ tension vents itself in expressions of anger and misbehaviour. The students’ frustration causes them to develop negative attitudes towards mathematics and the resulting unpleasant class atmosphere has a negative effect on the teacher as well.

Self-regulation is important to the learning process (Jarvela & Jarvenoja, 2011). Self-regulated learning is considered as an important predictor of student academic motivation and achievement. It can help students monitor their performance (Harris, Friedlander, Saddler, Frizzelle, & Graham, 2005), and evaluate their academic progress (De Bruin, Thiede, & Camp, 2011). In order to be able to both monitor their performance and evaluate their academic progress, students need to have certain autonomy within the learning process. Such autonomy can affect students’ self-efficacy and motivation, which also have a central impact on their academic outcomes (Zimmerman, 2008). The need for autonomy is related to the student’s need to feel that his/her actions express his/her abilities, tendencies and needs (Ryan & Deci, 2002). Pintrich and De Groot (1990) found a positive correlation between motivational beliefs and self-regulated learning. Similarly, Schunk and Zimmerman (2007) reported that there was a positive relationship between self-efficacy and academic achievement and that, if students are trained to have higher self-efficacy beliefs, their academic performance also improves.

In this study, we examined the effects of providing the students with the autonomy to take part in decision making concerning the grouping process on their self-competence regarding their mathematical abilities. The derived research questions are:
1. What can we learn about the students’ mathematical self-competence as a result of the given autonomy?

2. What can we learn from the students’ justifications to their choice of the exam level?

3. What are the students’ learning goals?

4. In what ways does the autonomy to take part in the decision making concerning the grouping of learning levels affect the mathematics class atmosphere?

To that end, we employed the following process: during the ninth grade we taught the mathematics topics in two levels: regular and extended. The exam following each topic was provided in two levels as well, and the students were given autonomy to choose the level they wanted to take. After each exam the students were asked to fill in a questionnaire in which they had to address questions referring to their perceived mathematical competence and to justify their choices concerning the exam level. This process was repeated three times during the ninth-grade year.

A premise of this study is that by providing the students with the autonomy to choose exam versions, they will then choose certain learning behaviours which have an important impact on the shaping of their self-competence regarding their mathematical abilities. Motivated by their own choice, we believe they will take responsibility for their learning and will better be able to assess the learning level at which they are capable. By choosing a certain version of an exam, they are then required to take responsibility for the consequences of their choice. They know that, if they want to succeed at a certain level, they need to invest the required efforts during the learning process. Either choice they make might help them shape their future learning of mathematics relying on their goals, abilities and self-competence.

2. Theoretical background

Students’ perceived competence concerning their mathematical abilities stems from various sources, among which are: motivation, self-efficacy, self-regulation and causal attributed theory. In what follows we provide a literature survey of these issues. In addition we provide a brief literature survey on class atmosphere.
2.1 Students’ perceived competence to learn mathematics

Students’ perceptions concerning their ability and willingness to cope with mathematics learning are influenced by various factors that, in many cases, are mutually affected. One of these factors is self-regulation which emphasises the self-perception of the individual and his/her patterns of actions (Bandura, 1986; Deci & Ryan, 1985). Self-regulation, in the educational context, was defined as a process in which the learner identifies learning goals, and performs control actions in his/her mind to achieve motivation and behaviour to fulfil them (Pintrich, 2000; Zimmerman, 2001).

Pintrich (2000) identified four premises of self-regulation theory. Two of these premises that are relevant to our study are the control and the target premises. The control premise is where the learner has the potential to criticise, control and supervise the characteristics of the learning environment. In order that the learner will be able to do the above actions, certain autonomy should be provided to him/her within the learning process. The second premise is the target premise that says the learner can set the goals he/she wants to achieve in studying. The learner can supervise the process toward obtaining them and regulates and adjusts his/her efforts, thinking, motivation and behaviour to fulfilment. Enabling the learner to choose the exam level can affect his/her learning behaviour in either of the following ways: when a student succeeds in a certain exam, his/her willingness to invest efforts and receive high scores in the next one of the same level is raised, or when a student realises he/she is not able to cope with the exam of the high level, he/she comes to the conclusion by him/herself that he/she should make efforts to succeed in the exam of the lower level.

Three basic psychological needs are indicated by the self-regulated theory: the needs for autonomy, relatedness and competence (Ryan & Deci, 2002). The first and the third needs are relevant to our study. The needs for autonomy are the needs to feel that actions express values and tendencies and correspond to own needs. Autonomy develops when support from meaningful adults is provided. The need for competence is the need to perceive one’s ability to accomplish tasks. The fulfilment of the above needs is essential for the proper emotional and cognitive development of the
individual (Ryan & Deci, 2000). We believe that providing students with the autonomy to choose the exam level addresses two of the above psychological needs: the needs for autonomy and competence.

