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Teaching, Learning Mathematics —Declarations *vs* Facts

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ABSTRACT

The study compares the mathematical achievements of high school students with their attitudes towards and perceptions of this subject. The study was conducted amongst students (n = 870) in the final (graduating) year of general high schools. Its purpose was to examine the relationship between the general performance in mathematics and attitude towards the subject, and to compare the general performance in mathematics of high school students with different attitudes towards mathematics. The correlation between mathematical abilities of general high school students and their attitude towards mathematics was found to be moderate. What is more, the correlation between attitudes towards mathematics and students' ability to solve tasks was found to be weak. Therefore, it can be concluded that if a student has a high or low ability to solve tasks, it does not necessarily mean that their attitude towards mathematics is also high or low, and the results achieved by the students are determined by the fact that taking an exam in mathematics is compulsory for final-year students rather than by the willingness to learn the subject. Students who are not enthusiastic about maths also take the compulsory final exams and very often their maths exam results were good.

KEYWORDS: teaching mathematics, poor academic performance, motivation to learn

Introduction

Mathematics, at its core, is the foundation of our daily functioning and development, permeating almost every aspect of human existence. Its presence manifests itself in a variety of forms and at various levels of complexity, from simple calculations that

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people do intuitively, to complex analyses serving as research tools in science and technology. It is the contemporary labour market, focusing on increasing digitization and automation, that puts emphasis on mathematical competence. This is true not only with respect to professions directly related to science, engineering or information technology, but also the humanities, arts and social sciences since all these domains are increasingly applying mathematical tools and methods. It is the ability to use logical thought, formulate problems precisely and find effective solutions, developed through learning mathematics, that is becoming a universal competence, valued across all sectors of the economy (Official Journal of the European Union, 2018).

In addition, mathematics plays a key role in a cognitive development of an individual. By systematically solving problems, proving theorems and analyzing logical structures, the human mind refines its ability for abstract thinking, critical analysis and creative problem-solving. Mathematics teaches intellectual discipline, precision of argumentation and the ability to draw data-based conclusions. These competencies, which go far beyond the discipline itself, are invaluable in the learning process, in adapting to changing conditions and effectively solving problems in every aspect of life. Mathematics, in this context, is perceived as not only a body of knowledge, but above all a tool that can shape the mind and develop the intellectual potential of the learner.

Importantly, there is no one true (external) point of view on the nature of mathematics, the goals of teaching mathematics and the essence of difficulties in the subject due to different perceptions of mathematics (Ernest, 1994). This results from the differences between "pure mathematics" and "school mathematics". Some researchers even point out that mathematics has become one of the most important myth-making areas in modern societies because it has been reduced merely to a school subject instead of perceiving it as a science (Walkerdine, 1998). What is more, the growing interest in "the problem of mathematics" in Poland results exclusively from the fact that mathematics has become a compulsory subject to be taken at the high school final exam rather than from the willingness to learn mathematics as a science or try to make it useful (Baczko-Dombi, 2022).

Despite the growing importance of mathematical competence in both everyday life and professional contexts, a significant number of students continue to express a negative attitude towards the subject. This raises pertinent questions about the impact of learners' dispositions on educational outcomes. Interest in the relationship between students' attitudes towards mathematics and their achievement stems from a need to better understand the motivational and cognitive mechanisms that underpin scholastic success. Does a positive attitude towards mathematics genuinely translate into higher achievement? Or might examination pressure and external motivation serve as sufficient drivers of academic performance, regardless of personal preference?

The aim of this study is to examine the relationship between the level of mathematical achievement among final-year secondary school students and their attitudes towards mathematics, including their perceptions of the subject. The analysis seeks not only to determine the strength and nature of this relationship, but also to identify factors that may support students in achieving educational success-even in the absence of a favourable disposition towards mathematics.

Attitudes towards mathematics

Mathematics education, that is "(…) a set of activities undertaken intentionally by teachers with a view to achieving socially acceptable teaching goals" (Zaczyński, 1997, p. 418), is the hard work of the teacher and the student alike. On the other hand, research conducted by David Blazar and Cynthia Pollard (2022) shows that students do not like making efforts or learning through making mistakes and exploring things; thus, they can find this way of learning frustrating. The researchers find it "disturbing" that students whose teachers were more effective in achieving better exam results, generally did better at school; however, such correlation did not result in the long-term benefits such as students' engagement in a learning process that requires considerable effort, resourcefulness, persistence and time, as well as overcoming various adversities.

