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COMPARISON OF PUPILS' SELF-CONCEPTS IN MATHEMATICS IN THE CONTEXT OF THE TRANSITION TO THE LOWER-SECONDARY SCHOOL

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Abstract

Academic self-concept shapes pupils' attitude toward individual subjects and overall academic performance. The study analyses the relationship between self-concept in mathematics and other domains of academic performance. Data were collected using the standardized SPAS questionnaire (*Student's Perception of Ability Scale*, Matějček, Vágnerová, 1992) and administered to Grade 5 and Grade 6 pupils. In Grade 5, self-concept in mathematics is significantly associated with higher self-confidence. In Grade 6, this link weakens and there is a gradual decline in self-concept across all examined domains. The transition from primary to lower-secondary education thus may lead not only to reduced confidence in mathematics but to lower academic performance and a diminished overall academic self-concept.

Keywords: Academic self-concept, Self-concept in mathematics, SPAS questionnaire, Transition to lower secondary school, Academic achievement, School performance

1. Introduction

Self-concept and academic achievement are two closely interrelated constructs that have gained an increasing attention in Czech education policy in recent years. The emphasis on supporting pupils' individual development and emotional well-being is evident both in the government's lead educational strategy document Strategy 2030+ (MŠMT, 2020) and in the curriculum-reform materials that articulate the future shape of the national curriculum and highlight factors influencing children's long-term relationship to learning (MŠMT, 2022). Recent surveys (MŠMT, 2020; OECD, 2019) further indicate a decline in pupils' willingness to attend school, a trend closely linked to self-concept, which in turn affects performance and academic success (Havlínová, Chmátalová, Slunečko, 2023). Self-concept is also tightly connected to pupils' motivation: a positive self-concept supports persistence, the approach to problem solving, and analytical thinking, which are the key aspects underpinning, among other things, the development of critical thinking (MŠMT, 2020).

Self-concept in mathematics, as one segment of the complex construct of academic self-concept, has increasingly drawn researchers' attention (e.g., Pajares, 2005; Usher, Pajares, 2009; Burnham, 2011; Smetáčková, 2016). In this area, a gradual decline has been observed alongside worsening overall academic outcomes (Eccles, Wigfield, 2000). Moreover, the Ústí nad Labem Region, where our study was conducted, is characterized by high rates of underachievement, grade repetition, and pronounced absenteeism (PAQ, 2023). All these factors are linked not only to academic self-concept but also to academic results and self-concept specifically in mathematics. A decline in self-concept in mathematics may also contribute to reduced pupils interested in STEM subjects (Rokos, Koldová, 2024), a concern echoed by other authors who indicate declining student interest in these fields (Trna, Trnová, 2015; Hašková, Bílek, Cakmakci, 2024; Skřivanová, 2025). Mathematics is a particularly salient component of STEM and underpins one of the two key literacies; logical–mathematical literacy is now assessed through expected learning outcomes in Grades 3, 5, and 9 (MŠMT, 2025).

2. Self-Concept of Academic Achievement in Mathematics

The construct of self-concept is a major research topic and is key to understanding the internal processes that shape human behaviour, action, and decision-making in specific situations. It is regarded as a foundation of the self (Smékal, 2009), has a dynamic nature through which it is continuously formed (Helus, 2018), and can be viewed as a summary of one's knowledge and beliefs about oneself (Výrost, Slaměník, 2008). Some authors treat self-concept as equivalent to self-reflection (Hartl, Hartlová, 2000) or as a term closely related to self-knowledge and self-evaluation (Macek, Šulcová, Konečná, 2009; Konečná, 2010; Průcha, Walterová, Mareš, 2013). Despite the diversity of these approaches, a common core emerges: a hypothetical construct describing self-concept as the content of consciousness primarily related to one's representation of the self (Průcha, Walterová, Mareš, 2013; Svoboda, Smolík, Tirpák, Uhrinová, 2020).