2.2 Students’ causal attribution

Decisions such as to choose a certain exam level are made as a result of understanding the reasons underlying this behaviour. Causal attribution theory concerns how people understand the reasons for their successes and failures. In an educational context the causal attribution theory postulates that the student attributes a cause to the outcome of their performance (Weiner, 1986, 1992). Furthermore, the student’s next activity as well as their motivation is influenced by the attributed cause more than by the outcome itself.

Attribution theory locates all causal attributions along three dimensions and the two that are relevant to our study are: internal or external, and controllable or uncontrollable. The first refers to the character of causality which can be either internal or external. Namely, the student may relate the cause of success or failure to their ability, to the amount of effort invested in the activity or to external factors like the difficulty of the assignment, the quality of teaching and so forth. The second dimension is control and it refers to the extent to which the student feels they can dominate and influence the causes of success/failure. In the questionnaire some of the questions related to the above distinctions. Causal attribution occurs mostly when student outcomes are important, unexpected or negative (Weiner, 1992). Students tend to assume success when the causes are personal like ability and failure when the causes are environmental. The reason for the latter phenomenon may stem from the assumption that, in situations meaningful to the student, factors concerning self-esteem and social appraisal are involved (Stephanou, 2003). Providing students with the autonomy to be part of the decision making concerning the mathematical level they will be allocated to may help them to better attribute a cause to the outcomes of their performances.

2.3 Mathematics and self-efficacy
Students’ self-efficacy beliefs influence their academic performances in several ways (Pajares, 2002): they influence students’ choices and behaviours. According to Bandura (1994, 1997) there are four sources of self-efficacy information, and two that are relevant to our study are past experience and previous performance. Successful experiences tend to increase self-efficacy whereas continuing failures tend to weaken it. Providing the students with the opportunity to choose the exam level enabled them to exclude themselves from a constant situation of successive failures. Hall and Ponton (2005) found that past experience and failures in mathematics usually dictate student opinions concerning their perception of their ability in mathematics as well as their optimism about career choices. Second is emotional and physical arousal, which demonstrates the students’ capability to accomplish tasks. For example, stress is an emotional arousal situation that may cause inconvenience, resulting in the decrease of the individual’s self-efficacy. Forcing students to cope with high-level exams that are beyond their capabilities may result in negative emotional arousal such as frustration and anxiety. It has been found that students with high levels of positive self-efficacy perform academic tasks more successfully and are more likely to try difficult tasks and be motivated to use diverse strategies to solve problems than students who do not believe in their own abilities (Pajares & Graham, 1999). Research has found self-efficacy and the use of self-regulation strategies to have reflexive positive influence on one another. Higher self-efficacy beliefs results in an increase of the use of self-regulation strategies (Usher & Pajares, 2008) and the use of self-regulation strategies may cause an increase in self-efficacy beliefs and academic achievements (Bouffard-Bouchard, Parent, & Larivee, 1991).

Another concept concerning self-efficacy is self-concept, which refers to the multidimensional perception of self (academic, social, and physical aspects). A review of the literature revealed that a positive association between mathematical self-concept and mathematics performance has consistently been found across different countries (Pajares & Graham, 1999). That is, students with a high level of mathematical self-concept generally show greater engagement, persistence, and effort in tasks relating to mathematics and in turn perform better than students with lower levels of mathematical self-concept. As self-efficacy beliefs determine how one feels, thinks, motivates oneself and behaves, we believe that exposing students to activities
such as choosing their exams level could raise their self-efficacy and might affect their perceived competence to learn mathematics.

### 2.4 Motivation and goal orientation

The term “motivation” refers to a personal process that produces, controls, and supports certain behaviours. Motivation is an integration of individuals’ behaviours, objectives and aspirations that lead them to fulfil their targets. Researchers have defined three dimensions of motivational behaviour and the one that is relevant to our study is direction (Maehr & Midgley, 1996). Behavioural direction refers to the choice of specific behaviour from a range of behaviours and sticking to it despite the obstacles. It includes autonomy, which describes the perception of the behaviour as consequential of free choice or external demand. Motivation is described by researchers according to the level of autonomy. The concept of autonomy support was coined to explain the social-contextual factors that affect students’ learning (Deci & Ryan, 1985; Ryan & Deci, 2000). This concept describes a person in a position of authority (e.g., a teacher) providing the other (the student) with information and choice, and minimising the use of pressure and control (Williams & Deci, 1996).

Self-regulation and motivation work hand in hand to explain student learning and success. When students are motivated to learn, they are more likely to invest time and energy into their learning (Zimmerman, 2000).

