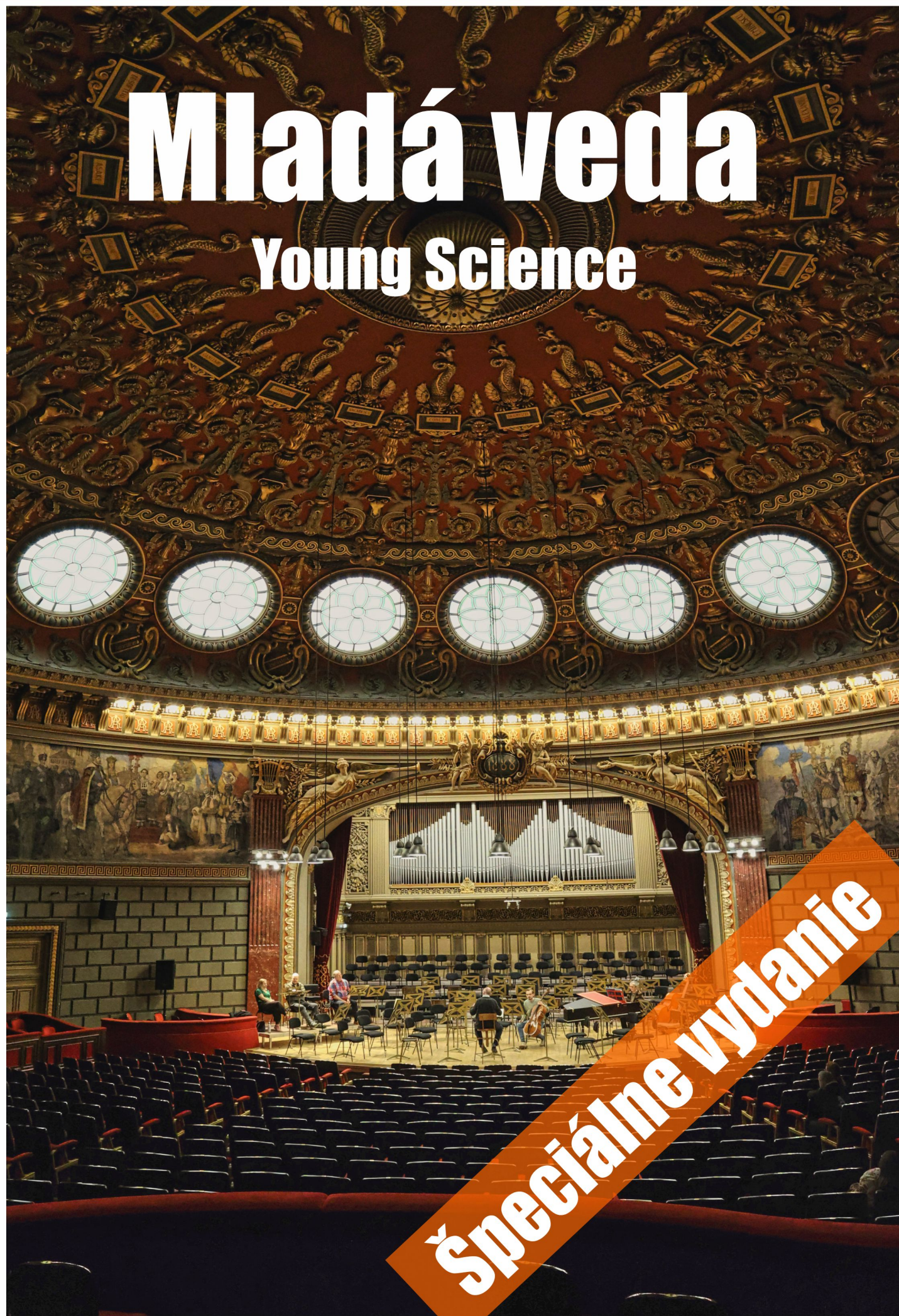


# Mladá veda

## Young Science



**Špeciálne vydanie**

# Mladá veda

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Kontakt: [info@mladaveda.sk](mailto:info@mladaveda.sk), tel.: +421 908 546 716, [www.mladaveda.sk](http://www.mladaveda.sk)

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Vydavateľstvo UNIVERSUM, spol. s r. o.

[www.universum-eu.sk](http://www.universum-eu.sk)

Javorinská 26, 080 01 Prešov

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# FOSTERING TECHNICAL CREATIVE THINKING IN PRIMARY EDUCATION: INSIGHTS FROM THE CZECH REPUBLIC

ROZVOJ TECHNICKÉHO TVŮRČÍHO MYŠLENÍ V PRIMÁRNÍM VZDĚLÁVÁNÍ  
V ČESKÉ REPUBLICE

**Pavína Částková, Michal Mrázek, Jiří Dostál, Hana Bučková, Daniel Kučerka <sup>1</sup>, Daniel Dostál <sup>2</sup>, Dominika Provázková Stolinská <sup>3</sup>, Veronika Kavková <sup>4</sup>**

The research team, affiliated with Palacký University Olomouc, is interdisciplinary, comprising experts in technical education, psychology, and primary education. Their collaborative research projects systematically address technical creativity and its development in primary education.

