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Illustrative Techniques in the Primary School

Cestmir Serafin

Abstract

The goal of this chapter is to contribute to the area of teaching about technology, especially by using illustrative aids, kits as didactic training tools in contemporary schools, and to define what is required by this field in view of the goals of the teaching process, especially of the education theory. The study summarises the issue of illustrative aids, from the view of their application to the area of general training, and formulates answers to some related practical issues of the relevant subject didactics. The chapter presents the results of past research surveys which were conducted in relation to incorporating illustrative aids - kits into education, and of the effectiveness of the implemented education in the practical reality of teaching. One subject of discussion also includes the condition/the current state of implementing education in the primary school environment. The aim of this chapter is to provide a comparative and analytical insight into the teaching of general technical subjects in primary schools in the context of technical kits, defining current trends and approaches to the implementation of educational activities. The broader intention is thus to contribute to the development of a sectoral didactics of technical subjects, targeted at lower school levels and educational practice.

Keywords: Illustrative techniques, illustrative aids, kits, education, primary school, didactics, subject didactic, electronics

1. Introduction

Combining physical and mental activities as a prerequisite for a well-rounded personal development – that is the benefit of technical kits, electronic ones especially. Such combination also pushes the limits of the pupils' efficiency. When used correctly, the creativity of pupils a superior developmental level of knowledge in terms of quality.

This process is also facilitated by innovations related to other scientific fields, such as cybernetics, system and information theory, ergonomics, bionics, developmental, social, and educational psychology etc. [1].

Technical kits in general have many positive effects in school education and appropriately complement and support this education. It can also be said that kits are also one of the subjects taught. If we look at the global growth of information technology, then we also see the need for growth in the integration of these technologies with kit

sets, and where else is this more appropriate than in teaching. This process of linking is also aided by the digitalisation that is now being pushed into children's education from kindergarten onwards. We can question whether this is a good thing or not. Many experts are in favour, others the opposite, but technological progress is part of the progress of mankind and will not pass us by. Therefore, these realities are necessary stimuli for the development of education, its theory and practice.

From the point of view of schools, the immateriality of electrical engineering as well as the materiality of technology and engineering pose a challenge for the design of educational programmes and for the relevant chapters in textbooks and methodological manuals dealing with it. In these cases, the curriculum is demanding of experiments that require the presence of technical equipment in schools. It is therefore important to stress the importance of material and didactic teaching aids, which certainly include building blocks as part of the technical facilities and schools and education in general.

2. Technics and education

In the current Czech education system, the concept of technology is interpreted as a matter of general vocational training and applied to it. In view of this, it is necessary to assume a corresponding approach to interpreting pedagogical rules and principles as they pertain to using kits.

The term *technics* (derived from the Greek word *tékhnē* – knowledge, craftsmanship) describes a vast, complex, hard-to-delineate part of the world we inhabit [2]. Thus, it is rather difficult to formulate its clear definition. It all depends on one's specific approach to science and philosophy. This problem is felt not only in Czech scientific circles, but also abroad – the works of W. Walat [3], O. Autio and R. Hansen [4], or A. Williams and J. Williams [5], as well as many others, can be mentioned as an example. There are usually two approaches to teaching subjects with a technical focus. According to J. Kropáč [6], W. Walat [3], the substance of the term in regard to teaching technical subjects can be expressed in two ways:

- *technics* as a set of tools that are artificially created by and for the benefit of man, and also as a set of methods and procedures used in their creation, use and disposal. However, this concept has one major drawback, namely the need to distinguish between two related aspects - in a narrower sense (the set of man-made tools) and in a broader sense (the processes of using man-made tools, resources, energy, etc.);
- *technics* refers to collections of tangible, purpose-made objects and intangible substances created by human activity. The way in which an activity is carried out is called technology. Both the concepts of technique and technology are then part of the technosphere - the man-made environment. This notion is based primarily on the work of J. Stoff [7] and has recently greatly influenced attitudes towards education, especially through the notion associated with constructivism.

It is understandable that technics is a social phenomenon since it, along with nature and society, creates and shapes human environment. According to J. Kropáč [6] whose works pick up on those by H. Wolffgramm [8, 9], technics has certain specifics which can be described as manifestations of its rules:

1. The unity of natural and social forces in technology - the basis is a technical object, system or process that is based on natural phenomena and rules.
2. Determination of technology - technology is a tool for achieving goals, it has a relationship to the goal as a means.
3. Technology is complex in nature - it is actually the result of the interplay of many natural, technical and social rules.
4. Plurality of technical solutions - usually the solution is not always obvious due to many external influences.

The use of technics is associated with the development of human societies and of social, intellectual, and physical skills of individuals. Thus, technics becomes a necessary part of solving the various situations and problems life brings. Schools, of course, react to this – by introducing vocational training into the education system, though this term is nowadays used in the figurative sense (practical activities, work guidance, the work world, etc.).

Traditionally, pedagogy has divided guidance into components (intellectual, moral, aesthetic, physical, and work ones) whose content addresses the interim goals of pedagogy (see K. Kohout [10] or A. Quinn [11], among others, for more details). These components include *work guidance* which can be understood as a framework for establishing a relationship to work and for acquiring general technical knowledge, skills, and habits [2, 12]. It is implemented by the practical focus of school subjects, by field trips, and leisure activities. Because work guidance deals with acquiring general technical knowledge, the term *technical guidance* is introduced.

According to J. Stoffa [7], vocational training can be viewed as a systematic controlled process of intentionally shaping one's personality as it relates to technics, in a way that makes sure that the person being educated has a correct attitude to technics and its use in their own life (a creation of the so-called technical literacy). These goals must be met on a scientific basis, consciously, and in the course of activities related to the technics which each person encounters as a part of their daily life, i.e. technics that may have an effect on the life of the person being educated. The content of this term lies in our understanding of the connections between technics, society, and nature. Therefore, the content of vocational training is rather universal and includes a wide range of technics as well as related activities.

By implementing vocational training, the following is created [6]:

- knowledge of technics, its production and use;
- proficiency, habits, and skills in regard to carrying out activities related to technics;
- creative proficiency and skills in working with technics;
- positive relationship and attitude to technics and activities related to it.

Therefore, let us talk about vocational training in the broadest sense of the term. This does not mean a specialised vocational training which results in occupational qualifications, but a vocational training whose aim is to establish technical literacy [2, 12].

T. Kozík and M. Kožuchová [13] establish three elementary areas as the basis of technical literacy:

1. attitudinal – to understand the role of technics in society (to understand different aspects of technics), namely in view of these types of relationships:
 - a. economic;
 - b. environmental;
 - c. social;
 - d. aesthetic;
 - e. moral;
2. content:
 - a. awareness of technical terms and processes;
 - b. using technical tools;
3. procedural – mastering the methods and system of scientific research.

The term *technical literacy* is also defined in the work of Z. Friedmann [14], as follows:

- Acquiring concepts, knowledge of technology and technical materials and acquiring technical skills, creativity;
- the ability to solve technical problems;
- developing an intellectual relationship with technology;
- understanding the relationship between science and technology and acquiring the skills to apply it;
- development of technical creative thinking.

