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Primary School Pupils' Comprehension of Technical Texts in the Context of Comprehension Level Research

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Abstract

The article addresses the issue of identifying and assessing the degree of connection between key competencies of primary school pupils, specifically spatial imagination and reading technical texts with comprehension. It provides a rationale for the chosen approach to the issue and outlines the strategic method used for processing the research data.

Keywords: spatial imagination, technical text, reading comprehension, research

Introduction

The issue of developing pupils' technical literacy is related to the question of why to pay special attention to reading comprehension within the teaching of the subject of Technology, if this area is already given attention through the development of reading competences. For example:

– teachers of Slovak language and literature – are responsible for the development of reading literacy and work directly with pupils on understanding various types of texts,

– researchers and experts in pedagogy and didactics – are engaged in the creation of methodologies, assessment and analysis of reading comprehension within the framework of national and international research (e.g. PIRLS, PISA).

The answer to this question lies in the fact that technical texts have specific characteristics that differ significantly from ordinary or literary texts. The main reasons are as follows:

1. Professional terminology – the text contains specific terms and symbols.
2. Precision – the text has the nature of a definition.

3. Logical structure – texts are organized step by step, with the sequence systematically following logic (instructions, procedures, calculations).

4. Text visualization – the text is linked with visual elements (diagrams, tables, charts, drawings) that need to be interpreted and connected with the text.

5. Practical application – solving technical tasks depends on understanding the text (technological processes, design activities, adherence to safety instructions).

6. Development of technical literacy – the ability to read and understand technical texts is part of technical literacy, which is important for performing technical professions as well as for everyday life.

7. Difficulty level – pupils who generally struggle with text comprehension need targeted support to understand technical content.

Understanding technical texts requires not only the ability to decode specialized terms and follow the logical structure of information but often also a well-developed spatial imagination. Technical texts commonly describe objects, processes, or mechanisms that are not immediately visible or accessible to sensory perception – for example, drawings, diagrams, assembly instructions for constructions, or technological procedures. Therefore, the pupils must not only verbally understand the text, but also visualize the spatial arrangement of elements, their shapes, dimensions and mutual relationships. Insufficient spatial imagination can significantly hinder the understanding of even well-formulated text. The assessment of the degree of correlation between spatial imagination and understanding of technical texts has become the subject of our interest within the framework of research activities supported by the VEGA 1/0055/24 Research of specific abilities and skills for reading comprehension in the subject of technology, taking into account the connection with the level of geometric and spatial imagination of elementary school pupils.

Characteristics and Justification of the Research

Based on the strategic intent, pupils' reactions to the differences between geometric and spatial imagination, as well as between educational and technical texts, will not be observed or evaluated. As a result, the research focus is simplified to concentrate on the relationship between spatial imagination and comprehension of technical texts. The defined research focus provided a basis for formulating research questions and hypotheses regarding a possible connection – specifically, the relationship between two cognitive abilities: spatial imagination (i.e., the ability to mentally manipulate geometric shapes and understand their spatial properties) and reading comprehension (i.e., the ability to understand and analyse the content of a text). The main research question is: How is the existing connection manifested – what is the degree of correlation between spatial imagination and the ability to read technical texts with comprehension? In defining the research problem aimed at examining the degree of this correlation, the following key aspects are identified (specification of the research problem):

1. The relationship between cognitive abilities, i.e., to what extent spatial imagination as a specific cognitive skill is related to the ability to comprehend technical texts. (Does a higher level of spatial imagination contribute to more efficient processing of information in technical texts?)
2. Technical thinking requires the ability to read with comprehension, process spatial information, and logically integrate it. (To what extent does spatial imagination influence the ability to interpret and analyse technical texts and concepts?)
3. Correlation analysis (Can the level of spatial imagination predict or influence the level of text comprehension?)
4. Practical implications for education (The research findings may impact didactic approaches to teaching the subject of Technology). The research problem focuses not only on the quantitative analysis of the correlation between these abilities but also on the practical implications for education and the development of pupils' technical literacy.