Mathematical self-concept is closely linked to self-evaluation, grounded not only in comparisons with individuals we admire and regard as embodying our aspirations (Haysová, 2009; Helus, 2018), but also in contrasts between our actual performance and an ideal performance (Smetáčková, 2016). It can be understood as an individual's belief in their capacities to solve specific mathematical problems and to do so successfully (Pajares, 2005; Smetáčková, 2016). Mathematical self-concept develops and forms mainly through four sources: repeated experiences of success; vicarious experiences of others' success, especially by close or similar others; persuasive feedback affirming one's capability; and the management of situational factors, notably emotions, stress, and somatic states (Bandura, 1997; Smetáčková, 2016). Key mathematical competencies are correlated with this form of self-concept, within these competencies, the aim is that, over the course of mathematics education, the pupils increase confidence in their abilities, deepen interest in mathematical applications, and develop a positive attitude towards mathematics (MŠMT, 2025). A positive self-concept in mathematics subsequently supports desirable academic outcomes: pupils then tend to approach new tasks with greater confidence and achieve higher success rates (Wigfield, Karpathian, 1991; Stringer, Heath, 2008; Helus, 2018).

A specific form of self-concept is academic self-concept, defined as the way a pupil perceives and evaluates themself in comparison with peers (Mertin, Krejčová et al., 2016). Self-concept in mathematics is therefore strongly shaped by this academic dimension and is reflected in pupils' overall approach to mathematics. With increasing age, school outcomes become more closely tied to academic self-concept and thus influence overall performance (Vágnerová, 2012). This is also captured by the *Big-Fish–Little-Pond Effect* (BFLPE): exposure to higher-achieving classmates is associated with lower academic self-concept, whereas exposure to lower-achieving classmates is associated with higher academic self-concept (Keller, Kim, Elwert, 2023). Accordingly, pupils surrounded by more successful classmates tend to report lower self-concept - even when their own performance is not poor (Marsh, 1984, as cited in Keller, Kim, Elwert, 2023). On the other hand, subject-specific academic self-concept fosters higher motivation, achievement, and supports pupil's broader personal development in the school environment (Mertin, Krejčová, 2016).

The article presents findings from a study conducted with the SPAS questionnaire (*Student's Perception of Ability Scale*; Matějček & Vágnerová, 1992). The research focuses on changes in academic self-concept in mathematics during the transition to lower secondary education (Grade 6). The aim is to analyse the relationship between self-concept in mathematics and other domains of school performance—reading, orthography, writing, general abilities, and self-confidence - with the attention to differences by grade, gender, and between students with special educational needs (SEN) and their non-SEN peers. Data were collected from the same group of pupils in Grade 5 in the 2023/2024 school year and again in Grade 6 in 2024/2025.

3. Methodology

The study used the SPAS questionnaire (Matějček & Vágnerová, 1992). Data collection and analysis were conducted in consultation with an experienced child psychologist, who also provided training on scoring, interpretation, and reporting. The instrument assesses six domains - general abilities, mathematics, reading, orthography, writing, and self-confidence - addressing pupils' perceptions of their abilities, their performance in specific subjects, and their position within the peer group. Items in the test are dichotomous (Yes/No).

For the statistical analysis, nonparametric tests were used, specifically the Wilcoxon signed-rank test, the Wilcoxon rank-sum test, and the Kruskal–Wallis test. In addition, a Linear Mixed Model (LMM) was used to reflect that each pupil was assessed twice (in Grade 5 and Grade 6).

The research sample consisted of pupils in Grade 5 in the 2023/2024 school year. We obtained completed questionnaires from 215 children (111 boys, 104 girls). At the second administration one year later (2024/2025), involving the classes with same pupils now in Grade 6, data were obtained for 177 children (92 boys, 85 girls). For analytic purposes, the key group comprised only pupils with data from both administrations, enabling direct comparisons. In total, 145 pupils were present at both tests.