Autorský kolektiv působí na Univerzitě Palackého v Olomouci a je interdisciplinárně složen napříč vzdělávacími obory. Zahrnuje odborníky na technické vzdělávání, psychologii a primární pedagogiku. V rámci společné projektové a vědecko-výzkumné činnosti se tým systematicky zaměřuje na problematiku technické tvořivosti a jejího rozvoje v podmínkách primárního vzdělávání.

## **Abstract**

Creativity is currently regarded as a key competence in an increasingly technology-driven world, and within this context the need for the systematic development of technical creativity is becoming progressively more emphasized across diverse spheres of human activity. In its contemporary understanding, technical creativity represents a complex set of creative

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<sup>1</sup> Work address: PhDr. Pavlína Částková, Ph.D.; Mgr. et Mgr. Michal Mrázek, Ph.D.; prof. PaedDr. PhDr. Jiří Dostál, Ph.D.; Mgr. Hana Bučková, Ph.D.; PaedDr. Ing. Daniel Kučerka, Ph.D., Katedra technické a informační výchovy, Pedagogická fakulta, Univerzita Palackého v Olomouci, Žižkovo nám. 5, Olomouc, 771 40, Czech Republic

E-mail: pavlina.castkova@upol.cz, michal.mrazek@upol.cz, j.dostal@upol.cz, hana.buckova@upol.cz, daniel.kucerka@upol.cz

<sup>2</sup> Work address: PhDr. Daniel Dostál, Ph.D., Katedra psychologie, Filozofická fakulta, Univerzita Palackého v Olomouci, Křížkovského 10, 779 00 Olomouc, Czech Republic

E-mail: daniel.dostal@upol.cz

<sup>3</sup> Work address: doc. PhDr. Dominika Provázková Stolinská, Ph.D., Katedra primární pedagogiky, Pedagogická fakulta, Univerzita Palackého v Olomouci, Žižkovo nám. 5, Olomouc, 771 40, Czech Republic

E-mail: dominika.provazkova@upol.cz

<sup>4</sup> Work address: Mgr. Veronika Kavková, Ph.D., Katedra psychologie a patopsychologie, Pedagogická fakulta, Univerzita Palackého v Olomouci, Žižkovo nám. 5, Olomouc, 771 40, Czech Republic

E-mail: veronika.kavkova@upol.cz

abilities, attitudes, and cognitive processes that lead to innovative and functional solutions to technical problems. To effectively foster technical creativity and creative thinking in pupils, it is essential to implement evidence-based strategies grounded in authentic classroom conditions. The aim of this paper is to present selected findings from a research study focused on exploring teachers' views on technical creativity and its integration into primary education at the lower primary level. A quantitative research design was employed using a non-standardized questionnaire. The results indicate that teachers who recognize the importance of technical creativity demonstrate greater motivation to incorporate it into their teaching practice. Furthermore, a strong relationship was identified between teachers' perceptions of their own creativity and their ability to implement creative elements in classroom practice. (Sharma, Sharma, 2025) Both the material and organizational conditions of schools, as well as teachers' length of professional experience, were confirmed as key factors influencing the development of pupils' technical creativity, with teaching experience emerging as a significant determinant of confidence in implementing creative activities in instruction.

Key words: technical creativity, technical education, primary school, teachers

### **Abstrakt**

Tvořivost je v současnosti vnímána jako klíčová dovednost v technologicky se vyvíjejícím světě, přičemž právě v tomto kontextu je potřeba systematického rozvoje technické tvořivosti stále výrazněji akcentována napříč oblastmi lidské činnosti. Technická tvořivost v dnešním pojetí představuje komplexní soubor tvůrčích schopností, postojů a myšlenkových operací, které vedou k inovativnímu a funkčnímu řešení technických úloh. Pro účinnou podporu technické tvořivosti i myšlení u žáků jsou nezbytné strategie založené na důkazech a vycházející z reálných podmínek. Cílem článku je představit dílčí výsledky výzkumné studie zaměřené na zkoumání názorů učitelů na technickou tvořivost a její začlenění do výuky na prvním stupni základní školy. Byl použit kvantitativní výzkumný design s využitím nestandardizovaného dotazníku. Výsledky naznačují, že učitelé, kteří si uvědomují význam technické tvořivosti, vykazují vyšší motivaci k jejímu uplatňování ve výuce. Dále byla zjištěna silná souvislost mezi tím, jak učitelé vnímají vlastní tvořivost, a jejich schopností implementovat tvůrčí prvky do praxe. Jako klíčové faktory ovlivňující rozvoj technické tvořivosti žáků byly potvrzeny jak materiální a organizační podmínky školy, tak délka pedagogické praxe učitelů, která se ukazuje jako významný determinant míry jistoty při realizaci tvůrčích činností ve výuce.