I. Škára [15] talks about the process of basic education, the aim of which should be, among other things, the creation of so-called technical literacy, which:

- allows pupils to recognise the aim and purpose of technics and technical activities;
- helps encourage and develop pupils' psychological potential and manual skills;
- equips pupils with a system of basic technical knowledge and skills;
- introduces pupils to technical professions, helping them make decisions in regard to their entering into social practice.

Based on the areas of technical literacy formulated above, we can observe that the acquired technical knowledge helps pupils to correctly get their bearings, especially in situations where they encounter technics or a technical object and become its users. However, the knowledge also helps them in situations where they have to solve issues which result from the failing functionalities of technical devices—objects, or if they themselves would like to create an adequately challenging technical object or are supposed to take part in its creation. This concerns knowledge of technics as a part of human culture, of its importance for humanity, and subsequently knowledge gained from key technical fields – especially disciplines which deal with technical materials; the technology of materials; technical graphics; studying machinery as well as its components and mechanisms; electrical engineering and electronics; and last but not least studying cybernetics as well as information and communication technologies.

3. Technical thinking

Technical thinking and its development is a fundamental goal and prerequisite for teaching technically oriented subjects, regardless of their specific focus. The Polish psychologist E. Franus [16] analysed the concept of “*technical thinking*” and states: “*Technical thinking is the process of reflecting and using physical laws as well as technical principles in technical creation and technological processes.*” We can say that this definition quite accurately defines two interrelated aspects related to technical thinking - cognitive processes with a predominantly analytical character, and creative processes, or also design processes, in which synthesis predominates.

These stated aspects of technical thinking could and should also be taken into account in the design and development of experimental activities included in technical subjects. When we talk about experimentation in these subjects, the logic and focus of cognitive processes is very similar to the cognitive processes resulting from play, but we must of course respect the wider social (psychological economic, etc.), natural (physical) and also technical context from a teaching perspective, which makes the actual abstraction rather difficult. In teaching practice, we often see trends in experimentation in technology that are based on natural science experiments, inspired by them in the form of experiments in the sense of an exploratory approach. These approaches have been published in their studies, for example, by D. Nezvalová [17], M. Papáček [18], J. Dostál [19] and others. It is not always beneficial, but what is indisputable is that these experiments apply a constructivist approach in teaching, which makes them positive for the student and the teacher. Pupils are put in the role of “scientists and researchers” - based on situations motivated by the teacher - pupils ask questions, look for evidence, formulate their explanations based on the evidence they arrive at, evaluate, communicate and verify [17].

What has now been stated is fully applicable to the questions connected with experimentation in technical subjects, but this experimentation cannot be complete if it merely promotes cognitive activity of a scientific character without revealing basic and general technical contexts, phenomena and relationships. In experimentation, the pupil's thought-creation and design processes (which form the second part of technical thinking) are combined with activities, situations, products and outputs that are concrete and real in their content. Thus, we can say that there is actually an application of the synthesis of the acquired knowledge to a new level to a “new quality of solution” (of course from the pupil's point of view) and thus also to its experimental verification. Understandably, in this case, the situations induced by the teacher

should include to a reasonable extent the different phases of the life of the technical device (design, construction, programming, production), including the environmental issues related to the disposal of the product [20].

The purpose of teaching technical subjects, i.e. subjects oriented towards technology, should be to encompass the pupil's cognitive activities and his creative processes, similarly to the solution of educational situations. These cognitive and creative activities are, after all, an integral part of meeting the legitimate needs of an individual or even a group, even in the context of creating, using, handling technology.

Man has placed between himself and nature an artificial environment, a material culture, by which he influences nature and which influences himself. Humans thus change and shape their environment, primarily through technology. At the same time, however, they also search for, discover, create, improve and extend this environment. These circumstances bring with them specific approaches, practices and methods of thinking precisely in relation to the technology that is conditioned by it.

As man, nature and the world change, so does the approach to education, and the shape of the school is changing, placing more and more emphasis on activity, experience, self-knowledge in creative activity, both mental and manual (unfortunately less so). It is essential to reinforce this concept, including in the preparation of those who will one day be teachers, because only in this direction can they be profiled for their future profession of teaching. The starting point in the concept of didactics of teaching subjects is therefore a critical analysis of the current concept of didactics in relation to the needs of teaching practice by assessing the level, quality and necessity of the competences acquired by pupils for their application in life.

An important part of the didacticism of technical subjects is the inherent concept of *technical thinking* and the method of its development in teaching. At present, the focus is mainly on the notion of creativity or *technical creativity*. As mentioned above, technical thinking is a specific form of thinking, a term with broadly defined content. In our view, a student's technical thinking is defined in the context of the concept of technical literacy (for example, the work of J. Kropáč [6]). The specifics of technical thinking are based on the nature of technology, where one of the key specifics is the uninterrupted continuity of theoretical and practical components, as well as the relationship between means and ends, or the determination of which means should be used to achieve a goal. Another fundamental aspect of technology and thinking is important here - complexity, because no significant context, whether technical or non-technical, can be ignored when working with technical equipment. It is also clear that different means can be used to achieve a goal or fulfil a purpose. In this case, we are confirmed by the need for critical and evaluative thinking.

Technical thinking includes operations such as analysis, synthesis, classification as well as analogies, abstractions and concretions [21]. In a context with a technical imagination, it is generally an analysis of a product, a concept, an activation of existing skills, knowledge and experience that can be used to address issues of construction and creation, and then a synthesis of all applicable realities by which we create a reality, i.e. arrive at a complete solution of design and product creation. In this context, we cite the work of the eminent Polish psychologist E. Franuse [16], which defines technical thinking as *a process that reflects and uses physical laws and technical principles in technical subjects and technological processes* [16].

German authors B. Hill and B. Meier [22] define technical thinking as a mediated and generalised reflection of reality, which is characterised and predetermined by a close relationship between the conceptual, visual and practical components of activities with technology. Thus, it is indisputable that technical thinking has cognitive and

creative content, which are composed of thought operations with ideal reflections of objective reality. One of the characteristic features of this technical thinking, then, is the inclusion not only of existing completely objective reality, but also of possibilities based on socialisation, social cognition. These realities can take different degrees and forms - from the creation of completely new objects (procedures) to the improvement of these objects (procedures) or the search for errors and failures.

According to L. Tondel [23], the above shows that technical thinking actually has two interrelated aspects:

- cognitive aspect - an activity in which we learn about the structure and function of new technical creations, their drawings. This aspect also occurs during assembly and disassembly (activity of an analytical nature);
- design (creative) aspect - a mental process that is focused on creative activities (designing, inventing, improving) or on solving technical processes and tasks (activity of a synthetic nature).

Both of these aspects are manifested in relation to technical construction kits, as both the cognitive and creative aspects are an integral part of the activities associated with any kit.