The raw scores were converted using the standardized ten-point STEN scale. STEN values were then derived from conversion tables that differ for boys and girls determined by age and total raw score. Higher STEN scores on the 1–10 scale indicate a higher level of self-concept in mathematics. Table 1 presents the percentage distribution of pupils together with their gender composition.

Table 1. The research sample

First Administration (2023/2024)		**Second Administration (2024/2025)**	
Boys	111 (52 %)	Boys	92 (52 %)
Girls	104 (48 %)	Girls	85 (48 %)
Total	215	Total	177

4. Results

The results are presented as follows: comparisons of self-concept across all tested domains between grades; differences in pupils' self-concept in mathematics after the transition to lower secondary school; grade-specific results by gender; comparisons between pupils with special educational needs (SEN) and those without SEN; and comparison of self-concept in mathematics with the other tested domains.

Figure 1 shows that Grade 5 pupils reported higher mean scores across all domains than the same pupils one year later, after the transition to lower secondary school. While the difference in academic self-concept was statistically significant ($p < .05$), the difference in self-concept in mathematics was not ($p > .05$). Nevertheless, there was a very small age-related decrease of 0.23 STEN points in self-concept in mathematics. Pupils in both grades rated their self-concept in mathematics at approximately the same (upper-average) level on the STEN scale.

Mathematics exhibits the highest mean scores in both grades, indicating a generally positive self-concept of pupils in this domain.