The discrepancies between students' declarations and facts as regards learning mathematics are caused by a number of interrelating factors. Maths anxiety, which is often declared by students, is not just an emotional barrier, but it activates areas in the brain that are responsible for physical pain, which in turn significantly hinders the learning process (Oszwa, 2020). The abstract nature of mathematics makes the learning process even more difficult, particularly when students are not shown specific examples from everyday life. When students do not understand the practical application of mathematics, they find the subject useless, which consequently lowers their motivation. In addition, a lack of self-confidence, often fuelled by negative stereotypes and peer comparison, leads to a decline in self-confidence and a growing maths anxiety. This is why many students start avoiding the challenges involved in learning mathematics, which—in the long run—leads to educational failure (Karpińska & Remża, 2019).

A positive attitude towards mathematics results in successful performance in mathematics. It can be claimed that behaviour oriented towards problem-solving is a deliberate action of an individual aimed at achieving set tasks by inventing new methods or following planned steps on a regular basis to remove any setbacks and obstacles to goal attainment. It is an individual phenomenon, and involves the exercise of higher-order cognitive abilities and a constant and persistent struggle at the conscious and unconscious levels.

Lalit Kumar (1995) studied attitudes of high school students towards mathematics in relation to gender. He found that attitudes towards mathematics are the same for men and women, meaning that both groups show a similar degree of interest in and approach to the domain in question. Thus, there are no evident differences in their attitudes, their level of involvement or the way they perceive mathematics, indicating gender equality regarding this sphere.

Xin Ma and Nand Kishor (1997) studied the relationship between the attitude towards mathematics and achievements in mathematics; the strength of this relationship diminished as students moved on from middle to high school. Their studies also show an unchanging and weak relationship between having family support and being successful in mathematics at school, and a greater confidence in one's own skills despite the same level of achievement in mathematics. The researchers further found no statistically significant differences between a student's background and their level of school achievement in the subject.

Nevin Orhun (2007), on the other hand, conducted research amongst students of mathematics aimed at establishing a relationship between gender and learning style, achievements in mathematics and attitude towards mathematics. He found that there are differences between preferred learning styles of men and women, their achievements in mathematics and attitudes towards mathematics. However, achievements in mathematics and attitudes towards mathematics were not gender-specific. Orhun observed that female students, in most cases, preferred a converging learning style, through practical application of ideas, focusing on deductive reasoning with low emotional impact and narrow interests. In contrast, male students were most likely to choose the assimilating learning style, seeking additional information, considering other cases and drawing additional conclusions. None of the groups followed an accommodating learning style.

Research framework

The research results presented in the article constitute an excerpt from extensively designed research that focused on exploration, diagnosis and verification. The purpose of the research was to depict—in the diagnostic layer—the state of educational failure in mathematics in general high schools, i.e. manifestations, types, causes of such failure, as well as preventive measures taken to avoid failure. The aim of the verification layer was to determine the relationships and correlations between low school achievements and failure in mathematics vs selected socioeconomic, biopsychological and pedagogical factors. The research was conducted in the 2018–2019 school year (second term) in nine general high schools in Białystok amongst students of 33 classes

(graduation classes at that time); the research formed the basis of a doctoral thesis, prepared under the supervision of dr hab. Anna Karpińska, Professor of the University of Bialystok, defended at the University of Bialystok at the Faculty of Education Sciences (13 December 2024).

In order to obtain and collect (total n=870) interesting information directly from students, researchers used the diagnostic survey method. It was also this method that made it possible to learn about a certain social phenomenon, determine its scope, level and intensity, as well as evaluate it and, consequently, design modifications. On this basis, three levels of school achievement in mathematics were distinguished: high, medium, and low. The students that participated in the research were categorized into a specific level based on their end-of-term grade in mathematics, as follows:

1) students with a high level of school achievement in mathematics—65 students (7.47%), who received excellent or very good grade in mathematics at the end of the term;
2) students with a medium level of school achievement in mathematics—432 students (48.62%), who received good or satisfactory grade in mathematics at the end of the term;
3) students with a low level of school achievement in mathematics—382 students (43.91%), who received acceptable or fail grade in mathematics at the end of the term.