In problem solving, cognitive thinking always has an auxiliary function in preparing the intellect for creative synthesis. Thus, we can say that creative thinking is related to the actual "content" of cognitive thinking, and both processes play an important, determining role in problem solving. If analysis is a fundamental attribute of cognitive processes in science and technology, and synthesis is a characteristic of creative processes, then there is a psychological barrier between cognitive and creative processes that occur simultaneously in thinking and yet separately in both scientific and technical thinking. However, it is a permeable barrier that divides the thinking process into a cognitive, analytical part and a creative, constructive part. This permeable barrier is a kind of Rubicon that we cross in our thinking, whether intentionally or unintentionally, to reach a higher level, a new quality. This then occurs when our thinking process gathers enough information and thought (productive content) to transform quantity into quality (according to the laws of dialectics). However, even then, this new quality still requires a "supply" of details, but at the same time it also already offers a hint of a solution to the problem. Therefore, the barrier mentioned above is also a symbol of a kind of transition from analysis to synthesis, from the cognitive process to the creative process, from quantity to quality, from discovery to action. The question of transition is therefore a question of fulfilling the necessary conditions for solving the problem.

According to Franus [16], problem-solving thinking can be twofold:

- with a homogeneous structure of a purely cognitive type, in the case where it is a non-productive process that is limited by knowledge of the content of the problem and does not lead to the solution of a new problem;
- with a dual structure, i.e. with a cognitive and creative aspect and a productive outcome.

In solving a difficult problem, intellectual work does not follow a simple model (nor does it copy that simple model), but involves many synthetic micro-parts

(microsyntheses) that form the final creative macrosynthetic complex. In addition to this complex, in multicomponent cases, the mental-cognitive creative or design structure also forms a “mosaic” of multiple microsynthetic parts.

Technical thinking, like any other type of creative thinking, is not only cognitive thinking but also a two-valued complex process that respects both simple and complex problems, as well as the structures of microsyntheses and macrosyntheses mentioned above.

In scientific thinking, creative synthesis is at the core of formulating theories within a research problem, but in technology it is at the core of finding as well as inventing and creating the structures of technical objects. In both cases, however, these are concrete or particularised (object) processes of so-called creative thinking. The quality of these processes, however, understandably differs considerably. However, both develop in the realm of concepts and ideas, which involve the form of words and sentences and then also require representation and concrete material substance.

Cognitive thinking performs various functions during the creative and analytical processes. In science, it is a research process that prepares the information needed to formulate a theory, or it can be a cognitive process that facilitates familiarity with the content of the problems to be solved. In technology, this concerns at least four general situations, namely, the provision of information to learn about the content of the problem, the learning of theories of science, technological principles and laws and rules in relation to the problem, the investigation of production processes and, last but not least, the investigation of the activities of the final product or object. In each of these situations, the result of knowledge is an act of creative synthesis as a key element for the completion of the creative process.

According to E. Franus [16], technical thinking, which is actually a concretized process, differs from other concretized processes in that it is concerned with the creation of an artificial world and the construction of technologies and objects in the broadest sense. However, with regard to the procedural and psychological aspects, this process is also characterised by a typically dual cognitive and creative structure (just like other concretized processes, for example, musical or artistic processes, etc.). Thus, it can be said that the key to cognition and creation is the procedural structure of thinking, which includes both the cognitive phase in analysis and the creative phase in synthesis (both are also closely related to the technical and constructional building blocks that connect these areas or phases). If we look at the content, then concretised technical thinking refers to a particular form of matter (substance) and therefore to a given technology or technique in the sense of an object. The various forms of matter (substance) and production technologies, methods and operations, also the results and works of the human intellect then constitute the concrete specifics of this concretised thinking. The same matter (substance), albeit in different forms and shapes and using different methods, has been and is the subject of study in different disciplines and also of description in different theories. Thus, specifically oriented concrete thinking manifests itself in all the sometimes hard-to-believe diverse forms of activity that we call creative.

Technical thinking, its content, is a broadly defined concept that can be divided according to different aspects. Indeed, the above text shows this in a way. According to E. Blomdahl and W. Rogal [24], E. Franus [16] also distinguishes four types of technical thinking, which, in our opinion, are also fully manifested in relation to construction and technically oriented building blocks:

- Visual thinking and reproductive thinking involving, for example, reading technical drawings;
- intuitive thinking, leading to the improvement of existing designs or even to the creation of new ones;
- conceptual thinking, which is based on systems of concepts or technical categories contained in explanations, proofs and planning;
- practical thinking, simple, routine, manipulative thinking, which can be associated with the assembly and disassembly of technical equipment, with discovery and diagnosis, with the inspection of new products.

For the development of technical thinking, a natural and important tool can be found in solving technical problems - K. Kraszewski [25] which is both a means and an end of teaching, regardless of whether these issues are of a cognitive or application nature. C. Gilbert [26] has shown a similarity between the problem-solving procedure and the process of producing or using technical equipment (i.e. technological process).

4. Technical kits as illustrative training aids in vocational training

The issue of kits has been debated and published in many professional journals, as well as at international conferences and seminars. An elementary general, comprehensive perspective of technical kits from a terminological and didactic point of view, including their application to teaching, is offered by J. Dostál [27] and later C. Serafin [28].

Before further analysis, it is useful to carry out some conceptual analysis, which in the case of technical building blocks can be done from two perspectives [28]:

1. Pedagogical-psychological, which defines technical building blocks as teaching aids used for learning in the form of:
 - application of didactic principles (such as demonstration, scientificity; connection between theory and practice; individual approach; appropriateness or permanence);
 - the integration of technical kits into the system of teaching aids;
 - a psychological and special pedagogical view of the kits as part of the pupil's development, both shaping and helping it;
2. professional-technical - this is the design aspect (e.g. safety, durability, reliability, ease of maintenance, operation, etc.), but this aspect must also always be linked to the pedagogical aspect in the context of teaching.

What is a technical kit? The definition of this term (yes it is a term) must be approached from two perspectives - technical and pedagogical.

The dictionary definition [29] states that kits are “unified functional parts (blocks) that are physically and logically compatible with each other and facilitate the construction of assemblies with various industrial and laboratory uses”. They are therefore “collections of objects that are to be assembled or joined to form a particular unit and also disassembled”. This concept is a technical definition.

C. Serafin [28] states that construction kits are mainly teaching aids which, in order to facilitate the assembly of objects (devices), are defined by their parts, their construction using a presented pattern and/or personal imagination. According to C. Serafin [28], the purpose of using technical building blocks in teaching can be:

- increase the effectiveness of education;
- give pupils a sense of technical engineering;
- explain the basic rules, terms, and principles;
- think through problems and solve them;
- pique the imagination and creativity of pupils;
- introduce elements of playfulness into education.

... we could go on.

The main goal of using technical kits in education can be considered to be the introduction of pupils to the basic knowledge of technical engineering and electronics, the deepening and expansion of their awareness, as well as the creation and improvement of their work skills and habits. The tasks solved with the use of kits on the basis of acquiring a certain degree of theoretical knowledge help with the development of logical and creative thinking. Furthermore, a successful assembly and performance of operations related to correctly closing and operating a circuit, device, or apparatus give the pupils a sense of self-realisation. The use of technical kits offers a suitable way to develop the technological knowledge of pupils, to deepen the illustrative nature of teaching, and at the same time to have pupils learn simple experimental work. Pupils find themselves in an active contact with studied phenomena, directly receive stimuli through their sensory organs, and thus specifically learn about the characteristics of the studied phenomena. When engaged in laboratory work, the pupils cause electrical phenomena and processes to occur, solving tasks and explaining the nature of the studied phenomena which they find hard to explain in terms of theory (this is especially true for electrical engineering). Finally, they arrive at conclusions, natural-scientific and technological theorems, and verify what was deductively communicated to them. This makes classes more interesting to pupils, and the acquired knowledge illustrative.