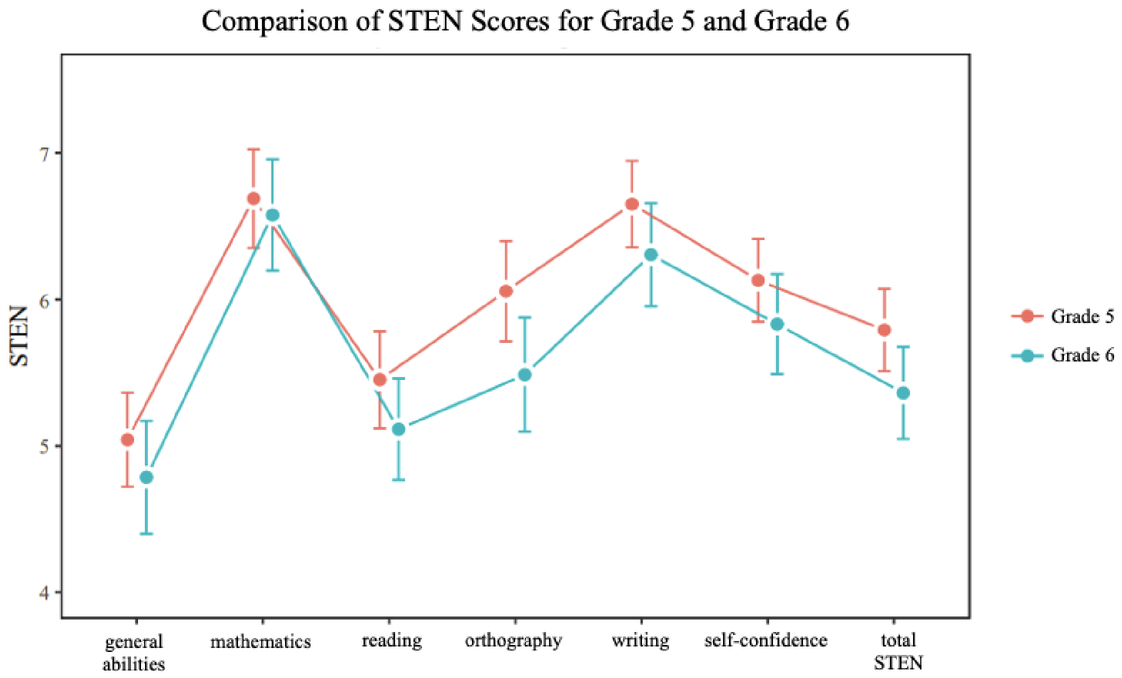

Chart 1. The mean scores in self-concept in all domains for both grades

In addition to Chart 1, Chart 2 depicts differences in pupils' self-concept in mathematics during the transition to lower secondary school. Specifically, it plots Grade 6 values against pupils' own Grade 5 values (i.e., Grade 6 − Grade 5). The chart displays, for each pupil, whether their self-concept in mathematics improved or declined in comparison with their younger self. Among the 145 pupils with matched observations, 36 obtained the same STEN value at both time points. The remaining scores span almost the full scale, indicating substantial heterogeneity: while some pupils showed marked decreases in self-concept in mathematics, others exhibited notable increases.

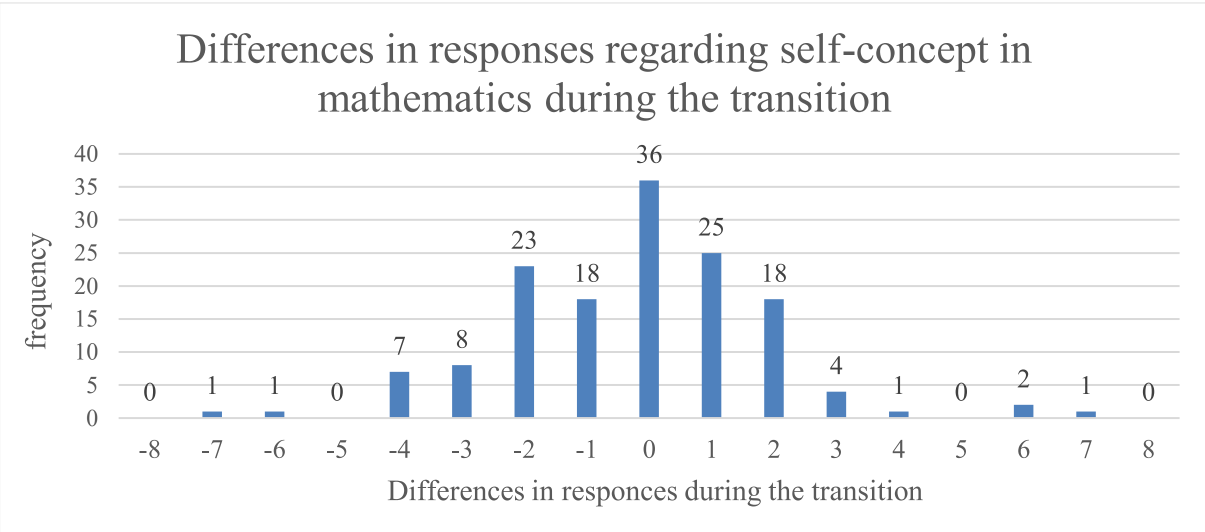

Chart 2. Differences between Grade 6 and Grade 5 responses in mathematics.

The next charts (3 and 4) present mean values by gender in Grades 5 and 6. In both grades, girls report a slightly more negative self-concept in mathematics than boys, and they show a more pronounced decline after the transition to lower secondary school (the mean decreased by 0.42 STEN points). On the contrary, boys exhibit a modest increase after the transition, with their mean rising by 0.14 STEN points. However, for neither group was the grade-to-grade change statistically significant at $\alpha = .05$ (girls: $p = .19352$; boys: $p = .37515$).

The charts also reveal domain-specific differences in which boys and girls excel. Boys achieved the highest STEN scores in mathematics (Grade 5: 7.20; Grade 6: 7.34), whereas girls recorded their highest mean STEN values in writing in both grades. In mathematics, girls' mean STEN values were in the average range (Grade 5: 6.14; Grade 6: 5.72). These differences were examined using the Wilcoxon rank-sum test; in the mathematics domain, a statistically significant difference between boys and girls was observed within each grade ($p < .05$).