The case study method enabled "the analysis of individual human fates caught up in specific educational situations, or the analysis of specific educational phenomena (that is, the percentage of school failure in mathematics) through individual biographies (that is, the percentage of students experiencing learning difficulties in mathematics) with a focus on developing a diagnosis of the given case or phenomenon in order to take therapeutic action" (Pilch & Bauman, 2001, p. 76).

Student's self-assessment

An indicator of school achievement and failure, in addition to end-of-term grades, is the student's self-assessment. It was assumed that if the respondent chooses the statement "I am a weak student", this indicates school failure of a temporary nature; on the other hand, if the respondent chooses the statement "I am a very weak student", this means they experienced evident failure of a relatively permanent nature (Karpińska, 2013).

Chart 1 as presented below illustrates the level of self-assessment of the students participating in the research. An important point is that less than 1% describe them-

selves as an excellent student, and approx. 6% believe they are very good at mathematics. One in five high school students (22%) believes they are a good student. The group participating in the research mostly describes themselves as satisfactory (38%) and weak (30%) students, and less than 4% as very weak.

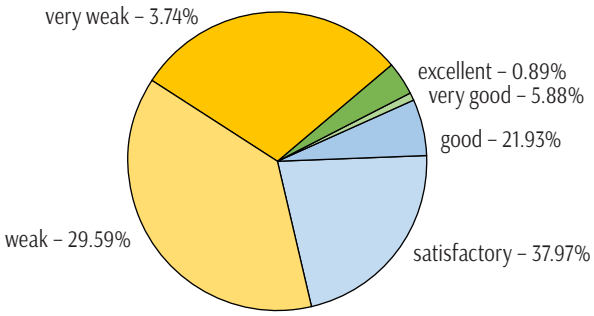

Chart 1. Student's self-assessment

Source: own research (based on a student questionnaire)

According to the adopted assumption, students who perceived themselves as weak and very weak in mathematics, experience failures of a temporary nature in this subject in the form of periodic difficulties and require the support of remedial teams or/and tutoring, as well as evident failures manifested by serious difficulties, the threat of repeating the year or being conditionally promoted to the next year. In compliance with their own self-assessment, one in three students (33%) experiences various forms of school failure in mathematics. This is lower than the value that defines the low level of school achievement in the sample under research (end-of-term grade in mathematics), that is about 44%. This allows us to conclude that more than 10% of students, despite a low end-of-term grade in mathematics (acceptable or fail), have an inflated self-assessment.

Table 1 presents more detailed data, i.e. the level of school achievement based on the end-of-term grade in mathematics is compared with the students' self-assessment.

The analysis of the data presented in Table 1 shows that most high school students are aware of their level of knowledge and skills in mathematics; this is confirmed by the calculated value of $X^2 = 648.91$ for $p < 0.001$ and $C_{kor} = 0.76$, which proves a very strong and high (statistically significant) relationship in the sample under study between the level of school achievement in mathematics and students' self-assessment (this is also confirmed by percentage results).

Table 1. Students' self-assessment *vs* the level of school achievement in mathematics

Achievement level	Student self-assessment													
	total		excellent		very good		good		sufficient		poor		very poor	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
total	**870**	**100.00**	**12**	**1.38**	**99**	**11.38**	**248**	**28.51**	**257**	**29.54**	**179**	**20.57**	**75**	**8.62**
high	**65**	**100.00**	12	18.46	41	63.08	12	18.46	-	-	-	-	-	-
medium	**423**	**100.00**	-	-	58	13.71	180	42.55	158	37.35	23	5.44	4	0.95
low	**382**	**100.00**	-	-	-	-	56	14.66	99	25.92	156	40.84	71	18.59

Source: own research (based on a student questionnaire) $X^2 = 648.91$; $df = 10$; $p < 0.001$; $C_{kor} = 0.76$.