Klíčová slova: technická tvořivost, technická výchova, primární škola, učitel

### **Background and introduction**

The concept of creativity is a crucial one at present, as creativity is considered one of the most important skills of the 21st century, which not only promotes innovative thinking and the ability to solve complex problems, but is also an essential element of a broader range of modern soft skills (Robinson, Stubberud, 2014). In the Czech Republic, the promotion of creative thinking is integrated into the education system through educational goals and standards for different age categories. The development of creativity is reflected in the characteristics of individual educational areas, key competences, cross-cutting themes and the

formulation of expected learning outcomes. The Czech curriculum document aims to fulfil the key competences set by the Council of the EU, Literacy, Oral expression, Numeracy and problem solving, and Basic learning content in teaching subjects – knowledge, skills, competences, values, etc. (Council of the European Union, 2018; FEP BE, 2023).

Schools and teachers are encouraged to integrate innovation into the educational process through courses and in-service training for teaching staff, focused both on general and specific educational areas (FEP BE, 2023). In addition, the courses include the provision of specific strategies and practices to promote creative thinking among pupils through examples of good practice. Furthermore, the Czech Republic is involved in international educational studies which provide, among other things, information on the level and effectiveness of creative thinking support compared to other countries. The 2022 PISA report (OECD, 2022) focused, among other things, on the assessment and promotion of creative thinking among students aged 15 from different countries.

The inclusion of the topic of creativity in international study demonstrates the clear support and need for further development of educational strategies and policies which would support creative thinking as a key competence for the 21st century. Even though creativity is perceived as part of the innovation process, it is not always sufficiently applied and appropriately developed (Částková, 2022; Runco 2007; Thorsteinsson, Page, 2017). Empirical studies focusing on the Czech primary education environment have pointed out, among others, the lack of development of creativity in the field of technology. Pupils' activities in the first years of schooling are often focused on the acquisition of basic skills and motor development, without providing sufficient space for the development of pupils' creative abilities and skills. Teachers' approaches to the implementation of Crafts and Technology vary both in terms of the application of pupils' creativity and in terms of educational content (Částková, 2022).

Differing approaches of teachers to pedagogical processes and educational content are noticeable in international studies, too (Hong, Hartzell, Greene, 2009; Wilson, Craft, Hall, 2009). According to Lapeniene and Dumciene (2014), three basic types of teachers can be identified who display different approaches to fostering creativity (both their own and their students') in teaching. These types include teachers with proactive, expected and/or contributory types of activity. The typology is based on an analysis of a sample of general education teachers and suggests different ways in which the latter might approach fostering student creativity. For example, teachers belonging to the proactive creativity group can be expected to actively seek and incorporate new methods and innovations, allowing them to systematically encourage pupils to experiment and discover new solutions. These teachers may also apply educational strategies which support the development of creativity, such as project-based learning, practical exercises or interdisciplinary approaches. On the other hand, teachers endowed with expected creativity apply the latter in line with the curriculum framework or specific school-level requirements. Although this category of teachers may be regarded as not particularly innovative, they are able to encourage students' creativity by providing a safe space for solving learning problems. In contrast, teachers with so called contributory creativity may only exercise creativity in situations where it is necessary; for example, when solving unexpected problems and/or improvising in teaching.

Given the fact that creativity is a universal principle permeating different areas of education (Torrance, 1969, 1972), an assumption exists that the teacher typology is transferable to the field of technical creativity. On the other hand, there may be differences in the actual application of this typology. Technical creativity often requires different approaches as it involves hands-on activities, manipulation of materials and the acquisition of specific practical skills with respect to the cognitive and motor levels of the learners. For example, proactive creativity in primary school practice does not necessarily involve the implementation of highly innovative projects, but rather the adaptation of technical tasks to playful and exploratory forms of work at the appropriate level of the pupil's cognitive development. Expected creativity in primary school may also be more dependent on the type of tasks. Simple but clearly structured open-ended or creative tasks need to match the lower levels of abstract thinking and practical experience of younger pupils. In this case, the necessary creativity could be limited by the (un)availability of materials and space. Thus, the typology can be theoretically transferred to technical education in primary school, but its application must consider the specificities of the age group, the content of teaching and the specific conditions of the school.

The promotion of pupils' creativity depends mainly on the teacher, his/her skills, experience, abilities and overall approach to both the field of technical education and the overall concept of pupils' creativity. The key components in the targeted development of pupils' technical creativity are the interrelated and interacting categories of teacher's concept, approach, and educational strategies applied by the teacher. While the concept is a broader theoretical framework comprising philosophy and values, the approach is a concrete way of implementing a concept in teaching practice. The specific teaching methods and didactic principles applied are then reflected in the form of educational strategies (Biesta, 2010; Janík, 2005), which can be both implicit and explicit in nature. If, in line with theory, we refer to explicit knowledge as easily identifiable and describable, then implicit knowledge represents a domain of unconscious understanding and skills, influencing ideas, behaviour, learning decision-making and problem solving (Dienes, Perner, 1999; Švec, 2003, 2005).