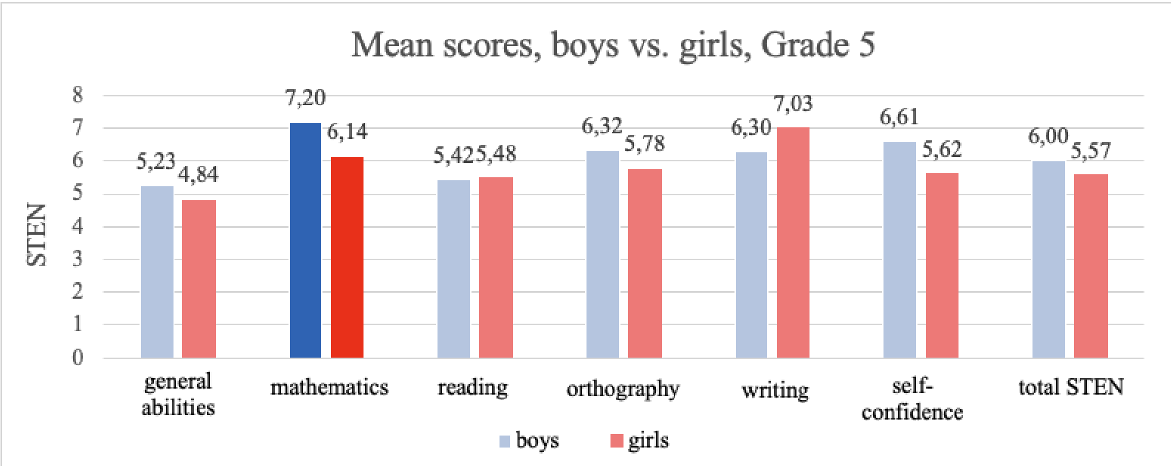

Chart 3. Gender differences in mean scores of self-concept, Grade 5

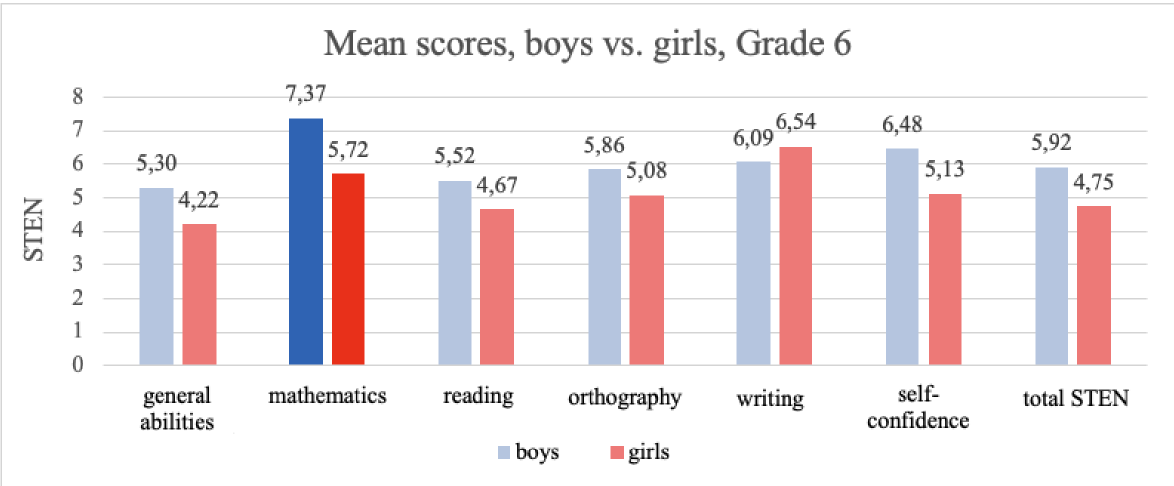

Chart 4. Gender differences in mean scores of self-concept, Grade 6

Comparisons of mean scores for pupils without SEN (non-SEN) and pupils with SEN (SEN) are shown in Charts 5 and 6. Although no statistically significant differences were detected between the groups across the transition to lower secondary school, the data suggest that pupils with SEN reported a more negative self-concept in mathematics than their peers without SEN. After the transition, the between-group difference in self-concept in mathematics shifted in a more negative direction relative to Grade 5; on average, self-concept in mathematics declined by about 0.20 STEN points. The same pattern held when examining each group separately: both pupils with SEN and those without SEN showed small declines, neither of which was statistically significant.

