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Research Focused on the Development of Technical Literacy of Elementary School Students

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Abstract

The article describes a strategic approach to the development of technical literacy of elementary school students from the point of view of research activities. The research activity is concretized for the development of graphic, spatial imagination, which is assumed by the activities related to the understanding of the text. Research aimed at determining the degree of correlation between reading an educational text with comprehension and geometric, spatial imagination will contribute to the evaluation of the issue.

Keywords: technical literacy, correlation rate research

Introduction

The targeted development of technical literacy of primary school pupils is realized by teaching the subject of technology. Pupils are informed about technical practice, while they acquire abilities and skills to solve technical problems at several levels, i.e. they interpret technical issues in different qualitative and quantitative degrees of understanding. The difference is caused by a number of factors, some of which we describe as fundamental. These are usually facts related to core competencies. It is possible to arrive at an optimal solution to this issue by analysing the problem in the context of the results of research that is focused on the issue in question. The research results affect the choice of teaching strategies, i.e. the discussion of the professional public will contribute to innovation:

- of national education (state education program) – it's about:
- recommendations aimed at school reform,

– recommendations leading to the innovation of content and performance standards,

– school educational programs that focus on deepening students' interest in technical practice.

Planned research procedure

Pupils acquire a positive attitude towards technology through activities imitating the reality of technical practice. The ability and skill to implement these activities is a strategy for developing students' technical literacy. When evaluating its level, we accept the context of created links with several areas of knowledge. With our approach, we concretize the link between geometric, spatial imagination and understanding of the text. We conclude that geometric, spatial imagination is an objective reality of technical literacy and has a conditioning effect for individual areas of technical knowledge – it has a key position in the understanding of technical solutions.

The development of technical literacy, implemented by teaching the subject of technology, does not include a systematic and conceptual approach to the issue of the deliberate development of geometric, spatial imagination, i.e. performance and content standards do not directly measure performance of geometric, spatial imagination. Arguments based on the analysis of the research results of the given issue will play a significant role when thinking about changing this state.

We admit (experience gained from teaching, or from conducted research) that there is an unsatisfactory state of students' geometric and spatial imagination. Such a state has a negative impact on many aspects of technical literacy.

The above is an argument for conducting research with the aim of knowing the reality of the discussed issue. The research will contribute to the guidance of those solutions that are oriented towards the deliberate development of geometric, spatial imagination, i.e. purposefully affect teaching methodology: in time (when), how (content, methods, forms and means), how and when to measure performance (defined by performance and content standards). The goal of the intervention established in this way innovates the processes of development of technical literacy.

We analyze technical literacy in terms of causal relationships. In this context, we ask ourselves the question – to what extent geometric, spatial imagination affects the understanding of the "text". The text interpreting technical practice is in many cases specific (terminology, means of communication, etc.). Didactically guides the development of students' abilities and skills leading to understanding, for example:

– principles and systems in technology (functionality, maintenance of devices and equipment),

– design solutions, graphic communication (reading technical drawings and graphs, reading kinematic and electrical diagrams),
– technological production procedures,
– safe handling of devices, equipment (operating manual), etc.

Correlation rate research

Pedagogical practice records reading comprehension research within the framework of monitoring the level of language literacy, or language competences. The approach chosen by us specifies the issue with the content of the text and evaluates understanding in the context of strategies for the development of technical literacy. In this case, it is possible to analyze the problem of understanding from several aspects. One of these aspects is the mutual correlation between the components of technical literacy. In our case, we are talking about correlations between geometric, spatial imagination and reading the educational text with comprehension. It follows from the above that geometric, spatial imagination is not an isolated element of the system of technical literacy, i.e. it binds to itself other attributes of technical literacy. This fact affects the evaluation of pupil performance in several contexts. For example the pupil inadequately determined the technological procedure for making the object according to the sketch, or technical drawing. We look for the cause in the context of, for example: ignorance of the agreed rules of graphic communication, an unmastered method of technical visualization and related graphic imagination, etc.

The conducted research (Beisetzer, Majherová, 2016, 2020; Beisetzer, Drtina, 2019) showed that the tested students do not have the required level of geometric, spatial imagination (criteria set by the researcher). From the stated statement, the question logically follows, what impact does it have on the activities that condition the geometric, spatial imagination. In this context, we are talking about research intention, which is included in the wider context of revealing the connections between individual attributes of technical literacy. Specifically, it is about determining the degree of correlation between reading an educational text with comprehension and geometric, spatial imagination. The goal of the research is to literally compare two performances of each student, i.e. the level of understanding of the text and the level of geometric, spatial imagination. Subsequently, these two levels are examined as a correlation factor. A number of specific questions are related to the issue, which can be a separate object of interest. For example, whether students sufficiently understand the connection between the individual attributes of technical literacy.

In our case, we specify this question on the ability to act on the basis of the read text. The goal of the research project is to determine the degree of correlation between reading an educational text with comprehension and geometric, spatial imagination of elementary school students. The goal resulted in tasks – research stages:

1. To find out the level of geometric, spatial imagination. Evaluate the results in the context of the required technical literacy of elementary school students. The diagnostic tool is a non-standardized test. The test contains tasks commonly used in professional practice. The difference in the difficulty of the tasks is compensated by a point subsidy. The formulation of the hypothesis is based on the assumption that the level of geometric, spatial imagination will be verified empirically, i.e. H1: 60% or less of the total number of students (boys and girls), will achieve a performance of 60% or more in geometric, spatial imagination. In the case of gender differentiation, we pronounce H2: There will be no statistically significant difference in the performance of geometric, spatial imagination of boys and girls. At the same time, individual performances are assigned characteristics – categories (Table 1).