### **Overview of research base of teachers approaches to teaching**

In line with professional studies and research (Fenstermacher et al., 2015; Jeffrey, Craft, 2004; Sternberg, 1998; Trigwell, et al., 1999) we conceive teachers' approach as a dynamic and complex set of pedagogical values, attitudes, preferred philosophies of education, methods, teaching styles, and strategies which influence teaching all across the spectrum - from the way teachers plan and implement instruction to their relationship with students, their responsiveness to classroom needs, and/or their reflection on their own pedagogical practices. This dynamic complexity is in many ways critical to student achievement. Hattie (2008) conducted research on teaching effectiveness in which he focused on identifying the factors having the greatest impact on student success. Based on a meta-analysis of over 800 studies and data from a variety of educational contexts, the latter identified the following factors:

- Feedback
- Teacher Expectations
- Teacher Quality

- Teacher Experience and Professional Development
- Instructional Strategies
- High Expectations and Motivation
- Student Cognitive Engagement
- Cooperative Learning
- Metacognition and Self-Regulation
- School Culture and Leadership

Consequently, pupil success depends on the complex interaction of a considerable number of factors, which is moreover variable depending on the educational field. Hattie's coherent, comprehensive research on the issue emphasizes that success depends on the overall environment in which instruction takes place and the pedagogical practices used in the classroom. Four main aspects of a teacher's work reflecting their teaching strategies were identified by Danielson (2007). The latter determines the traditional categories of planning and preparation, creating and maintaining the learning environment, instructing and guiding students, and professional development and reflection. In contrast, Marzano et al. (2001) distinguished nine instructional strategies representing tools for improving instruction and having a strong positive impact on students' academic performance. Relevant to the field of technology education is The Art and Science of Teaching model, combining both scientific and artistic aspects, considering both the systematic approach and the creative and emotional dimension of teaching approaches. Falling into the area are, for example, clearly defined educational objectives, identifying strategies aimed at student learning and development, reflecting on and assessing students and providing feedback to the teacher, creating a learning environment, promoting social interaction in learning and building a positive teacher-student relationship. When analysing teachers' approach to teaching, we looked more closely at the topic of creativity and its development in technical education.

The issue of teachers' approaches to the development of pupils' creativity was studied in a significant scientific way as early as in the 1960s, as evidenced by the Torrance (1972) review, which comprised a collection of 133 studies showing the positive effect of interventions on the development of pupils' creative thinking. One of the earliest major works based on quantitative research on approaches to teaching pupils documents the development of the Approaches to Teaching Inventory (ATI) research method in science (Prosser, Trigwell, 1993). In effect, it is a questionnaire which uses bipolar scaled items to determine the truth (agreement) of stated statements; in a simplified way, the instrument reveals 5 approaches to teaching based on teacher-centred or student-centred concepts of teaching. Later, the authors presented to the public a summary study of the development, modifications, and use of the instrument (Trigwell, Prosser, 2004).

Follow-up research related to approaches to teaching creativity, design and the arts was published at the turn of the century (Trigwell, 2002). In the context of these studies, it is noticeable that the research base is not only adhering to the use of ATI, but is being extended to include qualitative research approaches, too. Other more general research papers (Lindblom-Ylänne et al, 2006; Beusaert et al, 2013) build on the claim (Trigwell et al, 1998; Trigwell, 1999) stating a link between teachers' approaches to teaching and learners'

approaches to learning, with the findings (Lindblom-Ylänne et al, 2006) further indicating that the links mentioned vary systematically across the disciplines taught.

In conclusion, we can claim that approaches to teaching have been a traditional subject of research, not only with respect to qualitative research, but also in the field of developing learners' creativity. These findings, and in particular the existence of the ATI research tool (Trigwell and Prosser, 2004), have informed and inspired our own research on teachers' approaches to creativity in polytechnic education. On the one hand, we identified a distinct lack of research evidence in this area, while on the other hand, we reflect on the current changes in education, especially in the context of the decentralization of some education systems in the 21st century (Dudok, 2019; Gouédard, P., et al., 2020; Norouzi Larsari, 2022) and the related changes in teachers' roles (Lavonen et al, 2019). In the Czech school environment, teachers have become not only the implementers of the curriculum, but also its creators and/or designers. In the context of these trends, we suggest that, in addition to the accepted categorization of approaches to teaching (Trigwell, Prosser, 2004), there may be another division of teachers' approaches to teaching conditioned by the content taught (students' creativity). On this account, we decided to design our own survey instrument, which aims to determine whether the above categorization exists.

### **Pedagogical concept of technical creativity**

Even though the topic of creativity has a long history across different disciplines, technical creativity itself has only been studied since approximately the middle of the 20th century. Increased attention has been paid to the issue in the context of debates about the relationship between technical skills, innovation and creative thinking. Compared to other types of creativity, the technical one is still poorly empirically grounded in many ways. There are various methods of investigating technical creativity; however, a lack of comprehensive and standardized instruments is still a fact (Boden, 1990; Zhang, Zhang, 2026).