However, in all SPAS domains - with the sole exception of mathematics in Grade 6 - statistically significant differences ($p < .05$) between pupils with SEN (SEN) and those without SEN (non-SEN) were observed when grades were analysed separately. This pattern is consistent with Chart 5 and 6, which likewise indicate between-group differences.

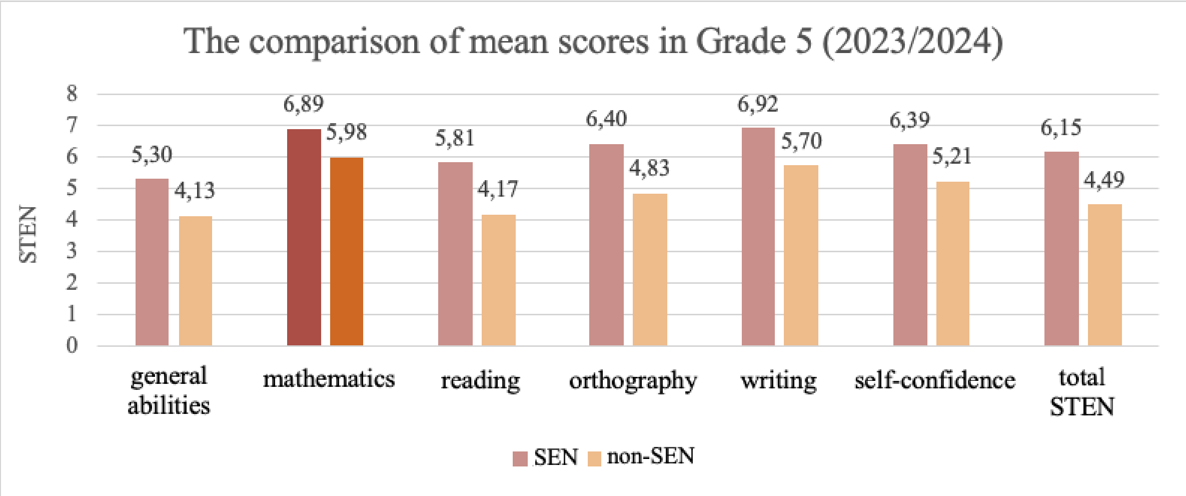

Chart 5. Means SEN (N=32) vs non-SEN (N=145) Grade 5

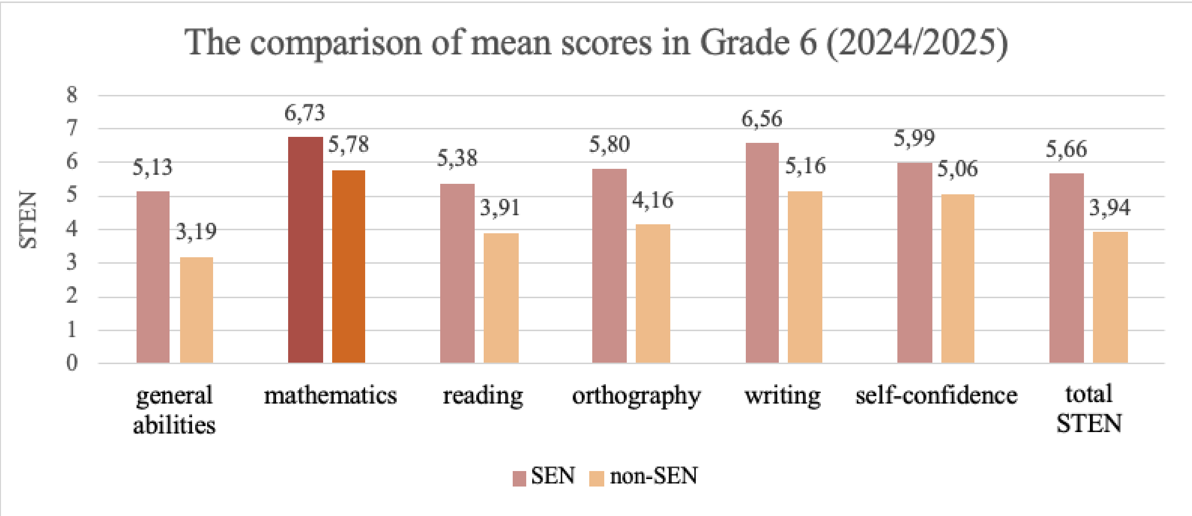

Chart 6. Means SEN (N=32) vs non-SEN (N=145) Grade 6

The final analysis examines how self-concept in mathematics across the primary-to-lower-secondary transition relates to the other SPAS scales. As shown in Table 2, statistically significant differences ($p < .05$) were found for nearly all domains relative to mathematics, with the sole exception of general abilities. The results indicate that the higher a pupil's STEN score on the academic self-concept scale, the higher their self-concept in mathematics. Academic self-concept thus emerged as the strongest predictor ($p < .05$). The language-related scales, such as reading ($p < .05$), orthography ($p < .05$), and writing ($p < .05$), were also significant and each displayed a negative association with self-concept in mathematics. In other words, pupils who view their language abilities as stronger tend to rate their mathematical abilities somewhat lower, consistent with internal cross-domain comparison (e.g., "strong in Czech" versus "weaker in mathematics").

On contrary, no significant effects were found for gender, grade, special educational needs (SEN), self-confidence, or any interactions among these variables. In other words, when comparing self-concept in mathematics with the other scales, neither the transition from Grade 5 to Grade 6 nor a pupil's gender or SEN status had a significant impact on how pupils perceive their mathematical ability. On the other hand, the previously interpreted results point to the observed questionnaire scores themselves and indicate potential factors that may underlie more positive or negative constructions of self-concept in mathematics.

Table 2. Correlation between self-concept in mathematics and other scales.