The aim of the research is to analyse the relationship between spatial imagination and comprehension of technical texts among primary school pupils through correlation measurement. The formulation of hypotheses is based on the assumption that empirical verification will reveal the degree of correlation between spatial imagination and understanding of technical texts. It is assumed that spatial imagination positively influences the ability to comprehend technical texts – i.e., that Pearson's correlation coefficient (r) will indicate a strong positive correlation for both boys and girls. Based on this assumption, the following research tasks are derived:

1. To determine the level of spatial imagination while considering gender differences (boys vs. girls), and to evaluate the results statistically. We assume that no more than 60% of students will achieve a score higher than 60% on the spatial imagination test. Furthermore, we expect that boys will perform statistically significantly better than girls.
2. To assess the level of technical text comprehension while taking gender differences into account, and to analyse the results statistically. We assume that no more than 60% of students will score above 60% on the technical text comprehension test. We also expect boys to outperform girls with statistically significant results.
3. To determine the correlation between spatial imagination and technical text comprehension, taking gender differences into consideration, and to evaluate the correlation statistically. We hypothesize that the correlation will be positive, and we expect Pearson's correlation coefficient (r) to reach or exceed 0.5.

Correlation and Regression Analysis

After measuring the levels of spatial imagination and comprehension of technical texts (within a quantitative research framework), the results of these tests are paired – i.e., each pupils completes both tests in order to enable statistical analysis focused on:

A. Correlation coefficient – In correlation analysis, the variables spatial imagination and text comprehension are treated as equal, with no assumed direction of influence.

B. Regression analysis – In a simple linear regression model, the relationship is specified as follows:

a) Dependent variable (Y) = comprehension of technical text;

b) Independent variable (X) = spatial imagination.

Note: While there may appear to be a contradiction between correlation and regression, the difference lies only in the interpretation of the relationship between variables:

1. Correlation examines the relationship between two variables without implying causality. In correlation analysis, both variables are treated equally–i.e., we do not claim that one influences the other, only that a relationship exists between them.

2. Regression models the relationship between variables by using one variable (X) to predict the other (Y). The choice of independent and dependent variables is based on the hypothesis or practical interpretation. That is:

a) Our hypothesis is that spatial imagination may influence the ability to comprehend technical texts.

b) While regression does not establish causality, it allows us to predict how changes in spatial imagination might relate to changes in text comprehension.

c) Reversing the model (X = text comprehension, Y = spatial imagination) would not be logically meaningful in the context of our hypothesis.

If a causal relationship were to be examined (e.g., through experimental methods), spatial imagination would be treated as the independent variable and text comprehension as the dependent variable. Therefore, in a correlational study, it is methodologically appropriate to refer to two variables in a correlation analysis, rather than “dependent variables.” The core research activities include the following:

1. Visualization of the relationship – data (scatter plot). Verifying the relationship between variables.

2. Calculation of the correlation coefficient (e.g., Pearson or Spearman coefficient):

a) Correlation represents a relationship between two variables (without distinguishing between dependent and independent variables), we do not label the correlation coefficient itself as a “traditional” variable (independent or dependent).

b) We determine the degree of relationship between spatial visualization and reading of technical texts.

c) We compare the results of boys and girls (analysis of differences between different pupils groups).

d) Possible conclusion: Pearson correlation coefficient $r = 0.65$ ($p < 0.001$), which indicates a moderately strong and positive correlation between spatial visualization and understanding of technical text.

To evaluate the interrelation between these two variables, the following approach is implemented:

1. The variables are treated as equivalent, i.e., one variable is not dependent on the other; they are considered equal in status (correlation does not imply causation).

2. Measurement of linear correlation between two interval or ratio variables – the use of Pearson's correlation coefficient (r). The value ranges from –1 to +1, where:

a) Strong positive correlation – as spatial imagination increases, reading comprehension also increases, i.e., $r \approx 1$ (the correlation value (r) is close to +1). There is a strong positive relationship between the level of spatial imagination and the ability to understand technical texts, i.e., pupils with better spatial imagination tend to have a better understanding of technical texts. This result supports the assumption that a higher level of spatial imagination is associated with better comprehension of technical texts.

b) Strong negative correlation – as spatial imagination increases, reading comprehension decreases, i.e., $r \approx -1$ (the correlation value is close to –1). A negative correlation may suggest that pupils with higher spatial imagination have poorer understanding of technical texts. Such a result requires further clarification through the analysis of additional variables.

c) No correlation – there is no linear relationship between the two variables, i.e., $r \approx 0$ (the correlation value *r* is close to 0). There is no strong linear relationship between these two variables. Comprehension of technical texts may be influenced by factors other than spatial imagination, such as prior experience. Therefore, it is necessary to examine additional factors and variables that may play an important role in text comprehension.