Two main types of goals are distinguished by the education research literature: mastery and performance. The first type (mastery) refers to the goals that represent students’ advisable outcome and is also called task orientation or learning goal. The second type (performance) refers to students’ general motives for accomplishing a task and is also called self-esteem orientation (Ames, 1992; Maehr & Midgley, 1996; Nicholls, 1989). Students with mastery goals focus on improving their abilities, developing new skills and obtaining mastery according to personal standards. They are eager to understand content knowledge, and evaluate their success by testing their ability to use it properly. They tend to respond to failure flexibly and remain focused on mastering skills and new knowledge. They do not take failure personally and they believe that efforts lead to success. Eccles and Wigfield (2002) found that mastery goals are linked to self-competence, and self-regulation.
Students with performance goals are primarily interested in whether they can perform assigned tasks correctly, as defined by the teacher. They seek success but mainly in familiar tasks and they give up quickly when faced with challenging tasks or avoid them altogether. Their perception of ability is nurtured by the chance of attracting external recognition. Perceived ability is judged by comparison with others, and high ability is evidenced by doing better than others (Ames & Archer, 1988; Nicholls, 1989). Providing students with the autonomy to choose the exam level may help us in distinguishing between students with mastery goals from those with performance goals.

2.5 Mathematics class atmosphere

Mathematics class atmosphere refers to students’ overall behaviour during the mathematics lessons which can originate either from positive feelings or from negative ones. Positive feelings can create a relaxing and pleasant class atmosphere in which the students do their best to learn mathematics while negative feelings can lead to students’ misbehaviour which can interrupt the learning process. Positive mathematics class atmosphere has an essential role both for the teacher and the students (Sakiz, Pape & Hoy; 2012). The research literature includes many references concerning the issue of the mathematics class atmosphere. Many of these studies examine the effects of implementing innovative teaching/learning methods on the learning process and as secondary goals on the mathematics class atmosphere (Ah Chee Mok, 2009; Bellomo & Wertheimer, 2010; Graves et al., 2009; Kaygin, Balcin, Yildiz, & Arslan, 2011). Black and Deci (2000) found that an autonomy-supportive school classroom climate has a positive effect on students’ perceived competence as well as on their invested efforts and school performance. In our study a negative classroom atmosphere due to students’ misbehaviour in the mathematics lessons was one of the reasons to provide the students with the autonomy to take part in the decision making regarding the learning level they would be grouped to.

3. The study

In this section we include information about the study participants, the course of the study and data collection and its analysis.
3.1 The study participants

Twenty-six ninth-grade students from a regional high school in the northern part of Israel took part in this study. Most of the students were from rural settlements. The students represented all achievement levels. During the study the students had to attend three exams. Twenty-six students sat the first exam, 24 students sat the second and 20 students sat the third. As the number of students decreased across the three exams we focus on data received from the 20 students who did all three exams.

3.2 The course of the study

During the study year of the ninth grade the learning topics were taught in two levels (something that is not usually done), starting with the basic level and extending it to a higher level. During the whole year three topics were taught in the above two levels and each topic was followed by a corresponding exam. Each exam was provided in two versions, regular and extended, and the students were given the option to choose between them. The differences between the two versions came to fruition in the difficulty level of the included tasks. While in the regular version the students were asked to demonstrate basic levels of the topics under examination, in the extended level, accomplishing the given tasks necessitated a profound understanding of the learning topics. The students could even change the exam version during the exam if they felt it was too easy/difficult for them. They were allowed to change the exam version during the first 15 minutes of the exam (out of 90 minutes) and those who did received extra time to finish the new chosen version. After each exam the students were asked to fill in a questionnaire in which they were asked to provide answers to questions referring to their perceived competence regarding their mathematics abilities and to justify their choice of the exam level.

3.3 Data collection – the questionnaire

The questionnaire included 12 questions. All the questions were grouped under the same heading; however, questions 1 and 2 were general and referred to the choosing process of the exam version, such as “which version did you choose and why?”. Questions 3–6 addressed the students’ attitudes concerning their perceived level of mastery of the topics under examination such as “set your degree of mastery concerning the trapezoid topic” (the student had to choose from a range of one to
Questions 7–11 addressed the students’ self-efficacy in terms of identifying their learning goals and characterising their learning motivation. Question 12 was composed from eight statements referring to the students’ attitudes towards mathematics.

In addition to the students’ responses to the questionnaire, the research data also comprised the students’ grades for the three exams.

3.4 Data analysis

Using analytic induction (Taylor & Bogdan, 1998) and content analysis (Neuendorf, 2002), the data collected from the students’ responses to the first two questions of the questionnaire were analysed by coding word or group of word frequency or existence and the following categories regarding the underlying reasons of the students’ choices emerged: external factors, self-perception of mathematical ability, goals, motivation and performance experience.

- **External factors.** This category included the students’ comments which referred to the exam level and the extent to which they were preparing for the exam, such as “I looked at the problems and they seemed simple”, “The extended version was difficult and I did not have enough time”.

- **Self-perception of mathematical ability.** This category included the students’ comments referring to their perceived mathematical ability, such as “My mathematical knowledge is quite good and I think I will manage at the high level” and “I am not very good at mathematics”.

- **Goals.** This category included the students’ comments in which they indicated information concerning their internal and external goals, such as “I really want to improve my mathematical knowledge” and “I want to go to university so I need to be good at mathematics”.