Domain	F – statistics	p-value	Relationship to self-concept in mathematics
Reading	46,1570	**p<0,001**	Negative
Orthography	43,3651	**p<0,001**	Negative
Writing	14,8761	**p<0,001**	Negative
Academic self-concept	113,0492	**p<0,001**	Negative

5. Conclusion

The aim of the study was to determine how pupils' academic self-concept in mathematics changes across the transition to lower secondary school and how selected factors affect this change. The analysed factors were age, gender, special educational needs (SEN), and self-concept in other domains. The key finding is that the transition is associated with a decline in academic self-concept ($p < .05$). For self-concept in mathematics, the data suggested a slight decrease after the transition; however, this difference was not statistically significant. The pattern held across all examined groups except boys in the gender comparison, with a more pronounced decline observed among girls on all variables considered. Whereas boys showed higher levels in both grades, girls' mean levels were lower; moreover, boys' self-concept in mathematics increased slightly after the transition, while girls' self-concept in mathematics declined, pointing to a possible gender-related difference in the perception of one's mathematical ability.

Another focus of the study was differences in self-concept in mathematics between pupils without SEN and those with SEN. Pupils with SEN displayed lower levels of self-concept across all examined domains compared with their non-SEN peers. This difference was evident in both Grade 5 and Grade 6. However, the results for pupils with SEN remained within the average range of self-concept in mathematics, suggesting a certain stability.

The final area we examined was the direct comparison between mathematical self-concept and the other domains. The analysis indicated a positive association between pupils' academic self-concept and their self-concept in mathematics: the higher the global score, the higher the mathematics-specific score. At the same time, higher self-concept on language domains, particularly reading, orthography, and writing, were associated with lower values on mathematical self-concept.

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