Amongst the students participating in the research, over half of high-achieving students in mathematics assess themselves as very good students, i.e. 63%. The group, in terms of achievements in mathematics, also includes excellent and good students (more than 18%; this applies to both response options). Thus, a perfectly symmetrical distribution is obtained amongst grades in the <6.4> range for students with a high level of achievement in mathematics, as presented in Chart 2.

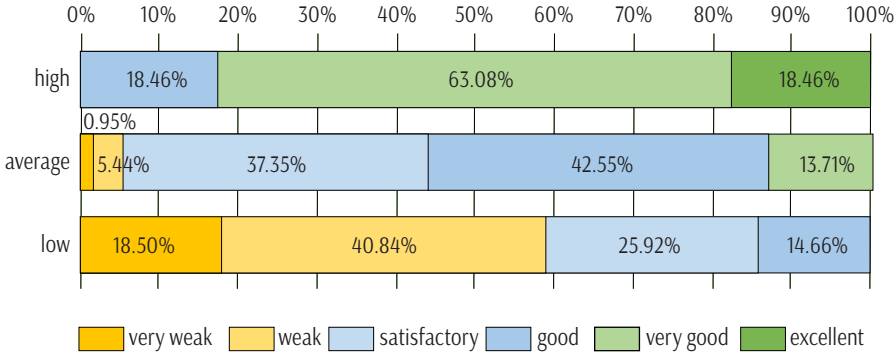

Chart 2. Students' self-assessment *vs* the level of school achievement in mathematics

Source: own research (based on a student questionnaire)

Amongst students with an average level of achievement, almost 14% consider themselves very good at mathematics, despite obtaining good and satisfactory grades at the end term. In terms of frequency, the largest number of students with average achievement assessed themselves as good students in mathematics (about 43%), slightly fewer third graders assessed themselves as satisfactory students (about 37%). Weak students in this group account for more than 5%, and the very weak for nearly

1%. In terms of quantitative distribution, there is a tendency to higher self-assessment than evident from the end-of-term grades received in the <5.1> range.

High school students with low school achievement in mathematics are generally aware of their difficulties. The largest number of students with low school achievement in mathematics assessed themselves quite low, i.e. 41% of them chose the response "weak", and 19% "very weak". This suggests a more critical self-assessment in the group of students with low school achievement in mathematics who participated in the research (cf. Chart 2). Satisfactory students in the self-assessment account for just over 25% of the group who participated in the research, and less than 15% of the respondents are considered good students. This allows us to conclude that amongst students with low school achievement in mathematics there is a large number of students with inflated self-assessment (more than 40%). Perhaps they are not aware of the difficulties or setbacks they experience.

Importantly, students' self-assessment plays a very significant role in the educational process. The ability to accurately assess our level of knowledge and skills is key to success; it motivates us to take action and set goals, and increases our persistence in pursuing them. However, it is also essential to be aware of our setbacks, not to overestimate our abilities, but—at the same time—not to underestimate them, as this can result in developing an inappropriate approach to learning, in this case to learning mathematics.

> Self-image characterised as a primary regulator of our behaviour plays an important role in being successful at school, among others. The research conducted by M. Tyszkowa shows that a positive self-image promotes mental resilience to difficult situations and facilitates proper functioning as a student (…). The regulatory role of self-image at school is mentioned by Tyszkowa, among others. Her research conducted amongst children and young people of school age showed higher mental resilience to difficult situations and better functioning as a student of children who had a positive self-image and whose self-assessment matched their real capabilities, compared to children who had a negative self-image and whose self-assessment was unstable and inaccurate (after Wrona-Polańska 1996, p. 37).

Motivation for learning mathematics

A very important cause of school failure is various disorders and deficiencies of cognitive processes. Fundamental disorders and deficiencies comprise a lack of motivation for learning, slow thinking, and difficulty concentrating. They impede the learning progress of children and young people at school and can be a source of school failure (Sochacka, 1998), as evidenced by the data shown in the table below and in the accompanying chart.