- **Motivation.** This category included the students’ comments that referred to motivation, such as “It is very important to me to succeed” and “I want to be with the good students in class”.

- **Performance experience.** This category included the students’ statements which indicated reasons for their decisions as a result of their experience in previous exams, such as “In the previous exam I chose the regular version and
it was easy for me”. We will elaborate on these categories later in the following section.

As regards to questions 3–6 from which we could learn about their level of mastery of the learned topics, and questions 7–11 from which we could learn about their learning goals, and question 12 from which we could learn about their attitudes towards mathematics, we compared all the above results of each student to get a whole picture of their learning behaviour.

4. Results and discussion

The following sections refer to the research questions stated earlier.

4.1 The effects of the autonomy to choose the exam level on the students’ self-competence

As was previously mentioned, only 20 (out of 26) students sat all three exams hence, the following results refer only to these students. Figure 1 presents the distribution of the students’ choice process across the three exams. The data presented shows a clear shift from the extended to the regular version of the exam. Namely, in the first exam most of the study participants chose the extended version, but the number of students choosing this version declined in the second and the third exams. The distribution of students in the third exam converges towards a normal distribution of typical heterogeneous class – two-thirds chose the regular level and one-third chose the extended one.

Figure 1: Students’ distribution according to level in the three exams
Out of the 20 students who sat the three exams, eight (seven did the extended version and one the regular one) students did not change the exam version across the three exams (termed “conservatives”) whereas 12 students changed versions once or twice during the three exams (termed “changers”). Table 1 presents the average grades received in the three exams:

Table 1: Distribution of average scores and standard deviations in the three exams

<table>
<thead>
<tr>
<th></th>
<th>First exam</th>
<th></th>
<th>Second exam</th>
<th></th>
<th>Third exam</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regular</td>
<td>Extended</td>
<td>Regular</td>
<td>Extended</td>
<td>Regular</td>
<td>Extended</td>
</tr>
<tr>
<td>Average score</td>
<td>44.1</td>
<td>57.4</td>
<td>57.1</td>
<td>67.6</td>
<td>71.8</td>
<td>75.0</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>17.1</td>
<td>24.6</td>
<td>29.6</td>
<td>15.1</td>
<td>22.8</td>
<td>19.5</td>
</tr>
</tbody>
</table>

The above results (Table 1) reveal that the students’ scores support their decisions to change from the extended to the regular version. A clear increase in scores can be observed in both versions across the three exams. We can therefore say that the students made the right choice in changing from extended to regular versions. The students’ decisions are in line with Pajares (2002), who asserted that, in case of free choice, students tend to choose tasks they feel they are capable of accomplishing and avoid those they do not.

In order to explore the students’ perceived competence across the three exams we asked them after each exam to place themselves in the mathematics class according to the following scale: 1–5: among the excellent students; 6–10: among the good students; 11–15: among the average students and 16–20: among the low-level students. Figure 2 presents the results obtained.
Results presented in Figure 2 show that the number of students with high self-competence increased across the three exams and the number of students with low self-competence decreased despite the fact that some of them changed versions from extended to regular. One would expect that moving from extended to regular exams would result in lower self-competence, but the results show otherwise. One possible explanation of this phenomenon is that, in the first exam, the students’ decision was arbitrary. The decision could not be based on previous exam experience. Hence, although they received a low score, it did not affect their self-competence. The students’ choices in the second and the third exams, however, were based on the scores they received in previous exams. The fact that in successive exams they received a better score may explain the rise in their self-competence. Researchers found that supporting student’s self-competence affects and motivates their learning (Ryan & Deci, 2000). In our study we used external resources (providing the students with the freedom to choose their examining level) to support the students’ mathematical competence. As was previously mentioned, eight students out of the 20 that did the three exams did not change the exam version (seven did the extended and one the regular). These students located themselves either as excellent or as good students so we may assume that their self-competence regarding their mathematical abilities is relatively high.

The students’ behaviour can also be explained by the internal/external dimension of the attribution theory (Weiner, 1986, 1992). This dimension refers to the
character of causality which can be either internal or external. Since these students located themselves to be among the good students in class, we may say that they relate the cause of their lack of success in the first exam to the amount of effort they invested in it. These students were motivated to succeed as can be seen in their successive exams in which their scores were improved. We may also say that the above student group was motivated by mastery goals. Across the three exams they focused on improving their mathematical abilities which resulted in receiving better scores. They behaved as if they did not view failure (the relatively low scores in the first exam) as reflecting an inability to cope with the mathematical topics under examination but as a result of their insufficient invested efforts.