In the educational context, we focused on methodological practices aimed at identifying teachers' approaches to the development of students' general creativity. Included in the practices are, for example, the questionnaire method, observation, analysis of the teaching process, case studies, and/or analysis of teaching materials and learning activities. Specific questionnaire tools comprise the Creativity Support Index (CSI), the Creative Teaching Questionnaire (CTQ), and the Teacher Creativity Behaviour Inventory (TCBI) (Dikici, Soh, 2015; Carol, Latulipe, 2009). As useful as these research tools may be in mapping sub-aspects of technical creativity (for example assessment of conditions, creative behaviours and actions, pedagogical creativity), they still do not cover the necessary area of teachers' attitudes toward technical creativity.

Our research focus consisted in understanding and analysing pedagogical conceptions of technical creativity, which required a distinctive tool capable of reflecting the specificities of the pedagogical environment, and particularly the practice-oriented teaching of younger school-age pupils. Yet another reason for constructing a research instrument of our own was the specificity of the target group of primary school teachers resulting from the interdisciplinary nature of teaching. The creation of the instrument itself subsequently made it possible to record and analyse the relevant aspects of technical creativity influencing the form

of teaching a practically oriented subject in primary school practice. To capture and understand as comprehensively as possible the implicit pedagogical knowledge of teachers, their approaches to teaching and the pedagogical strategies they use in practice, we decided to combine different approaches to analysing the teaching process when creating our own research tool. The resulting instrument therefore reflects the integration of theoretical frameworks from the field of educational research and the analysis of the educational process.

Another important source of our research instrument was the theory of implicit pedagogical knowledge. Implicit knowledge, as described by authors such as Goffin, Koners (2011) and Šíp, Švec (2013), means the internal cognitive structures which, on the one hand, influence an individual's decision-making and behaviour, but, on the other hand, are not articulated or realized in a simple way. With this claim in mind, we have decided to take into consideration the level of self-reflection, allowing one to focus on identifying the analysis of 'hidden' knowledge which influences pedagogical practice. Approaches applying tools to examine teachers' decisions, attitudes and reactions within specific teaching scenarios (Goffin, Koners, 2011) were taken as a basis. Descriptions of interactions and situations in teaching, projected into individual statements expressing subjective views of teachers' own pedagogical practice, are intended to identify implicit knowledge (Švec, 2003; Janík, 2005, 2007).

The aim of this study is to present a multidimensional questionnaire method to investigate teachers' opinions on technical creativity and its teaching.

## **Methods**

### **Recruitment and sample**

Data collection was conducted in two phases. In the first phase, data were obtained from a convenience sample of 75 teachers, all with experience teaching *Practical Activities* at the first or second level of primary school. Participants were selected based on intentional multiple selection, determined by categorizing relevant features. The research area was the whole Czech Republic, from which four regions, South Moravia, Pardubice, Pilsen and Central Bohemia, were randomly selected. This was followed by proportional stratified sampling of schools and a survey of primary school teachers. The primary objective of this phase was to pilot test the instrument, specifically assessing the clarity, relevance, and basic statistical properties of its items.

The second and main phase of data collection was conducted online. Primary school teachers across the Czech Republic were invited to participate via email, using contact information publicly available on school websites. The questionnaire was open for responses over a four-month period. In total, nearly 7,500 teachers were contacted, and 511 individuals (6.82%) responded and completed the questionnaire. Table 1 presents an overview of the key characteristics of the final research sample.

The study adhered to established scientific principles and methodological standards while strictly following the ethical guidelines of Palacký University in Olomouc. Participants were fully informed about the study's purpose, objectives, and data usage. They were made aware of potential risks and benefits and provided informed consent. Confidentiality and anonymity were ensured, with data used exclusively for research purposes. Participants

retained the right to withdraw at any stage without consequences. The research complied with the university's ethical code and applicable legal regulations.

Variable	Frequency	Variable	Frequency
<i>Gender</i>		<i>Region</i>	
Female	486 95%	Prague	9 2%
Male	25 5%	Central Bohemian	27 5%
<i>Age (years)</i>		South Bohemian	14 3%
≤ 30	156 31%	Plzeň	71 14%
31 – 40	83 16%	Karlovy Vary	2 < 1%
41 – 50	131 26%	Ústí nad Labem	4 < 1%
> 50	141 28%	Liberec	2 < 1%
<i>Work experience length (years)</i>		Hradec Králové	6 1%
≤ 5	208 41%	Pardubice	72 14%
6 – 10	55 11%	Vysočina	10 2%
11 – 20	78 15%	South Moravian	149 29%
> 20	170 33%	Olomouc	80 16%
<i>Teaches Crafts &amp; Technology at</i>		Zlín	23 5%
Primary school	425 83%	Moravian-Silesian	40 8%
Lower-secondary school	9 2%	(not reported)	2 < 1%
Primary & lower-secondary school	25 5%		
Other type of school	52 10%		

Table 1 - Demographic characteristics of the research sample  
Source: authors

Participants completed a questionnaire collecting demographic information (gender, age, region), details about their teaching experience (school type, workplace, years of experience), and questions on their school's technical facilities and challenges in teaching Crafts and Technology.