Table 2. Motivation for learning *vs* the level of school achievement in mathematics

Level of school achievement	Motivation to learn mathematics											
	total		very low		low		average		high		very high	
	n	%	n	%	n	%	n	%	n	%	n	%
total	**870**	**100.00**	**142**	**16.32**	**231**	**26.55**	**317**	**36.44**	**153**	**17.59**	**27**	**3.10**
high	**65**	**100.00**	-	-	2	3.08	31	47.69	24	36.92	8	12.31
medium	**423**	**100.00**	59	13.95	87	20.57	173	40.90	95	22.46	9	2.13
low	**382**	**100.00**	83	21.73	142	37.17	113	29.58	34	8.90	10	2.62

Source: own research $X^2 = 119.08$; $df = 8$; $p < 0.001$; $C_{kor} = 0.41$.

John Dewey believed that the most essential attitude that can be developed at school is the desire to learn (Dewey, 1986). Hence, the aim of the research was to verify the following null hypothesis: There is no relationship between the motivation for learning mathematics and the grades received by students.

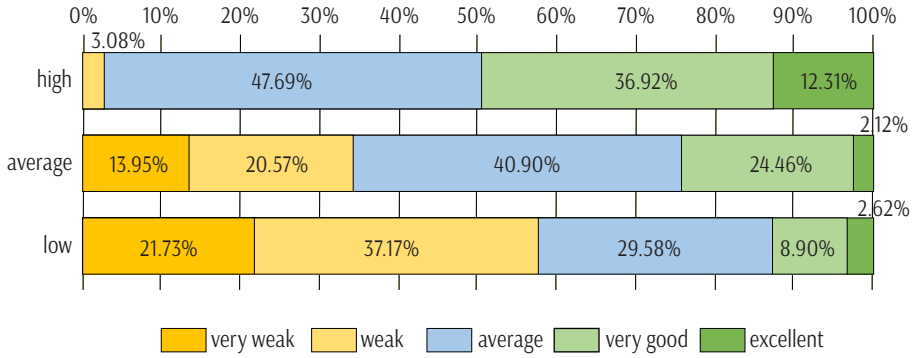

Chart 3. Motivation for learning *vs* the level of school achievement in mathematics

Source: own research.

Applying the rules of statistical inference on the basis of the calculated value of $X^2 = 119.08$ $df = 8$; $p < 0.001$ and the fact that $X^2_{empirical} > X^2_{theoretical}$, the null hypothesis is rejected, and the contrary hypothesis is accepted, thus there is a relationship between the motivation for learning and school achievement in mathematics. The strength of the relationship is moderate and Pearson's adjusted contingency coefficient C is $C_{kor} = 0.41$.

As shown in Chart 3, students with high levels of school achievement in mathematics almost in 100% of the cases indicate at least average motivation for learning. At the same time, the number of high school students with an average level of

achievement declaring their motivation for learning to be below average is already about 35%, and amongst respondents with a low level of achievement, more than 50% declare their motivation to learn mathematics to be below average.

The motivation for learning reflects the student's subjective feelings, their desire to engage in lessons and in the learning process. Thus, it is a factor inherently related to the student, which constitutes a direct response to higher-order needs felt by the student, and therefore closely related to school education. According to Abraham Maslow's hierarchy of needs theory, this factor determines the emergence of the need for knowledge and the need to engage creatively with intellectual challenges as well as serves as a key mechanism for changing an individual's behaviour in order to achieve better grades (Madsen, 1980).

The degree of concentration in mathematics lessons

Another biopsychological factor that the high school students who participated in the research can influence directly (and teachers indirectly) is their concentration in class.

Table 3. Degree of concentration in mathematics lessons *vs* the level of school achievement in this subject

Level of school achievement	Degree of concentration in mathematics lessons											
	total		very low		low		average		high		very high	
	n	%	n	%	n	%	n	%	n	%	n	%
total	**870**	**100.00**	**72**	**8.28**	**149**	**17.13**	**375**	**43.10**	**237**	**27.24**	**37**	**4.25**
high	**65**	**100.00**	-	-	2	3.08	22	33.85	36	55.38	5	7.69
medium	**423**	**100.00**	33	7.80	44	10.40	182	43.03	147	34.75	17	4.02
low	**382**	**100.00**	39	10.21	103	26.96	171	44.76	54	14.14	15	3.93

Source: own research 2019 $X^2 = 102.70$; $df = 8$; $p < 0.001$; $C_{ko}r = 0.38$.