As to the 12 students who changed versions once or twice across the three exams, most of them located themselves as belonging to the average students in class. Hence we may assume that their self-competence regarding their mathematical abilities was not very high. Nevertheless, in the first exam they decided to choose the extended version. Thus we may attribute their decision to be motivated by performance goals (Ames, 1992; Maehr & Midgley, 1996; Nicholls, 1989). Students with performance goals seek success but give up quickly when faced with challenging tasks. This kind of behaviour was observed among this student group. Since their perception of ability is nurtured by the chance of attracting external recognition (their parents and classmates) they decided to choose the extended level in the first exam. When they faced difficulties in coping with the exam’s problems they gave up and in the next exam they chose the regular version. In terms of the self-regulated theory (Ryan & Deci, 2002), fulfilment of the basic psychological needs of autonomy and competence are essential for the proper emotional and cognitive development of the learner (Ryan & Deci, 2000). The need for competence is the need to perceive one’s ability to accomplish tasks. In our case, we nurtured both the need of autonomy and the need of competence by allowing the students to choose the exam level they found appropriate to their abilities. In viewing the students’ behaviour in terms of self-efficacy beliefs it is well known that these beliefs influence the students’ academic performances (Pajares, 2002). One of the sources of self-efficacy information is past experience. Pajares (2002) found that successful experiences tend to increase self-efficacy whereas continuing failures tend to weaken it. Hall and Ponton (2005) found that failures in mathematics usually dictate student opinions concerning their
perception of their ability in mathematics as well as their optimism about career choices. Providing the students with the opportunity to choose the exam level enabled them to exclude themselves from a constant situation of successive failures.

The second source of self-efficacy information is emotional arousal, which demonstrates the students’ capability to accomplish tasks. Forcing students to cope with high-level exams that are beyond their capabilities may result in negative emotional arousal such as frustration and anxiety. By enabling them the autonomy to change the exam level, the students could change the situation in which they feel they are not capable to accomplish the task (the extended version) to the situation in which they can succeed (the regular version).

4.2 Reasons underlying the choice of exam version

A total of 90 (some of the students provided more than one reason) reasons underlying the choice of the exam version were provided by all the study participants. A review of these reasons revealed that they fall into five main categories: goals, self-perception concerning mathematical ability, motivation, external factors and performance experience. First we elaborate on the emerging categories and then we compare two student groups: the “conservatives” and the “changers”.

Goals (26 responses [out of 90]): Under this category we included statements concerning short- and long-term aims, such as: “I really want to improve my mathematical knowledge”, “I changed the exam version as I wanted to get a better grade”, “I intend to learn in the high-level group” and “I want to be able to enter university to learn in a good-quality faculty such as the computer science faculty”.

Self-perception of mathematical ability (22 responses [out of 90]): Under this category we included comments such as “I think I am capable of learning at the medium level and I wanted to see if it was difficult for me”, “the extended level is difficult for me and I feel I do not know enough mathematics”, “my mathematical knowledge is quite good and I think I will manage at the high level” and “this [extended level] reflects my abilities”.

External factors (22 responses [out of 90]): Under this category we included comments which referred to the exam level and the extent to which students were preparing for the exam, such as “I looked at the problems and they seemed simple”,
“the extended exam was more difficult and I did not have enough time to study for the exam” and “I did not study for the exam so I chose the regular version”.

Performance experience (11 responses [out of 90]): Under this category we included statements which indicated reasons for decisions as a result of experience in the previous exams, such as “in the previous exam I chose the regular version and it was easy for me”, “I did not succeed in the extended version so I decided to do the regular one”, “usually I do the extended exam but this time I did not understand the questions in it so I chose to do the regular” and “until now I chose the extended exam and I did not get good grades so this time I chose the regular to get a better grade”.

Motivation (nine responses [out of 90]): Under this category we included statements such as “I want to be on the high level so that I will not be left behind”, “it is very important to me to succeed”, “I do not want to give up my studies”, “I like challenges” and “I want to do my best to get better grades”.

In order to answer the question whether there are differences between the stated reasons of the two student groups we compared the groups concerning the number of reasons provided in each category and the results are presented in Table 2.

Table 2: Students’ distribution according to categories and the two student groups

<table>
<thead>
<tr>
<th>Category</th>
<th>First exam C</th>
<th>Second exam C</th>
<th>Third exam C</th>
<th>Total C</th>
<th>Total N_c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goals</td>
<td>3</td>
<td>8</td>
<td>2</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Ability</td>
<td>7</td>
<td>6</td>
<td>2</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>External factors</td>
<td>4</td>
<td>1</td>
<td>6</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Performance experience</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Motivation</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
<td><strong>17</strong></td>
<td><strong>16</strong></td>
<td><strong>46</strong></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>

The first column of Table 2 refers to the emerging categories. The following columns refer to the three exams and each pair of columns indicates the number of reasons provided by the two student groups: the “changers” (c) and the “conservatives” (N_c). The last two columns refer to the total number of reasons of each category in the three exams provided by the two student groups: the “changers” (c) and the “conservatives” (N_c).
Interpretation of Table 2 reveals that, generally, the reasons provided by the “changers” were dynamic across the three exams whereas the reasons provided by the “conservatives” were stable across the three exams. In what follows we discuss the obtained results of the “conservative” students group and then of the “changers” student group.