In connection with technical kits in the teaching environment, we can establish the most important positive and negative aspects (see below).

The positive aspects include [28]:

- pupils are not overworked as they can set their own pace;
- proportionality in regard to developmental aspects (puberty, motor skills, perception);

- a suitable microclimate is provided;
- the voltage is very small (approximately up to 12 V), meaning that the value of flowing currents can be measured in milliamperes – it is always necessary to eliminate any possibility of electrical injury;
- the used materials are harmless; the colours cannot be wiped off;
- ergonomic perspectives are adhered to.

Negative aspects include [28]:

- static sedentary work (though not always);
- pupils' eyesight is stressed (depending on the size of function units);
- strenuous assembly (depending on the nature/type of kit).

In this context, it is worth mentioning again the constructivist approach to education, where the constructivist theory emphasises the active participation of the subjects, i.e. that they do not acquire their knowledge passively, but construct it themselves. Learners' knowledge and skills are developed in an organised environment and are adapted to this environment in a complex way.

The constructivist approach in teaching is based primarily on the pupils' activities and is intended to lead to the development of their cognitive abilities, their thinking and creativity (both mental and manual). However, an important role is played by motivation, activation, autonomy and respect; respect for pupils who interpret new facts on the basis of their own understanding of what they have learned now and previously, their existing knowledge and experience. These mental structures thus form patterns as the basis for new, constructed knowledge.

If a teacher adopts a constructivist approach in his/her teaching, then he/she assesses and diagnoses the students' dispositions and attitudes towards the expected content and the way of processing it, and then adapts his/her practice to these results (for more details see L. Hajerová-Müllerová et al. [30]). It is therefore primarily up to the teacher (although the pupils play the main role here) to create the appropriate conditions and provide the materials to facilitate pupils' construction of knowledge, while respecting their individual peculiarities and pace. The teacher must ensure that pupils are active, motivate them, guide them and link their knowledge to activities and skills. Whether we want it or not, this construct is ideally combined with the use of constructive, technical building blocks.

5. Technical kits and modelling

The current concept of models and modelling is multifaceted and reflects the multiformity of human actions. Generally speaking, models can be divided into two groups [28]:

- *Models of reality* - these are models that are identical to the original in terms of their physical nature, they can also be mathematical models whose purpose is to discover/clarify laws that will be experimentally verified. In this concept, models

are isomorphic, as there is an analogy between the elements of the model and the objects being modelled, while the interrelationships are preserved. Three aspects apply to models - reflexivity, symmetry and transitivity.

- *Theoretical models* - these are always mathematical models that are based on either a model of reality or a model of theory. However, within this concept, not all parts of reality are modelled, the representation of elements is not mutually unambiguous, the relationships between the elements represented are not preserved or symmetry is missing. Such models are homomorphic.

Model can be understood as a mentally conceivable or materially realisable (technical) system that reflects or represents the object of investigation and that is capable of replacing it so that by examining it new information about the object being modelled can be obtained [31]. For example, the relevant configuration of wiring units, assembled by a student on an electronic kit, is an example of such a model, and thus represents to some extent the result of a back-transformation of the model (i.e., the electrical schematic) to the original original (i.e., the electrical device). In order to clearly differentiate technical kits from actual originals used in technical practice, it is more appropriate to call them “pseudo-originals”.

In technical practice, one often encounters a “reverse transformation” (due to specific conditions), meaning the creation of a technical original, i.e. a new product, or an improvement of the technical condition (such condition is often addressed, for example, by amateur electronics). **Figure 1** shows a diagram for modelling technical practice by the application of technical kits.

Explanatory function is one of the most important roles any model can have. In relation to experiments, the term *modelling* can be understood to mean the relationship between two independent objects – a primary problem object, and a secondary model. Modelling makes it possible to solve a problem with a single object (be it a physical, or mathematical one), and then mentally infer the solution, using the second object. Therefore, the similarity between both objects or their behaviour always serves as the basis. Modelling can be divided into [31]:

- *physical modelling* – an object’s physical model can capture not only its mathematic specifications, but important physical behaviour. We distinguish between:
 - a. *similarity modelling* – the problems being solved are physically similar to one another which means that they share a non-dimensional description and that non-dimensional arguments correspond to one another, i.e. similarity criteria;
 - b. *analogue modelling* – basically two identical problems, with the same mathematical description. Two objects which are physically completely different from one another (e.g. the flow of liquid in pipes vs. electric current in a conductor) can have the same mathematical description;

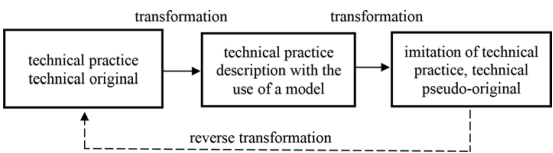


Figure 1.
Diagram for modelling technical practice by the application of technical kits.

- *Computational modelling* – a theory must be formulated for this type of modelling, but no physical model is necessary.

The modelling of technical reality and the process of creating technical models represent a fundamental area that accompanies the creation and application of technical kits in education [28]. As already mentioned here, working with technical building blocks develops technical imagination in students as an important intellectual activity, so very important and integral part of technical thinking. Technical thinking and technical imagination are two sides of the same coin, whose content is directed into the realm of technology and which, like the coin, cannot be separated. Technical imagination influences the development of technical thinking and technical thinking conditions technical imagination.

The purpose of working with technical building blocks in the context of both modelling and constructivism is for the pupil to be able to draw an analogy between the original and the model (a kind of pseudo-original) on the basis of the model. A necessary condition is the correspondence in the structure of both systems and their properties (the construction of any technical kit is then defined and limited by this condition). Thus, the technical object under study, whose model is created by means of a technical kit, is actually any device (black box) using this pseudo-original.

Modelling, the creation of models, is of course a creative activity and as such is part of technical experimentation and research, part of the cognitive process. In teaching, then, we call this activity an educational technical experiment as the realisation of a heuristic method of discovering new knowledge through a sophisticated procedure of observation, investigation, measurement and evaluation by exact means, i.e., measurement. The aim is to reveal new information about a phenomenon, material, etc.

Working with different kits is one of the chief points of general vocational training. The reason why we say this is that it is important to actively involve pupils in the subject of study. In case of technical kits, this is most often implemented by experiments – technical experiments, be it in regular classes held in a classroom, or at a laboratory. Technical experiments is to give pupils a sense of technical reality or processes. Experimental activities are a prominent part of the cognitive process and also a method for evoking direct experiences which result in the acquisition of knowledge.

Academic technical experiments are characterised by a systematic psychological activity for the purpose of acquiring knowledge which brings about deeper, but at the same time general technical thinking.

In the school environment, technical experiments include the development of pupils' independent creative activities and their logical thinking; the formation of scientific-technical notions about the studied object; the development of positive and realistic attitudes to technics; discovering physical laws; forming a correct relationship to technical-economic tools; and developing the pupils' ability to express themselves.