3. The data are non-parametric – the value ranges from –1 to +1; hence, Spearman's correlation coefficient is used (applied similarly to Pearson's).

4. Relationship – Correlation analysis indicates a relationship but not causality (to confirm causality, experimental methods must be used).

The evaluation of the correlation between spatial imagination and comprehension of technical texts represents a statistical analysis of the relationship between the results of two tests – the spatial imagination test and the technical text comprehension test. Within the chosen analytical approach, the following hypotheses are tested through correlation analysis:

a) The correlation between spatial imagination and comprehension of technical texts will be positive, with the expectation that Pearson's correlation coefficient (r) will reach or exceed a value of 0.5.

b) As the level of spatial imagination decreases, the level of comprehension of technical texts will also decrease, and this trend is expected to occur in both boys and girls.

We evaluate the correlation (statistical data analysis) using Pearson's correlation coefficient for the following reasons:

- the processed variables are quantitative,
- there is a linear relationship between the variables,
- the evaluated data are on an interval scale,
- the analysed variables follow a normal distribution.

By calculating Pearson's correlation coefficient, we determine the degree of the relationship between spatial imagination and reading technical texts. The interpretation of the correlation coefficient values (values below zero are interpreted analogously for negative correlation) is as follows:

- 0.9 to 1.0: Very strong positive correlation,
- 0.7 to 0.9: Strong positive correlation,
- 0.5 to 0.7: Moderate positive correlation,
- 0.3 to 0.5: Weak positive correlation,
- 0 to 0.3: Very weak or no correlation.

3. Regression analysis – regression model ($Y = \beta_0 + \beta_1 X + \varepsilon$). This allows us to examine the predictive relationship between variables (spatial visualization and reading comprehension). We determine to what extent and how one ability predicts the other. This is a simple linear regression (spatial visualization and understanding of technical text). Regarding the selection of the regression model (simple linear regression), we note the following:

a) We examine to what extent one ability (e.g., spatial visualization) predicts the other (understanding of technical text).

b) Multiple regression will not be conducted, i.e., other factors that may influence text comprehension (e.g., language skills, prior experience, etc.) will not be taken into account.

c) Interpretation of results – results will be explained through:

- Regression coefficient (β) – indicates the strength and direction of the relationship between variables:
  - β_0 = intercept (the value of Y when X = 0);
  - β_1 = regression coefficient (how much Y changes when X increases by one unit);
  - ε = error term of the model.

- Coefficient of determination (R^2) – expresses the percentage of variability in one variable that can be explained by the other (explained variability).
- Statistical significance of the relationship – p-value.

d) Possible conclusions:

- If the β coefficient is positive and statistically significant, it means that higher spatial visualization likely leads to better understanding of technical text.
- If β is close to zero or not statistically significant, it indicates that the relationship is weak or nonexistent.
- Regression model: each 1-point increase in spatial visualization increases technical text comprehension by 0.58 points.
- R^2 value = 0.42, which means that 42% of the variability in text comprehension is explained by spatial visualization.

Conclusion

The direction and purpose of the research are determined by the research strategy and clearly defined objectives. The strategy was designed to ensure the following:

1. Logical consistency of the research process, i.e., systematic progression and coherence across the individual phases.
2. Adaptive flexibility, allowing for adjustments to the approach based on ongoing empirical findings.
3. Optimal utilization of available resources – including material, human, and temporal resources.

Reading technical texts with comprehension represents a key component of technical literacy, and its importance is growing in the context of several current educational challenges:

1. Lifelong learning – the ability to independently search for, interpret, and apply information is a fundamental prerequisite for success in both further education and practical life. The absence of this competence significantly limits an individual's developmental potential.
2. Development of critical thinking – text comprehension goes beyond basic decoding and includes interpretation, analysis, and evaluation of content. These processes directly support the development of cognitive abilities that underlie critical thinking, including the ability to ask questions and verify information.
3. Development of cross-curricular competencies – reading comprehension is a transversal skill applicable across various educational domains, contributing to pupils' overall educational success.
4. Prevention of academic failure – early diagnosis and targeted development of the ability to understand technical texts are crucial for ensuring balanced cognitive development and successful educational progress in pupils.

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