The core of the questionnaire consisted of 49 seven-point Likert-type test items, which formed the basis for the presented method. The question format and method development are discussed in a separate chapter.

### Data analysis

The development of the research instrument drew principally on theoretical foundations and empirical studies focused on creativity. Considering the specifics of the field, elements from the theory and research on the pedagogical concept of teaching (Mareš, 1996) were subsequently integrated into the research instrument. This enabled us to take into consideration various aspects of the teaching process, such as the structure of teaching, objectives and methods of teaching. Furthermore, categories related to the conditions and processes of teaching implementation were included, which facilitated the capture of external

factors potentially influencing the teacher's approach. Principles of self-reflection were integrated as well to capture both explicit and implicit components of teaching practice. In this way, the tool provides a comprehensive view of teachers' approach, perceptions, inclusion and development of students' technical creativity in their teaching.

In order to obtain a large amount of data from respondents, we have opted for a self-reflective questionnaire covering the following seven thematic categories: (1) Perception of the Topic, (2) Creative Self-Concept, (3) Knowledge of the Topic, (4) Teaching Experience, (5) Motivation to Incorporate Technical Creativity, (6) School Conditions, and (7) Implementation Process.

The categories reflect the theoretical background and themes described above, while the key categorisation is based on Mareš's (1996) teacher's conception of teaching, which comprises teaching objectives, teaching content, teaching methods and forms, assessment and feedback, and classroom relationships and communication. The categories focusing on the teacher's personality, perception of the topic (Roučová, 2013), creative self-concept (Karwowski, Lebuda, 2017), knowledge of the topic (Eraut, 2000, Janík, 2005), experience, motivation, conditions and implementation (process) (Nonaka, Nishiguchi, 2001) are not omitted either.

Within each category, 7 items were formulated in the form of a declarative sentence. Respondents expressed their level of agreement on a seven-point scale with verbal anchors of 1 - Strongly Disagree and 7 - Strongly Agree.

To ensure content validity of the selected items, the test was submitted to a panel of 9 experts (4 academics, 3 practising teachers, 1 research methodologist, and 1 psychologist) for an unbiased review. The items were evaluated with respect to their usefulness and necessity (Gilbert, Prion, 2016; Madadzadeh, Bahariniya, 2023) so that Lawshe's Content Validity Ratio (CVR) and Content Validity Index (CVI) could be calculated. All items showed adequate levels of content validity: the CVR came out in the range of 0.77-1.00 ( $M = 0.904$ ) and the item-level content validity index (I-CVI) in the range of 0.77-1.00. The scale-level content validity index (SCVI-Ave) was 0.936 (Madadzadeh, Bahariniya, 2023).

Subsequently, the 49 test items thus created were presented to a set of 75 teachers who were asked to answer and, moreover, to add feedback in case the wording of any item was not clear. Based on the feedback from the teachers, modifications and revisions were made to the items to ensure their clarity and validity for use in the wider research. The process of item design and validation involved theoretical reflection, expert judgment, and verification of the target group's understanding.

In the second phase of the research, the data collected from the respondents ( $N=511$ ) were analysed to check the structural validity of the questionnaire and to interpret the multidimensional data structure. For these purposes, confirmatory factor analysis and cluster analysis of the respondents according to the specified factors were applied.

The questionnaire was further modified to achieve a clear factor structure. A confirmatory factor analysis was computed using the data obtained in the main data collection phase. A model with seven correlated factors, each comprising 7 ordinal items, showed poor fit to the data,  $\chi^2(1106) = 6814.091$ ,  $CFI = .857$ ,  $TLI = .848$ ,  $RMSEA = .092$  [.089, .094],

SRMR = .081. These values being insufficient, items showing local dependence or double saturation were removed by means of modification indices.

The number of items was reduced to 4–5 per scale, resulting in a total of 30 items. Confirmatory factor analysis (CFA) indicated an acceptable model fit, with modification indices near the goodness-of-fit thresholds:  $\chi^2(384) = 852.964$ , CFI = 0.948, TLI = 0.941, RMSEA = 0.064 [0.060, 0.069], SRMR = 0.048. Omega reliability coefficient was above .75 for all but one scale (range: .75–.88). The School Conditions scale, however, showed low reliability ( $\omega = .57$ ). A complete list of items is provided in the supplementary materials.

### Interrelationships of teachers' conceptions of technical creativity

The factors studied of teachers' conceptions of technical creativity enter close relationships with each other; the correlations of the latent variables ranging from .59 to .87 (median .73, see Table 2).