Academic technical experiments can be classified in many different ways, for example [2]:

- according to their relationship to technical practice (technical or technological experiments);
- according to their external form (academic, in hobby clubs, or home experiments);

- according to their internal form (student's – performed by the students; demonstrative – performed by the teacher);
- according to the identity of the experimenter (educator, or the educated);
- according to the function of the cognitive process (verification, illustration, application, problem);
- according to the stage of the education process (motivation, acquisition, testing).

Technical experiments supported by the use of technical kits encourage pupils to master the methods and experimental skills related to electrical engineering, as well as practical skills and general work habits. When using a technical kit in a school technical experiment, it is necessary for students to see the experiment as a necessary and natural consequence of their learning activities, to need to observe phenomena and to test theories.

6. Technical kits as material didactic training tools

On a general level, kits can be characterised as a set of objects whose purpose is to be assembled and combined into arbitrary or strictly defined wholes, forming objects which can then be disassembled.

Technical kits perfectly fit into this definition, but how do they work in the context of teaching? What is the situation with their inclusion in didactic training tools [2], i.e. material didactic training tools? Generally speaking, such material didactic training tools can be divided into training aids and didactic technical equipment. Technical kits can be categorised not only as training aids, but also as a system of didactic technical equipment, especially if they are combined with a control computer.

Attitudes towards the use of the term “training aid” J. Drahovzal et al. [32] and P. Bohony [33] have been varied and not always clear. Considering the aim of this study, let us endorse the definition formulated by A. Hašková [34] or J. Pavelka [35]: “A training aid is such a material didactic training tool whose didactic functions facilitate a more effective attainment of the teaching's goals and which serves as a prerequisite for meeting guidance/education goals.”

From the perspective of fundamental pedagogical categories, training aids rank behind *goal – content – methods* [32]. This does not mean, however, that their role is marginal. Over the course of schooling, the educator temporarily objectifies one of his or her functions by using training aids, in fact. Objectification can be understood as an intentional transfer of a function, characterised by a typical subjectivism, to a technical system which guarantees its objective and standard nature [32].

According to A. Melezinek [36] *training aids* (especially those of a technical nature) can be divided into *non-adaptive* ones which are related to a one-way communication, i.e. the educator to the educated, and *adaptive ones*, involved in a two-way communication that includes feedback. This division is not strictly defined (**Figure 2**).

In this respect, A. Melazinek [36] mentions the term *technology of teaching* which describes the aggregate of all technical devices and systems used during schooling, one of them being electrotechnical kits. This issue is further elaborated by A. Hašková [1].

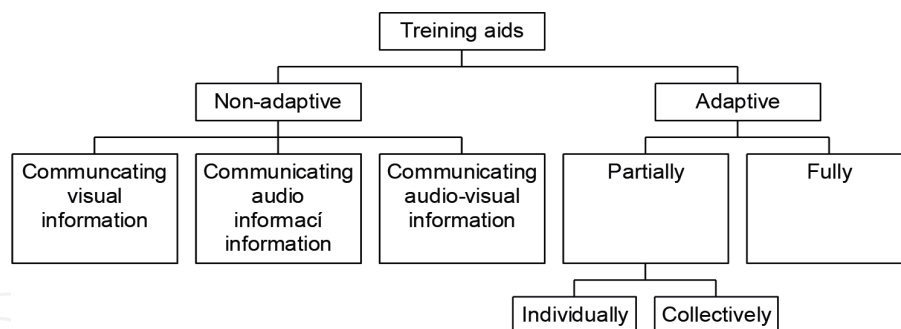


Figure 2.
 Training aids classification.

In the guidance-education process, training aids can be rationally used as [32]:

- motivation and simulation tools, i.e. means of stoking a pupil’s internal relationship to learning, of solving problems and problem situations which encourage creative searching, discovering, and acting;
- sources of information which give the pupil a sense of the curriculum in a way that makes the process of learning as easy as possible; as a means of verbal and non-verbal communication, training aids should help the pupil understand the nature of various phenomena in different ways;
- tools for systemising knowledge in order to connect new knowledge with previously learned terms and information; training aids should make it easier for pupils to organise the lesson’s subject matter;
- tools for mastering work methods while learning about new phenomena;
- tools for combining school and practice;
- tools for assuming a differentiated approach to the pupil.

Clearly, training aids are a prominent link in the process of creating knowledge and verifying its validity, but their content, form, and presentation in education also affect the overall formation of the pupil’s personality and encourage them to fulfil their current and perspective tasks and goals.

When dealing with the issue of updating the teaching management process, especially from the perspective of *humanising the education system*, it is necessary to ask: “In the teaching process, what kind of training aids (i.e. technical kits, too) should make up the indispensable foundation of the school’s methodical equipment?” To answer this question, we will further delve into the classification and categorisation of training aids whose content differentiation and concretisation can be based on the following perspectives:

- incorporating electrotechnical kits into education drastically changes the way an educator works. The share of “living labour”, which has been a prevailing factor in their work up until now, decreases. In terms of the replaceability and irreplaceability of the so-called living labour, traditional education can be compared to the “manufactory” period of technical development when viewed from the

perspective of modern production. Such replaceability manifests itself wherever an activity does not require one to directly participate in managing the process of guidance/education;

- in the interest of improving teaching's effectiveness as a whole, it is useful to relieve the educator of all activities of a non-creative nature (e.g. the evaluation of didactic tests, homework, practice, etc.). Such activities can be automated, or mechanised and ceded to didactic technical equipment (on the basis of a continuous feedback registered by a programme or a feedback device).

There is a manifest trend in the process of managing education to implement a so-called automated teaching system which, in regard to teaching with electrotechnical kits, consists of [28]:

- an education management programme, i.e. the expected algorithm for educating pupils, structuring the expected learning and teaching methods, and the educator's optimum approach to meeting guidance/education goals;
- material didactic training tools (training aids, kits, didactic technical equipment, micro- and macro-environmental architectonic solutions);
- diagnostic technical equipment to assess results and regulate guidance/education processes;
- pupils' learning activities themselves and their management by the educator in the scope of programme management.

An education management programme can be viewed as a general principle, i.e. a methodical algorithm for the sequence of the educator's and pupil's didactic activities which facilitates the objectification of learning's basic functions and the effective management of the guidance-education process L. Zormanová [37] which includes, among other things, operating technical kits. An education algorithm, differentiated with respect to the basic groups of pupils who take part in the education process, is a fundamental element.

Material tools act as a catalyst in the educator's hands and change into tools of modern communication, of managing and regulating learning activities. They can effectively contribute to the development of the creative activities educators and pupils engage in, as long as they are used in a methodically correct fashion.

The contemporary development of training aids is heading towards a gradual formation of a complex communication system in practical education. Through this system, the connection between humans and technics will be established more quickly and most of all more easily.

Every training aid (i.e. electrotechnical kits as well) can work not only as a carrier of information, but also as its communicator. It can evoke the dynamism of the cognitive process in relation to didactic activities. At the same time, it can influence the emotional and volitional sphere of the pupil's personality development to a different extent. The so-called "pedagogised aids", i.e. objects adjusted to didactic purposes (e.g. a methodical use of an electric motor section) are also more illustrative.