Table 1. Category of performances of geometric, spatial imagination

Performance GSI		Number of pupils	RC [%]
[%]	Category		
100%	Significant		
90÷99,9			
80÷89,9	Notable		
70÷79,9	Good		
60÷69,9	Sufficient		
50÷59,9	Insufficient		
40÷49,9			
30÷39,9	Only sometimes effective		
20÷29,9			
10÷19,9	Ineffective		
0÷9,9			

The legend:
GSI – geometric, spatial imagination,
RC – relative count.

2. Determine and interpret the level of understanding of the educational text in the context of the required technical literacy of elementary school students. In this case too, a diagnostic tool is used for data collection – non-standard didactic test. The tasks are generated from the text applied to the teaching of the subject of technology (e.g. textbook text or workbook text). Tasks focus on understanding in the context of content and performance standards. The methods of testing work with an educational text are aimed at determining the level of understanding in particular:

- interpretation of something, explanation of something, etc.,
- the content of the technical term within the required vocabulary,
- context of principles and systems,
- image interpretation,

– graphic communication,
– act on the basis of instructions with designated aids,
– simulation and modeling of processes, etc.

The formulation of the hypothesis is based on the assumption that the level of understanding of the text will be verified empirically, i.e. H3: 60% or less of the total number of students (boys and girls) will achieve a performance of 60% or more in understanding the text. In the case of gender differentiation, we pronounce H4: There will be no statistically significant difference in the text comprehension performance of boys and girls. Table 2 represents the categorization of educational text comprehension performances.

Table 2. Categories of understanding the educational text

Performance GSI		Number of pupils	RC
[%]	Category		[%]
100%	Significant		
90÷99,9			
80÷89,9	Notable		
70÷79,9	Good		
60÷69,9	Sufficient		
50÷59,9	Prospective		
40÷49,9			
30÷39,9	Insufficient		
20÷29,9			
10÷19,9	Unfavorable		
0÷9,9			

The legend:
UTT – understanding of the teaching text,
RC – relative count.

3. It follows from the chosen approach that the system of development of technical literacy, as independent variable, it is a cause that is supposed to cause a consequence – the development of geometric, spatial imagination with an impact on reading the text with understanding (Figure 1).

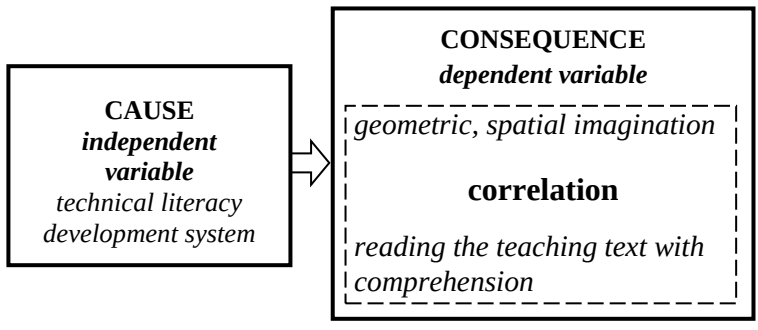

Figure 1. Relationship of variables

When formulating the hypothesis, we start from the subject of the research, i.e. the scientific assumption is determined from the theory of the given issue and acquired experience, with the fact that the degree of correlation between reading an educational text with understanding and geometric, spatial imagination is empirically verified. H5: As the level of geometric and spatial imagination decreases, the level of understanding of the teaching text will also decrease statistically significantly, both in the group of boys and in the group of girls. H6: There will be no statistically significant difference in the text comprehension performance of boys and girls.

The data obtained in the first and second stages are related in the third stage in order to determine the degree of correlation between reading an educational text with comprehension and geometric, spatial imagination (Table 3).

Table 3 gives an overview about the number of individual performances of text comprehension in connection with performance of geometric, spatial imagination, i.e. e.g. students with 80÷69.9% performance of geometric, spatial imagination are classified into individual categories of performance of text reading with comprehension based on the performance of the text reading comprehension test (see Table 2).

Table 3. Correlation of two performances (GSI and UTT)

PERFORMANCE											
GSI	**UTT**										
	100%		90÷99,9%		90÷99,9%		...	10÷19,9%		0÷9,9%	
	N	RC	N	RC	N	RC		N	RC	N	RC
100											
90÷99,9											
80÷89,9											
10÷19,9											
0÷9,9											

The legend:
GSI – geometric, spatial imagination,
UTT – understanding of the teaching text,
N – number of pupils,
RC – relative count.

Conclusion

Teaching strategies respond to innovative trends that are based on the reality of detailed knowledge of the studied phenomena. One of the argumentative supports is the research results. This will also be the case in the case of the development of geometric, spatial imagination based on the principle of conceptuality and systematicity.

The presented research intention aims to optimize the system of development of technical literacy of elementary school pupils. This will contribute to the

state in which the developmental levels of geometric, spatial imagination from the point of view:

- general development of the student's personality,
- the specifics of technical literacy,
- criteria that are imposed on the content, form, means and methods of teaching the subject of technology.

Research on the degree of correlation between reading an educational text with comprehension and geometric, spatial imagination is recommended to be carried out at the national level in order to methodically process the research conclusions for the application of a newly conceived model of teaching technology in the field of development of geometric, spatial imagination.

The article is a presentation of activities related to the project proposal 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 students.

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