“Conservatives” (N_c)

For those within the “conservatives” grouping, in most categories the number of provided reasons was more or less stable across the three exams. As was previously mentioned, the majority of this student group sat the extended level in all the three exams. Moreover, all of these students considered themselves as either excellent or good students which can imply a high level of self-concept regarding their mathematical abilities. This is in line with Pajares and Graham (1999) who found that students with a high level of mathematical self-concept generally show greater engagement, persistence, and effort in mathematical tasks.

The highest number of reasons provided by the “conservatives” in the first exam referred to goals and mathematical ability and in the third exam referred to goals. In fact, these students provided a stable account of their mathematical abilities across the three exams and the grades they received provided a kind of confirmation of their feelings. It is fair to say that they were motivated mainly by their goals to improve their achievements. The rise in scores across the three exams shows that their decision to keep the same exam version was wise. Viewing these results in terms of self-efficacy beliefs we may say that the self-efficacy beliefs of the “conservatives” affected their academic performances in their choices and behaviours (Pajares, 2002). The self-efficacy beliefs of the “conservatives” were also nurtured by their goals. They had solid goals and they believed in their ability to cope with the extended version of the exams. They did not need justifications referring to performance experience nor motivation to justify their choices. The minor differences in the number of the reasons provided from one exam to another can also be explained by the process of self-regulation: the assessment of performance did not cause a change in the goals the students set to themselves across the three exams.

The low number of reasons which referred to external factors and performance experience provided by this student group reinforces the fact that they are confident in
their ability to cope with the extended versions of the exams. Hence, although they did not receive high scores in the first exam, they did not attribute their lack of success to external factors or performance experience reasons but in fact invested more efforts in improving their knowledge in order to better succeed in the following exams. In terms of the causal attribution theory (Weiner, 1986, 1992) we may say that this student group locates the reasons for their success and failures along the internal dimension. That is, they relate the cause of their performances to the amount of effort they invested in learning before the exams.

It was noted that for the “conservatives” grouping, there was a low number of reasons which referred to motivation and this decreased across the three exams. This may be related to the fact that they had confidence in their mathematical abilities and were mainly motivated by their goals. It can be explained by the direction dimension of motivational behaviour which refers to the choice of specific behaviour and sticking to it despite the obstacles (Maehr & Midgley, 1996). Although they received low scores in the first exam, they did not change the exam version from extended to regular. On the contrary, motivated by their goals, they invested more efforts to improve their mathematical knowledge. Viewing the goals as one of the constituents of the self-regulated process (Pintrich, 2000) we may say that these students set goals for themselves (to succeed in the extended version) and then adjust their behaviour to fulfil them. During the whole process they use control and assessment actions to test the “quality” of their performance and products (e.g., test scores) that may result in the setting of new goals.

“Changers” (C)

The number of reasons provided by the “changers” referring to external factors and performance experience increased across the three exams whereas the number of reasons provided by them referring to goals and ability decreased across the three exams. In terms of the causal attribution theory (Weiner, 1986, 1992) we may say that this student group locates the reasons for their failures along the external dimension. That is, they relate the cause of their achievements to external factors like the difficulty of the exam. Moreover, since most of them consider themselves as belonging to the good or average students in class, their self-competence regarding their ability to cope with the extended version is probably not very high and they
realise that they will better succeed in the regular version of the exam. Although they attributed their lack of success to external factors in the first exam, nevertheless they changed the exam version in the next exam realising their failure is not only a result of external factors.

The initial number of the “changers’” reasons referring to goals was low and it decreased from one exam to another. We may assume that the goals set for the first exam seem to the students to be less achievable after they received the exam’s grades. The research literature distinguishes between specialisation goals, which focus on improving one’s ability and developing particular skills, and operational goals, which focus on achievements and the demonstration of abilities (Ames, 1992; Maehr & Midgley, 1996). In the case of the “changers”, we can assume that their goals were operational ones.

The high number of reasons concerning mathematical ability in the first exam provided by the “changers” may be a result of the fact that they had to fill in the questionnaire after the exam. They probably had difficulties in solving the exam problems (as verified by the low scores they received) and so the majority of reasons they provided were concerned with mathematical ability.

The shift of the “changers” from extended to regular exam versions supported by the provided reasons may indicate a process of consolidation concerning the students’ self-perceptions. The decision of most of the students to choose the extended version in the first exam possibly stemmed from their ambitions and goals. The scores they received in the first exam indicated to them their actual mathematical achievement and helped them to monitor their choices better. The exams can be seen as learning operations which stimulate the process of shaping self-competence and redefining goals. After low scores in the first exam a decrease in students’ self-efficacy resulted in the change of versions from the extended to the regular. These results are in line with Bong and Skaalvik (2003) who found that high-level mathematics students are more accurate in their mathematical self-efficacy than low-level achievers. When students have freedom to express a preference, they usually tend to choose tasks in which they feel confident and avoid others (Pajares, 2002).