In the education process, electrotechnical kits are used as a tool to meet education goals, thus facilitating interactions between the educator, pupil, and electrotechnical

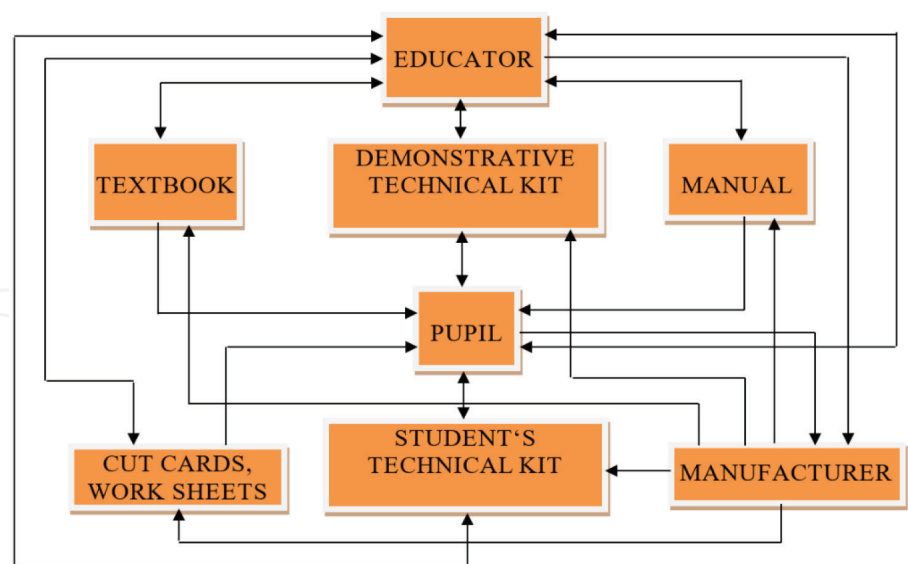


Figure 3.
The communication structure of frontal education with the use of technical kits.

kit. Such interactions take place in different ways – verbally, non-verbally, by means of activities, etc. **Figure 3** shows the communication structure of the entire system where communication flows between the system’s individual elements.

Obviously, education can become effective when the educative potential of technical kits is applied and harnessed, but technical kits themselves do not guarantee effective education.

These two perspectives also need to be employed when choosing technical kits. In this case, the technical viewpoint must be made subordinate to the need in order to emphasise the important aspects of a demonstrated phenomenon, for the experiment to be illustrative and clearly arranged, and to provoke pupils’ thinking.

Training aids, and thus technical kits as well, are characterised by a close relationship to the content of teaching. In the education process, aids directly affect the pupils’ learning activities by their didactic functions and become a part in the transmission channel between the educator and pupils.

7. Pupils as users of technical kits

Pupils and the educator participate in the education process, constitute an active force in educational activities, and at the same time are their own guidance operators. The quality of the educational influence’s results also strongly depends on the internal prerequisites of the educator’s and pupils’ personalities, as well as on the quality and intensity of their mutual interaction.

A pupil’s personality goes through different stages of development, changes. In each age span, it gains certain characteristics which are typical for the given period and age group. These age-related particularities need to be respected in the education process, too [38] – this naturally fully applies to the relationship with technical kits.

The personality of the person being educated cannot be perceived in isolation as a passive object of our influence. Each individual perceives and receives stimuli from the external environment in a unique, different fashion, and also reacts to them in diverse ways. He or she affects the external environmental factors in return,

influencing, shaping, and remoulding them. This active influence, however, is directed not only towards stimuli from the external environment, but towards oneself. Over time, a pupil becomes a self-regulating agent who sets autonomous goals, imposes tasks on themselves, and decides how to achieve them. The ability of autoregulation and self-education should be one of the chief aims of the education process.

Different children perceive school education differently: there are big disparities, both from the perspective of psychological and physical development. In the guidance-education process, the individual being educated is not isolated but has diverse relationships with the other elements in their environment. At the same time, though, it must be stressed that playing is an activity in which children engage from a very early age and which satisfies their inner needs. All objects they play with, i.e. objects whose shape, composition, and purpose are adapted to the purpose of children's games, help them express their ideas, dreams, and wishes and develop their skills or abilities. The educational significance of toys lies in the expansion and enrichment of a fundamental children's activity – playing – in coexistence with the universal development of their personality.

Activities with a prevalence of physical exercise constitute a significant part of a pupil's day. In pre-school age, they result in the development of basic manual skills. According to E. Takáčová [39], children and playing are two terms which have been associated with one another from time immemorial. As the child's ability to navigate the outside world increases, so does the manner of their playing. Toys open the door to the world of children's games. Children's toys can be evaluated from three basic perspectives which apply to electrotechnical kits as well:

- pedagogical perspective – games inspire a child to engage in a creative activity;
- hygienic-safety perspective – cleanliness, harmless materials, and safety;
- aesthetic perspective – a toy, in fact, is the very first artistic object a child encounters.

Nowadays, toys and games of diverse types are a part of daily life, positively shape one's personality, and are a means of developing one's technical and artistic expression.

Insight gained from brain research shows that the left hemisphere, characterised as verbal and rational, is dominant for speech, while the right one is emotive, non-verbal, intuitive and controls, among other things, emotions, holistic processes, one's global worldview, spatial perception and orientation. In childhood, a pupil's right hemisphere is more mature than the left one, which is why functions controlled by the right hemisphere prevail in the child's psychology. According to J. Brierley [40], there are apparent differences between the activities girls and boys engage in. On average, all left-hemisphere-mediated speech functions are slightly more advanced in girls than in boys of the same age. In case of boys, non-verbal spatial functions, mediated by the right hemisphere, and ability to conduct spatial work with patterns and shapes are more developed. Actually, boys as young as two perform better in this area. It follows, then, that boys excel in examining things, which is a crucial factor in natural or technical sciences, a fact that is significantly affected by the selection of and preference for the materials and equipment used in schools. This is exactly where kits come into play. By incorporating them, we introduce an element of playing into

the guidance-education process (E. Roučová [41] mentions the term “technical toy” which denotes a certain technical object or several of its technical elements).

Playing with kits can have an immense educational effect on children. To undergo cognitive development, a child needs to have toys that develop psychological functions: perception, memory, imagination, thinking. Kits fulfil this precise requirement. When a pupil observes, perceives, and acquires new information or knowledge, they are encouraged to construct and model, study the principles, etc. All of these activities force them to think, draw on their existing knowledge, rely on their imagination, and most of all create new things while learning how to evaluate.

The process of acquiring skills and habits has three stages [38]:

1. the acquisition of knowledge;
2. the acquisition of motor and sensory skills;
3. the acquisition of habits.

Skills and habits are formed and perfected when complex conditioned responses emerge and become reinforced. That is why there are three stages of motor and sensory skills which lead to the acquisition of habits [38]:

- a. generalisation stage – irradiation of excitations in the motor region of cerebral cortex. Movements are made uneconomically;
- b. concentration stage – corresponds to a gradual concentration of excitations in the brain's motor centre; temporary conditioned responses are formed;
- c. automation stage – corresponds to the reinforcement of stereotypes.