Statistical analyses in terms of this variable confirmed that there is a relationship between the degree of concentration in class and school achievement in mathematics ($C_{kor} = 0.38$).

About 3% of high-achieving students declare that their level of concentration during their work in mathematics lessons is low. Amongst students with an average level of achievement, there are already more than 18% of those with low or very low levels of concentration. In contrast, twice as many (i.e. about 37%) students with low level of school achievement describe their level of concentration as below average.

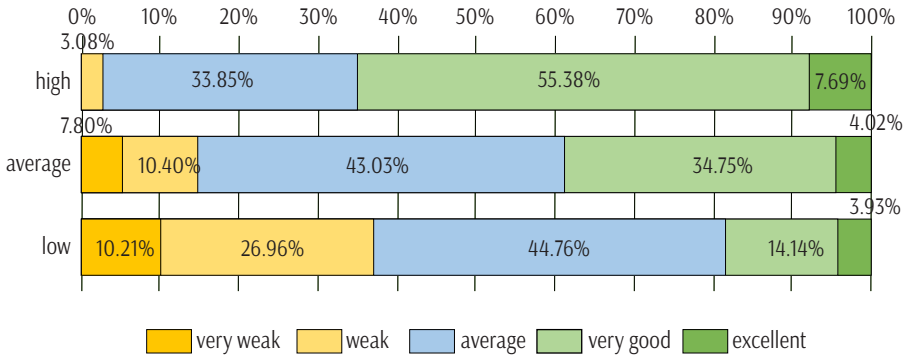

Chart 4. Degree of concentration in class *vs* level of school achievement in mathematics

Source: own research (based on a student questionnaire).

An equally important reason why students achieve low grades in mathematics is their pace of work in class, as teachers of mathematics distinguish 'work in class' category in their subject grading systems.

The pace of student work in class

Data declared by high school students concerning the pace of their work in mathematics are shown in Table 4 and on Chart 5.

Table 4. The pace of student work in class *vs* the level of school achievement in mathematics

Level of school achievement	The pace of student work in class											
	total		very slow		slow		average		fast		very fast	
	n	%	n	%	n	%	n	%	n	%	n	%
total	**870**	**100.00**	**73**	**8.39**	**235**	**27.01**	**373**	**42.87**	**166**	**19.08**	**23**	**2.64**
high	**65**	**100.00**	-	-	5	7.69	17	26.15	34	52.31	9	13.85
medium	**423**	**100.00**	24	5.67	73	17.26	219	51.77	93	21.99	14	3.31
low	**382**	**100.00**	49	12.83	157	41.10	137	35.86	39	10.21	-	-

Source: own research 2019 $\chi^2 = 183.42$; $df = 8$; $p < 0.001$; $C_{kor} = 0.49$.

Statistical analyses confirmed the existence of a relationship between the pace of work during the lesson and the level of achievement in mathematics. The strength of the relationship is moderate, and $C_{kor} = 0.49$.

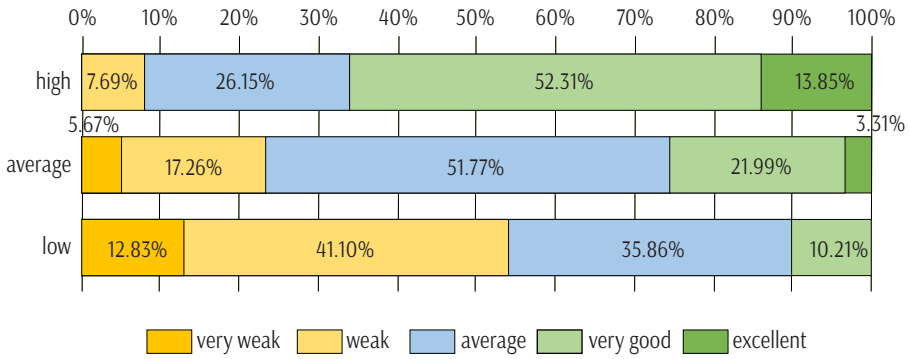

Chart 5. The pace of work in class *vs* the level of school achievement in mathematics

Source: own research (based on a student questionnaire).

About 8% of high-achieving students declare that their pace of work in mathematics is low. Amongst students with average levels of achievement, there are already three times as many high school students who work very slowly or slowly (23%), and amongst low-achieving students, more than half declare that their pace of work is below average.