The reasons referring to motivation showed mixed behaviour: the increase in the number of reasons from the first to the second exam and the decrease in the
number of reasons from the second to the third exam. This phenomenon can be explained by the “changers’” behaviour. That is, their motivation came to fruition in believing that, by changing the exam version, they would succeed more and when these beliefs were verified (a raise in the scores from the first to the second exam) their motivation was fulfilled from their point of view.

In this study the student had to choose the exam version and therefore chose a certain behaviour. The difficulties the students experienced during the exam and the score they received serve as a source to shape their future behaviour. A possible interpretation may be: “I succeeded in the exam so I am capable of handling this version [regular]), so I might move to the harder one [extended]”, or, conversely, “Up to now I have chosen the extended version and have had no success so I have decided to choose the regular in order to succeed”. The “conservatives”, who demonstrated stability in their ability across the exams, received confirmation of their self-competence which showed in the gradual increase in their scores. As regards the “changers”, their behaviour was monitored by external factors and performance experience.

4.3 Learning goals of the students

After each of the three exams the students were asked in the questionnaire to refer to their learning goals. A total of 183 goals were revealed from the students’ responses. We refer only to responses received from the 20 students who sat all the three exams. Most of the students indicated several learning goals. These learning goals were classified into five main categories: learning in a high-level group; succeeding in their studies; receiving good scores; deepening their mathematical understanding; and learning in an average-level group.

In the category “learning in a high-level group” were included responses such as “I want to learn in the five-unit group [the highest level in our educational system] and I will not settle for any other option” and “to reach the maximum unit level”. In the category “success” were included responses such as “I want to succeed in my studies and in the matriculation examinations” and “I really want to succeed in mathematics and hope that I will actually do so”. In the category “good scores” were included responses such as “I want to receive a score between 70 and 90 in the five-unit group” and “I want to be in a position where I will pass the five-unit exam with a
score over 75”. In the category “deepening mathematical understanding” were included responses such as “I want to understand the mathematical learning themes, especially in geometry” and “sometimes I feel I understand the learning material but when I try to solve problems I realise I do not”. In the category “learning in an average-level group” were included responses such as “I cannot learn in the four-unit group as one needs to learn geometry and it is very difficult for me” and “I would prefer to get a good grade in the three-unit group than to get a low grade in the higher groups [4 and 5 units]”.

The distribution of the students’ responses concerning their learning goals across the three exams is presented in Figure 3.

![Distribution of learning goals](image)

Figure 3: Distribution of the students’ learning goals

Interpretation of Figure 3 reveals that the main goal of the students across the three exams is to learn in the high-level group although many of them changed the exam version from extended to regular. This can be explained by their knowledge that learning in the high-level group may enhance their chances of going to university. These goals may be considered as external ones as they are probably derived either from social pressure or are suggested by parents who encourage them to maximise their learning efforts. As regards the “receiving high scores” category the number of responses decreases across the three exams. This may be a result of data presented in Table 1 in which a gradual rise across the three exams in the students’ scores both in
the extended and the regular versions is observed. The responses relating to "deepening mathematical understanding" shows a stable number across the three exams. These responses were provided mostly by the student group who did not change the exam’s versions. We may assume that these students who consider themselves as belonging to the excellent student group in class have high self-competence regarding their mathematical abilities and among their learning goals are to deepen their mathematical understanding.

The goals indicated by the students are achievement goals that according to Ames (1992) can be classified according to the student’s intentions. Two main types of goals were distinguished by the education research literature: mastery and performance (Ames & Archer, 1988). The students who indicated goals to deepen their mathematical understanding can be considered as having mastery goals as such students focus on improving their abilities, developing new skills and obtaining mastery according to personal standards. They are eager to understand the content knowledge, and evaluate their success by testing their ability to use it properly. The other emerging categories may be attributed to students with performance goals who are primarily interested in whether they can perform assigned tasks correctly, as defined by the teacher. They seek success but mainly in familiar tasks and they avoid them or give up quickly when faced with challenging tasks. Their perception of ability is nurtured by the possibility of attracting external recognition. Perceived ability is judged by comparison with others, and high ability is evidenced by doing better than others (Ames & Archer, 1988; Nicholls, 1989).

Only a negligible number of students indicated goals classified under the category “learning in an average-level group”. Naturally, people set high goals for themselves even if they realised some of them would be difficult to accomplish. This can also explain the high number of goals under the category “learning in a high level group”. Delving into the data revealed that the students who indicated goals belonging to the category: “learning in an average-level group” were low achievers and had difficulties in coping with the regular version of the exams.