Applying these phases and stages to the guidance-education process (generally) results not only in the acquisition of knowledge and skills, but also in a heightened awareness of work organisation, hygiene, and occupational safety, as well as in the formation of a worldview and future occupational orientation. In particular, children can use technical kits to learn effectively which allows such kits to be included under the work term “*didactic toys*”.

Technical kits develop not only technical skills, but also social relationships. According to J. Daněk and M. Šmejkalová [42], construction almost always forces pupils to cooperate, communicate with one another, and exchange elements they need in order to complete a project. Pupils share their experience when working together. Working with any kit in schools is challenging not only in terms of organisation, but also of thinking and technical imagination. That is why kits are viewed as a toy which greatly affects the development of children's thinking and is notable due to its high formative value. Playing with kits also frequently works as a tool of socialisation.

8. Technical kits and the technical creativity of pupils

In relation to the issues described above, it is useful to talk about creativity, in this context namely about technical creativity. Defining “creativity” has been a point

of interest for many scientists. They are not united in their views – there are many definitions which try to describe this term [12, 43, 44]. For our text, the following will suffice: “*creativity is a human ability based on cognitive and motivation processes where inspiration, imagination, and intuition are also involved to a great extent. It manifests itself in coming up with such solutions that are correct, and at the same time new, unusual, and unexpected*” [45].

In technical vocational education, creativity is conceptualised as part of the general creativity that is taught, although there are of course some specific disciplines where the creative process is indirectly or peripherally involved in teaching (example: electrical engineering versus economics).

The concept of creativity can be narrowed down to technical creativity, i.e. creative technical activity, then we mean basic technical skills, technical communication skills (verbal and graphic), the ability to use working tools or devices and then apply them in technical and non-technical practice. Closely related to the above is the notion of technical fitness, which is the ability to perform work movements as a result of coordination between the relevant muscle groups and between muscle action and thinking.

If pupils are encouraged to be creative, then creativity is an organic part of education that enhances working skills, influences social relationships and facilitates the overall development of the pupil's personality. According to J. Hlavsa [46], the goal of guiding pupils to creativity should be precisely the formation of their creative personality with regard to effective work activities, self-formation and optimization of social behaviour. Identification of the interconnection of creative activities with vocational education creates conditions for the development of creative technical thinking in pupils. Y. K. Michael [47] states that the basic characteristics of creative technical thinking are originality and independence.

Keeping to J. Hlavsa [46], we can state that the creative thinking of pupils is a mental process characterised by self-reliance and the ability to recognise and solve unknown matters based on what has already been recognised.

As has been said here several times, the creative process accompanies all activities of a creative nature, especially those of a technical nature. Working with technical building blocks can serve as a model example of the development of the creative process in terms of creative skills and the application of creative technical thinking. According to A. Marszałek [48], the creative process can be divided into four basic stages with regard to technical subjects:

- *initiation stage* - includes the pupil's previous life, his education, skill, emotions, etc.;
- *incubation stage* - the stage of searching for a solution. This phase requires from the pupils a higher level of questioning ability as well as a more intensive involvement (searching for sources, looking for connections and analogies or alternatives);
- *illumination phase* - this is the phase of discovering a partial or even definitive solution. This phase cannot be planned, it is possible to observe the circumstances that contribute to the solution;
- *verification phase* - this is the testing of the solution in practice.

Methods of developing technical creativity and creative technical thinking are discussed, for example, by I. Lokšová [49] and H. Lytton [50]). If we decide to study ways of developing creativity, we have to start from heuristic methods. Based on the classical categorisation of J. Čap [51], this is the following division:

- question formulation - whether we are successful in trying to solve a problem creatively depends on how well the questions are formulated;
- generating a significant number of hypotheses, ideas and suggestions - most of us tend to be brief. In practice, however, it is better to list a large number of ideas and then proceed to the selection process later;
- motivation to produce ideas - there is a need to take the fear and anxiety out of asking questions and instead engage students in discussion and creative activity. Once the pupils lose their shyness, they usually start to improve their proposals themselves;
- separating idea generation from idea evaluation - we usually tend to evaluate an idea as soon as it is discovered. We need to wait a while and put them aside as a better idea may emerge;
- organising information, using it and gathering it in the context of new data - this is about representing data and interpreting it, as well as finding more new information;
- reframing the problem - a complex problem should be broken down into sub-problems. Synthesising these sub-problems can then lead to a solution to the original complex problem;
- overcoming the habitual or usual view of phenomena - it is actually the inability to perceive things differently, through a different lens;
- wild ideas - even extreme, often provocative ideas are sometimes great ideas and may be necessary to solve problems, especially if one has to come up with a completely new solution;
- combining different elements - combining familiar elements from a whole in an unusual way;
- analogy - a common approach to problem solving. This approach is based on one's own past experience in solving a similar problem;
- talking out loud - helping to clarify a difficult problem by retelling it;
- group solution - uses different perspectives from different people who are familiar with the content of the problem;
- external activities and modelling is a method of simplifying a complex problem into a model by considering a limited number of external conditions;

- unusual association - a solution to a problem may emerge from unusual facts and similar associations. It is recommended to postpone solving the problem, focus on something else, and then return to solving the problem.

The above classification is therefore closely related to the promotion of creativity also in relation to technical building blocks. A. Petrova [43], J. Honzíková [52] state that the most important methods of creativity development include brainstorming, HOBOT technique, Phillips 66 technique and 635 technique, among others.

Methods for developing creativity place exceptionally big demands on the educator who must divide pupils into groups, formulate tasks, monitor their solving as well as the pupils' reactions, and regularly make qualified interventions. It is also appropriate for the teacher to evaluate whether submitted solutions are correct.

9. Technical kits in Czech primary school

The main objective of the research was to identify, analyse and then describe the current state of teaching using technical kits in primary schools in the Czech Republic. Teachers in primary schools and multi-year grammar schools in the Olomouc, Zlin and Moravian-Silesian regions were contacted. A self-constructed questionnaire was used as a research tool for data collection, which was distributed to the respondents, filled in and electronically evaluated using MS Excel statistical tools. From the available tools for the questionnaire, the cloud application Google Forms was selected, whose services suited the nature and structure of the questions.

The questionnaire was distributed via email, which, in addition to the accompanying message text, also contained a link through which respondents could access the questionnaire. Most of the questions in the questionnaire were set as mandatory, meaning that the respondent had to comment. However, the questionnaire also contained questions marked as optional, for which the respondent indicated a response only if he or she was able or willing to answer on the issue.

The questionnaire consisted of three parts. The first part contained questions aimed at quantifying the respondents. The second part dealt with teaching experience and the third assessed the reasons and also offered suggestions from the respondents. We asked about active experiences with building blocks in teaching (e.g. in what way, what methodological materials, what types of building blocks, in what subjects, etc.), as well as the context of computer science, programming opportunities, digital literacy development, and reasons for not using building blocks in teaching. In total, the questionnaire contained 30 questions.