The discrepancy between the teacher's pace during the lesson and the student's pace is evidenced by the comments made by students concerning things that they find most distracting during mathematics classes. Below, there are some of the students' statements: "The thing that distracts me the most is that the pace of doing exercises is too fast, sometimes I struggle to even copy from the board, let alone solving the exercises by myself." "Exercises are done too fast, they are complex, which makes it impossible to understand anything." "No individual approach to the student. The teacher solves exercises too quickly without explaining them for students who do not understand. She prefers to do more exercises rather than explaining them in depth so that everybody would understand." "Exercises are solved too quickly, which makes it impossible for me to understand anything; I get frustrated, and, in consequence, I feel like giving up on the task."

The pace of work that is too fast (enforced by the teacher) was mentioned in one in three comments about mathematics classes, and the large amount of material to be learnt causes further lesson-related problems as pointed out by high school students, i.e.: "No time to revise difficult material that was covered earlier." "No time to explain the topic to those students who do not understand it." "No time to think about the solution and justify why we are doing a given exercise." "No matter how much time I spend, I still struggle during the class, my teacher can't and won't help me. I am helpless. I don't like maths lessons!!!"

The statements cited above may indicate a high level of frustration amongst high school students, which consequently results in social disorders and may manifest itself in neglecting school duties or even avoiding them as an effective way to solve school problems (cf. Zińczuk, 2019).

Neglecting school duties

Data on the attitudes towards school duties of the high school students who participated in the research are shown in Table 5 and Chart 6.

Table 5. Neglecting school duties *vs* the level of school achievement in mathematics

Level of school achievement	Neglecting school duties											
	total		no		rather not		cannot say		rather yes		yes	
	n	%	n	%	n	%	n	%	n	%	n	%
total	**870**	**100.00**	63	7.24	271	31.15	255	29.31	217	24.94	64	7.36
high	**65**	**100.00**	7	10.77	34	52.31	19	29.23	3	4.62	2	3.08
medium	**423**	**100.00**	36	8.51	139	32.86	143	33.81	82	19.39	23	5.44
low	**382**	**100.00**	20	5.24	98	25.65	93	24.35	132	34.55	39	10.21

Source: own research (based on a student questionnaire) $X^2 = 61.87$; $df = 8$; $p < 0.001$; $C_{kor} = 0.30$.

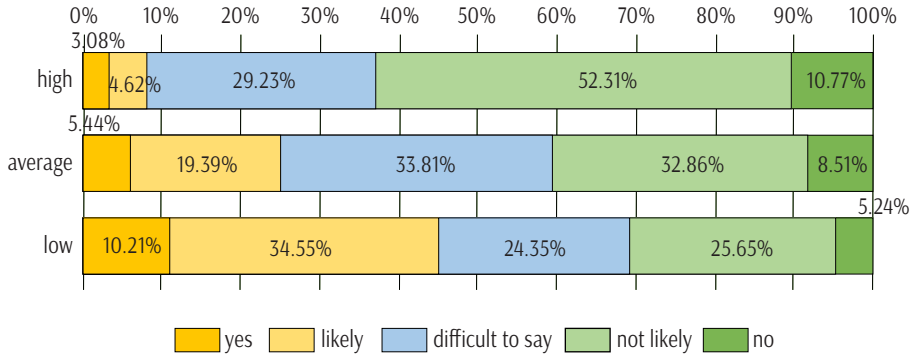

Chart 6. Neglecting school duties *vs* the level of school achievement in mathematics

Source: own research (based on a student questionnaire).

The statistical analysis performed confirmed the relationship between neglecting school duties and the level of achievement in mathematics ($\chi^2 = 61.87$; $df = 8$; $p < 0.001$; $C_{kor} = 0.30$)

In the group of high school students from Białystok, almost 8% of the respondents with a high level of achievement in mathematics declare that they occasionally neglect their school duties, and about 63% of them try to perform school duties diligently, which was confirmed by their replies, that is "no" or "not likely" given in the questionnaire.