Scale	Correlation matrix							Descriptive statistics		
	PT	CSC	KT	TE	MTC	SC	IP	M	SD	Skew.
PT		.80	.52	.73	.58	.42	.65	29.42	6.14	-2.19
CSC	.84		.61	.69	.66	.47	.68	22.67	4.89	-1.73
KT	.62	.70		.48	.69	.52	.53	19.12	4.93	-0.50
TE	.87	.76	.59		.58	.46	.68	26.63	5.37	-1.25
MTC	.68	.76	.80	.73		.55	.66	20.69	4.80	-0.84
SC	.65	.70	.76	.70	.83		.56	18.21	4.21	-0.08
IP	.78	.82	.63	.84	.83	.86		20.68	4.46	-0.74

Table 2 - Intercorrelations and descriptive statistics of the 7 identified factors

Source: authors

*Note: The upper triangle of the correlation matrix shows Pearson product-moment correlation coefficients, the lower triangle depicts latent variable correlations. PT – Perception of the Topic, CSC – Creative Self-Concept, KT – Knowledge of the Topic, TE – Teaching Experience, MTC – Motivation to Incorporate Technical Creativity, SC – School Conditions, IP – Implementation Process.*

To better illustrate the proximity of individual factors, we visualized the correlation matrix of latent variables as a scatter plot. The seven factors were positioned using multidimensional scaling (Gower, 1966), with mutual distances defined as one minus the correlation coefficient. Figure 1 presents the resulting scatter plot, where points are color-coded according to cluster membership identified via k-means clustering ( $k = 3$ ) to enhance readability.

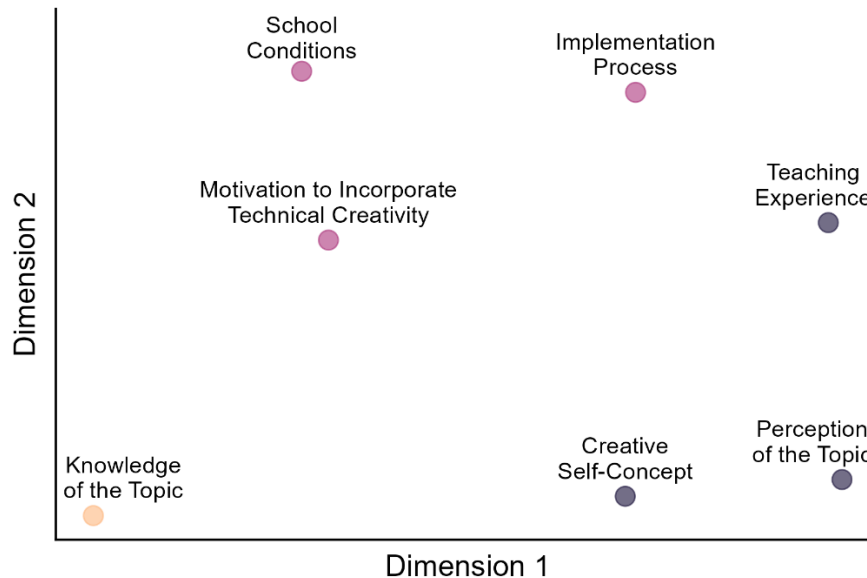


Figure 1 - Distances of individual factors projected into two-dimensional space  
Source: authors

To interpret the two-dimensional space, the terms Dimension 1= intrapersonal characteristics and Dimension 2= external conditions were proposed. The above-mentioned facilitated the description of the factor model by means of 3 cluster categories following the clustering of factors according to respondent groups.

- Cluster of intrapersonal characteristics
- Cluster of external conditions
- Cluster of knowledge of the topic

However, the simplified model of the three clusters comprises 2 factors which are specific, as shown in Figure 1. Even though the MTC factor falls into the Cluster of external conditions, its position in the two-dimensional space is almost borderline.

Teachers perceive motivation as a significant, and practically the most important factor (maximum mean value, Table 2). However, there is no uniform view of motivation among teachers in the context of the diversity between intrinsic and extrinsic motivation. Extrinsic motivation appears to be somewhat more important, which means that teachers' approach to technical creativity is influenced more by the motivational conditions of the school environment. Indeed, this interpretation could be supported by the correlation coefficients between motivation factors, school conditions and the implementation process (SC->MTC  $r^2 = 0.83$ ; IP->MTC  $r^2 = 0.83$ ; SC -> IP  $r^2 = 0.86$ ).

Knowledge of the Topic appears to be a highly distinctive factor as it practically does not fit into the two-dimensional space (Figure 1). In other words, this factor virtually stands outside our proposed dimensions, forming its own, separate cluster. Thus, the question is how knowledge of the issue contributes to shaping a teacher's approach to technical creativity? Is the factor a dominant or a superior one? Can it be described as crucial and necessary? Or else, is it only a supporting or complementary factor? A more detailed analysis of Table 2 suggests that the knowledge factor is not very significant according to the mean value. The association with other factors ( $r > .07$ ) would suggest that knowledge is related to teachers' own creative

self-concept and motivation. Provisionally, we would consider knowledge to be an independent, supporting factor for the dimension of external conditions. Yet the interpretation cannot be regarded as watertight as the position of the knowledge factor is extremely specific (figure 1).

A clearer explanation could be given by answering the questions mentioned above, which would be facilitated by the completion of the research with, for example, qualitative interviews aimed at a deeper and more detailed description of the factor of knowledge of technical creativity in relation to other factors or dimensions.