### 4.4 The class atmosphere

One of the researchers is a high school mathematics teacher, and the research was conducted in one of her classes. The following excerpt is a reflection on the process:
"As a school teacher for over 20 years, I had the opportunity to teach ninth-grade students many times, and I must say that in most cases the class atmosphere was unpleasant in comparison with the other classes I had taught, especially during the second semester in which the students knew they were going to be grouped to learning levels which might affect their studies in high school and even at university. During the mathematics lessons the students did not cooperate and many assertions like ‘What’s the point, anyway? I will be allocated to the average-level class next year’ were frequently heard in class. No matter what teaching methods I used, nor private talks I had with some of the students – nothing helped. In many of the talks with the students they expressed their dissatisfaction about being grouped in various levels in mathematics without having the opportunity to be part of this process. Their parents also complained that the school did not enable the students to make efforts to improve themselves in order to be able to join the higher-level mathematics group. I applied the above idea of letting the students be part of the decision making regarding the level of mathematics they would be grouped to and letting them choose the exam versions across the ninth grade. I was witness to a change in their behaviour across the learning year. It was indeed a big change: the class atmosphere was completely changed, expressions of frustration became very rare and both students and parents more readily accepted the mathematics level they were grouped to as they had the feeling the choice was theirs. In fact, most of the students were eventually placed on the level that suited their talents. Instead of the situation in which the student received a message at the end of the study year concerning the learning level he/she was grouped to, the students were engaged in a gradual process that helped them internalise and accept the learning level that fitted their talents. The autonomy provided to the students also shaped their self-competence regarding their mathematics abilities”. These results are in line with Black and Deci (2000) who found that an autonomy-supportive school classroom climate has a positive effect on students’ perceived competence as well as on their interest/enjoyment, efforts, and school performance. The concept of autonomy support was coined for understanding the social-contextual factors that affect students’ learning motivation (Deci & Ryan, 1985; Ryan & Deci, 2000). This concept describes a person in a position of authority (e.g., a teacher) as providing the other (the student) with information and choice, and minimising the use of pressure and control (Williams & Deci, 1996). Hallam and
Ireson (2007) explored pupils’ satisfaction with their ability group placement and arrived at similar conclusions.

There is no doubt that class atmosphere has a meaningful impact both on the teacher and the students during the teaching/learning process. Many researchers explored the effects of implementing innovative teaching/learning methods on the learning process on the one hand and on the mathematics class atmosphere on the other (Ah Chee Mok, 2009; Bellomo & Wertheimer, 2010; Graves et al., 2009; Kaygin et al., 2011) reaching the conclusion that they are mutually affected.

5. Concluding remarks and implications for teachers’ education

The process the students were engaged in during the ninth grade in which they were able to choose the exam version enabled a gradual adaptation to the mathematics level that fitted their talents. This gradual process involved the students’ development of a mechanism of management to monitor their mathematical self-perception, motivation and behaviour. According to the research results, the self-choice of the exam level nurtured the students’ need for autonomy and provided opportunities for each student to examine his/her goals and check them according to his/her performance. Observation of the students’ distribution according to the exam level in the three exams (Figure 1) demonstrates a shift from the case in which most of the students chose the extended level (exam 1) towards a case (exam 3) in which two-thirds of the class chose the regular exam and one-third the extended one. The gradual rise in the students’ scores across the three exams also points to the fact that they made the right decision in terms of exam level.

The reasons underlying the choice process indicated by the students were diverse and point to a process of shaping the students’ self-competence regarding their mathematical abilities according to the learning goals they set themselves and their actual achievements. The change in numbers of learning goals across the three exams (Figure 3) also points to a process in which the students are trying to find their place in class according to their talent and their actual achievements. When comparing the two student groups – that is, the one which changed exam versions (the “changers”) and the one which did not (the “conservatives”), we found that for the “changers” there was a shift from reasons concerning ability after the first exam to reasons concerning external factors and performance experience after the second and the third
exam whereas the reasons provided by the “conservative” group showed a stable distribution across the three exams for most of the categories. Whereas, however, the “conservative” group was motivated mainly by its goals, the “changers” changed their reasons from ability to external factors and performance experience.

The students’ learning goals were mainly performance or achievement goals and only the students belonging to the “conservative” student group set themselves mastery goals such as to deepen their mathematical understanding.

One of the research outcomes was the improvement in the class atmosphere. The class atmosphere was improved and expressions of frustration became very rare; above all, a rise in students’ competence concerning the learning of mathematics was observed across the three exams. Hence it can be concluded that, by the end of the ninth grade, the students made the right choice regarding the mathematical level that fitted their talents.

As to implications for teacher education, we believe that during their teaching practice teachers should be exposed to various ideas, such as the one presented in this study, so that they will be able to handle situations similar to the one described here. Such exposure conveys a message that teachers should be aware of and attentive to their students’ needs and invest efforts to create a suitable learning environment for them in order to enhance their mathematical learning.

Although the present study was conducted in the mathematics class, we believe it could be successful in any other learning subjects.

As the research group was not large we suggest that this research is repeated with a larger population in order to establish the results obtained.

References