In the group of students with an average level of achievement, there are already 25% of the respondents who notice that they neglect their school duties and about 41% who perform their school duties diligently. On the other hand, in the group of low-achieving students, 45% allow the possibility of neglecting school duties and only about 30% declare that they completely or almost completely perform their school duties.

The statements made by high school students that are quoted on the previous page and the results as regards neglecting school duties by low-achieving students in mathematics paint a very unfavourable picture, that is students perceive their own slow working pace as a result of the teacher's overly fast approach. They believe that they have little control over the course of the lesson, so they would reduce the risks and avoid failure by neglecting their school duties, as explained by the attribution theory developed by B. Weiner. This, however, does not mean that the students' level of motivation for learning is low. On the contrary, they are highly motivated, but to avoid failure, not to achieve success (cf. Kozieł, 2011).

Attempt at a summary—conclusions

Already in 2019, the Supreme Audit Office (*Najwyższa Izba Kontroli*, NIK) expressed concern about the pass rate in mathematics (*Teaching Mathematics at Schools*, 2019). The key factors that contributed to the low pass rate included the overly fast pace of the lesson, limited access to remedial classes, no classes for specially gifted students, the fact that teachers did not support their students equally and that classes comprised students with diverse levels of competence. In addition, the research shows that in recent years school failure in mathematics has definitely become more common (the number of school failures has increased). This is probably due to the fact that the final exam (matura) in mathematics was made obligatory again in 2010, which means that every graduating student has to take the exam in mathematics at the basic level. Until 2010, only students interested in mathematics took the exam, hence better results. Interestingly, even amongst students who do not experience failures in mathematics on a daily basis, the pace of work has decreased significantly, which translates into lower results in high school final exams, and problems in math-

ematics are an implication of an array of circumstances shaping their image and place in the teaching process.

The empirical distribution of school achievement in mathematics in the general high school respondents allows us to conclude that in the high schools that took part in the research the predominant level of school achievement is average, i.e. the final grade in mathematics obtained for the first term by almost half of the third graders was good or satisfactory. Low school achievement is slightly less common, but still the total number is alarmingly high, i.e. the end-of-term grade in mathematics obtained by about 44% of third graders was acceptable or fail. High-achievers in mathematics constitute the least numerous group, i.e. slightly more than 7% of high school students obtained excellent or very good end-of-term grade in mathematics.

In the sample under study, there are more people with low school achievement in mathematics than those who see themselves as weak and very weak students in mathematics. This, in turn, allows us to conclude that a considerable number of students has inflated self-esteem. In total, students who experience various forms of school failure in mathematics, in their self-assessment comprise about 30%. This is less than the value that defines the low level of school achievement in the sample under research (about 44%). This allows us to conclude that more than 10% of students, despite a low end-of-term grade in mathematics (acceptable or fail), have an inflated self-assessment.

For low-achieving students in mathematics, high school is a real breeding ground for failure. Such students believe that learning mathematics requires them to make a disproportionately greater amount of effort studying the subject compared to the results they achieve. In addition, the issue might be rooted in the very essence of teaching mathematics, that is the process is task-based, and solving tasks comprises a multitude of situations where students can make mistakes, which results in a lower or even a fail grade. Such perceptions of mathematics as a school subject are determined by reluctance to learn mathematics, teaching reasons, including no time during the lesson for explanation, discussion, asking questions, as well as subjective attitudes towards the subject. About 40% of low-achieving students openly admit that they do not like mathematics.

Mathematics is perceived as a difficult subject, and the motivation for learning it varies amongst students, which justifies a moderate relationship between motivation and school achievement in mathematics. The lower the motivation for learning and the lower the level of concentration, the lower school achievement. Statistical analyses concerning this variable confirmed a relationship between the level of concentration during the lesson and school achievement in mathematics, and a relationship between the level of school achievement in mathematics and the pace of work in class.

In the group of students from high schools in Białystok it is the low-achieving students who neglect school duties more often than other students, and the statistical analysis also confirms a relationship between the level of school achievement and neglecting school duties.

From a group of 382 respondents (with low school achievement), 183 detailed results of the final exam in mathematics were obtained. The analysis of individual cases allows us to conclude that exam results are not determined exclusively by grades, but there are many other factors, such as stress level, motivation, concentration level, work pace or even additional classes that can also significantly affect the final result.

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