The data are handled in accordance with the principles of open science and the rules of data handling followed at Palacký University in Olomouc. All processes are implemented with respect for transparency, accessibility and ethical principles, while ensuring the protection of privacy and confidentiality of information. Data are available upon request.

## **Discussion**

The examination of teachers' approaches to technical creativity represents a complex phenomenon, the dynamics and interrelations of which are not easily captured. The primary aim of this research was to introduce a multidimensional questionnaire focused on teachers' beliefs about technical creativity and its integration into teaching at the primary school level. The construction of the research instrument was informed by theoretical frameworks drawn from relevant pedagogical and psychological literature, as well as prior empirical studies analyzing teachers' instructional approaches. Special attention was paid to identifying implicit pedagogical knowledge and to conceptualizing technical creativity as a key domain of inquiry. This comprehensive perspective necessarily entails certain limitations, particularly due to the absence of directly comparable prior studies. Nevertheless, the partial results offer valuable insights and indicate directions for further analyses.

The developed questionnaire was validated, although it was necessary to adjust the number of relevant items to yield a credible factorial model. Accordingly, the number of items was reduced from 49 to 30. The omega reliability coefficients of the individual factors were predominantly high ( $\omega \geq .75$ ). The reduced model demonstrated acceptable levels of reliability and satisfactory fit indices, while the smaller number of items yielded a more interpretable factor structure with sufficient informational value.

The findings of the study confirm that teachers' conceptual understanding of technical creativity is not only complex but also internally interrelated. Strong correlations between factors such as Teaching Experience (TE) and Perception of the Topic (PT) align with previous research showing that teaching experience influences not only classroom practices but also attitudes toward innovative instructional strategies (Runco & Jaeger, 2012; Govan, Bruch, 1967). A particularly significant finding is the robust link between Creative Self-Concept (CSC) and Implementation Process (IP). This relationship is supported by studies indicating that teachers with greater confidence in their creative capacities are more likely to incorporate innovative methods in their teaching (Beghetto, Kaufman, 2014; Izquierdo-Sanchis et al., 2025). Furthermore, teachers who view creativity as a developmental attribute are more motivated to promote it in their practice (Bereczki, Kárpáti, 2018). The theory of creativity as a dynamic system (Plucker, Beghetto, 2004) reinforces the idea that teacher

creativity is not merely an individual trait, but is shaped by broader ecological factors, including school-level conditions and professional culture.

Moreover, the findings suggest that the development of technical creativity in schools requires not only individual teacher motivation but also systematic support at the school and policy levels. The influence of School Conditions (SC) on the Motivation to Incorporate Technical Creativity (MTC) underscores the crucial role of institutional support in fostering students' creative potential. This result is consistent with the Componential Theory of Creativity (Amabile, 1996), which emphasizes the importance of external factors such as innovation-friendly environments, access to material didactic resources (MDP), and a supportive school culture (Andiliou, Murphy, 2010).

The negatively skewed distribution of certain factors, such as PT and CSC, indicates that most teachers perceive technical creativity positively. In contrast, lower scores on the School Conditions (SC) factor point to potential barriers to its implementation. This discrepancy illustrates the well-documented "creativity gap"—the divergence between teachers' positive attitudes toward creativity and the limited practical conditions for supporting it (Craft, 2005; Puryear, Lamb, 2024).

## **Conclusion**

Creativity is one of the key pillars of the modern education system across the board. Attention should be paid to creativity in the field of technology, which is important for the development of both individuals and society. The ability to come up with original and effective ideas is crucial for the development of competitiveness of individuals and companies, which in turn has a desirable positive impact on economic and social development. Inconsistent and unsystematic approach of educators in pedagogical strategies can significantly limit the ability of pupils to show innovative thinking and to solve problems (not only) of technical nature effectively. In the context of the Czech Republic and the ongoing curricular changes, attention is simultaneously paid to the content of teaching itself, as well as to the pedagogical approaches and strategies which shape the educational process and determine the development of the pupil. To do this, it is necessary to draw on empirical data, appropriate research methods and validated tools.

The results of the research suggest that teachers who have a strong awareness of technical creativity and a positive perception of their own creativity are more motivated to implement it in their teaching, with school conditions and their teaching experience also playing a key role.

In summary, the study provided valuable insights into teachers' approaches to technical creativity. However, it has several limitations. Firstly, there is a lack of direct comparison with previous research, which limits the ability to verify the results. Another limitation is the potential bias in the data due to social desirability responses, particularly in questions concerning the use of innovative methods. The generalisability of the results may be affected by the sample selection, differences in school environments and institutional support may have influenced responses. The proposed model of teachers' approaches is exploratory and therefore requires further validation with a larger sample. Although the study provides valuable information, its results need to be interpreted with the limitations mentioned above in

mind. Future research should validate the model and further analyse the factors influencing the promotion of technical creativity in schools.

In this research, a gender dimension has been incorporated, with particular emphasis on the issue of the feminization of Czech primary education. This aspect is considered a relevant factor that may influence the study's outcomes. The study employs basic gender definitions, specifically male, female, and other, with a focus on respecting diverse gender identities and their impact on the examined context.

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