The primary use of engineering kits by respondents varies from subject to subject. **Figure 4** shows the top 4 most frequently reported subjects (including leisure activities) with kit-supported learning and the ways in which respondents use kits in these subjects. As can be seen from **Figure 4**, for most of them the main area of interest is problem solving and in the case of the Computer Science subject then programming and algorithmization. Then, in Technical Education, the most common areas of interest are learning about how technology works and competitions. Not surprisingly, in the teaching of physics, the implementation of measurements using sensors (**Table 1**).

Nowadays, there is a considerable number of technical kits on the market that can be applied to teaching. According to the answers of our respondents, it is evident that the leading position is held by construction-oriented building sets such as LEGO,

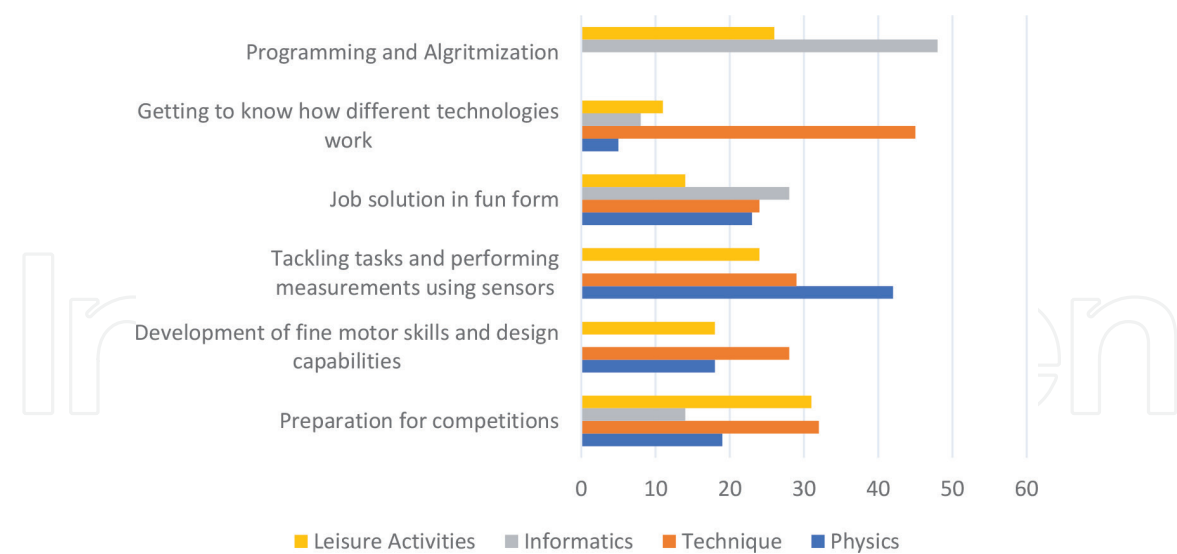


Figure 4.
Active experience with technical kits in teaching.

Gender	Age	Number
woman	under 26 years	8
	27 to 40 years	14
	40 to 50 years	16
	over 50 years	20
	Σ	58
man	under 26 years	5
	27 to 40 years	10
	40 to 50 years	12
	over 50 years	14
	Σ	41
Total respondents		99

Table 1.
Gender and age distribution of respondents.

which is known mainly for its technical building sets that connect the construction area with robotics, programming. Many respondents also reported a combination of several building blocks, but where LEGO building blocks were always the most represented. The Czech kit Merkur, which also has its robotic variants, ranks next in terms of number of users.

An essential part of teaching with kits, which each teacher may have a slightly different perspective on, is construction, even in terms of the type of technical kit. Due to the lack of definition of this area in the curriculum of primary schools in the Czech Republic and the prevailing low hourly allocation, the teacher has to decide what he/she wants to primarily focus on in teaching. If the primary goal of the lesson is not construction, the process of model building may be shortened (which is, of course, undesirable). Thus, the contribution of constructing to the overall lesson process and the teachers' own perspectives on constructing were investigated. Teachers who

Percentage of constructing on the implemented activity	Frequency of respondents
10%	11
20%	8
30%	12
40%	24
50%	26
More than 50%	47
Pupils only implement the activities, the model gets built	13

Table 2.
Proportion of construction in the implementation of short tasks in one lesson.

tend to use a set of shorter tasks within the lesson have a different contribution of construction to the flow of the lesson. About half, however, report that constructing a model takes pupils at least half of the lesson. In an ideal situation, this leaves roughly 20 minutes in a lesson (45 minutes) for the actual functionality, measurements and other activities (**Table 2**).

A very important factor that can discourage teachers from using kits is insufficient or inadequate methodological support. Thanks to the Internet, there is a large number of teaching materials, themes and examples available. However, not all of them are suitable for teaching. Therefore, we tried to find out from our respondents what type of methodological materials they use and to what extent in their teaching. As we found, respondents most often rely on the manual that is part of the kit supplied by the manufacturer (69% of respondents). This is understandable because these manuals or instructions usually contain all the basic information for working with the kit and also provide some tasks that can be done with the kit. Another source of information is then the internet (21% of respondents), both from websites (kit manufacturers or user communities (11% of respondents) and instructional videos (9% of respondents). Respondents either adopt the information obtained in this way into their own teaching or modify it and create their own tasks based on it. To a lesser extent, respondents reported working with a variety of texts, including foreign literature.

10. Conclusion

The education strategy in the Czech Republic is based on the development of polytechnic education, informatics and the promotion of digital literacy. However, strategies are one thing, but real support is another. Despite some positive steps associated with European Union projects, support for technical and natural science areas in particular is relatively weak, and this concerns not only material and technological support for teaching, but also, and above all, methodological and knowledge and skills support on the part of teachers.

Technology has an irreplaceable place in education at all levels. It takes on a special positive significance in combination with the desired development of digital and information literacy, where technology in the form of building blocks offers tools and procedures that contribute to this development in a positive way for both pupils and teachers. However, the building blocks in the concept of teaching aids must respect the functional and temporal specificities of teaching, both gnoseologically

and logically. It is understandable that a content analysis of the teaching process will best show the teacher the optimal possibilities for selecting appropriate methods and forms of teaching, including adequate teaching aids, but also teaching programmes and didactic techniques, but the teacher must apply all this creatively.

The area of the use and integration of technical building blocks into the teaching process is conditioned by many factors, which have been even partially mentioned here, but it should be borne in mind that the current development is directed towards the creation of complex technological systems combining both the constructional and the informatics and digital areas. Through such tools, a faster and, above all, easier transfer of information between teacher and pupil is realised. Thus, the application of technical building blocks can provide pupils with practical skills, knowledge and habits in addition to the development of their intellectual abilities and skills in the broadest spectrum, and the building blocks can be considered as a comprehensive tool for pupil development. By using knowledge from the field of creativity, especially technical creativity, as well as didactics, subject and subject area, this goal can be achieved and pupils can develop skills such as problem formulation, general approach to problem solving, ability to find a solution and optimise it in every situation. This applies to everyone's everyday life.

In conclusion, technical building blocks are undoubtedly an interesting technical system for educational activities. Therefore, they deserve to be significantly included in the material and technical base of all types and levels of schools, where pupils prepare theoretically and practically for their personal and professional life.


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