



Illustrative electrical engineering in the primary school

Cestmir Serafin ^a *

^a Faculty of Education, Palacký University in Olomouc, Zizka sq. n. 5, Olomouc 771 40, Czech Republic

Abstract

Electro technical kits have many positive effects in school education, suitably supplement as well as support it, and are also one of its subject matters. Considering the fast, global development information technology is experiencing, there is a growing need to combine computer systems and electro technical kits in education. This assists in the process of digitization, too, which asserts itself in the conditions set for educating children as early as in nursery schools.

The constructivist concept of education is based on the activities of students which lead to the development of their cognitive skills, thinking, and creativity; the issues of motivation, activity, independence, creativity, and humanizing education are appreciated; respect is given to the notion that students interpret new facts on the basis of understanding what they learned previously; of their existing knowledge and experiences. These mental structures constitute patterns which serve as a foundation for new, constructed knowledge.

When a teacher assumes the constructivist approach to education, they assess and diagnose the students' dispositions and attitudes to the expected content and to the manner of its processing. Subsequently, the teacher adapts their approach to these results. It is the teacher's responsibility to establish suitable conditions and materials for education to take place, to make it easier for students to construct new knowledge as a part of their education, to respect their individual traits and pace, ensure that the students are active, and combine their knowledge with activities and skills – all of this can be ideally combined by using of electro technical kits.

The paper presents the results of past research surveys which were conducted in relation to incorporating electrical engineering into education, and of the effectiveness of the implemented education in the practical reality of teaching which includes using electro technical kits as one of the basic didactic training tools in this sphere of technics. One subject of discussion also includes the condition / the current state of implementing education in the primary school environment.

© 2016 IJCI & the Authors. Published by *International Journal of Curriculum and Instruction (IJCI)*. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (CC BY-NC-ND) (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Education; Technical Education; Electrotechnical kits; Illustrative Electrical Engineering; Primary School

* Doc. Ing. Cestmir Serafin, Dr., Ing.Paed.IGIP. Tel.: +420-585 635 880
E-mail address: cestmir.serafin@upol.cz

1. Introduction

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, e.g. M. Hunter, 1999, M. Kožuchová, 1995, or G. Petty, 1996 and others. They are not united in their views – there are many definitions, which try to describe this term (A. Petrová, 1999). The following version will suffice for our goals: 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” (J. Průcha, E. Walterová, J. Mareš, 2013).

Apart from the above-mentioned definition, the creative level structure below is also very important (J. Honzíková, J. Bajtoš, 2004):

- micro-creative level – most schoolwork happens on this level. It accompanies humans throughout their entire lives. Its significance is derived from emotional responses of varying strengths, ones which accompany the creative process. It is an immense internal motivating force for individuals;
- macro-creative level – a higher level of human skills as the products of creative activities hold significance not only to creators, but to others as well. The creator’s emotional response is usually stronger as appreciation from others comes into play;
- mega-creative level – is determined by products appreciated on the largest scale. These products become the property of a professional group, nation, or humanity. They are ground-breaking and ingenious.

In vocational training, creativity is a part of general creativity, though there are some specific fields where the creative process also happens. Depending on the nature of prevailing activities, elements of the creative process can be classified thusly in our opinion:

- imagining and proposing the shape of an object, taking into account its material properties and assumed functions;
- estimating and selecting correct dimensions;
- analysing individual parts of the object, proposing optimum connections;
- planning the technological procedure and thinking it through;
- taking economic, ergonomic, environmental, and design requirements into account;
- using and applying previous knowledge and skills;
- recognising the cause and effect of finding hidden connections;

- shifting from concrete thought to illustrative visual thinking and notional logical-abstract reasoning;
- systematic practical activities which gradually unblock and release creativity;
- tangibly experiencing the individual stages of the creative process.

Narrowing the above-mentioned term creativity to mean only technical creativity, i.e. creative technical activity (G. Petty, 1996), we are referring to basic technical skills, namely the skills of technical communication – verbal and graphic, the ability to use common technical work tools and to subsequently apply them to technical, but also non-technical practice. The term technical proficiency is closely related to this, meaning the ability to perform work movements as a result of the coordination between relevant muscle groups, as well as between thinking and muscle activity.

Creativity guidance is an organic component of a person's guidance and education; it improves their work efficiency, affects social relationships, and facilitates their overall personal development. The creative process accompanies all creative actions, in particular those of technical nature, and thus understandably cannot happen without appropriate education, especially in relation to creativity and creative technical thinking. Working with electrotechnical kits can serve as a model example of developing creative skills and applying creative technical thinking. According to A. Marszałek (A. Marszałek, 2001), the creative process can be divided into four basic stages in regard to general technical subjects:

- the initiation stage – its content covers a pupil's entire life up until now, including their education, skills, background, emotions, etc. This stage also includes the formation and formulation of a problem;
- the incubation stage – one where a solution is sought. It requires pupils to possess a higher-level ability to ask questions, and overall to participate more intensely – researching sources, context, analogies, experiments, alternatives;
- the illumination stage – discovering a partial or definitive solution. This stage cannot be planned in advance; it is only possible to observe some of the circumstances which contribute to the problem's resolution;
- the verification stage – testing the solution in practice.

There are quite a lot of methods for developing technical creativity and creative technical thinking (see, for example I. Lokšová (I. Lokšová, 2003). The following text mentions only those examples which can be applied to electrotechnical kits, but their practical application is contingent on whether or not a person is aware of them at all. It is true, nevertheless, that the whole issue of creativity can be addressed by, for example, a "buck-passing" fiat: "Follow your imagination, children!" In that case, this model situation usually occurs:

- some pupils start working – creativity occurs on an individual level;
- some pupils do not know what they are supposed to do, and start asking questions – they spend a lot of time thinking which leaves little time for the work itself;
- finally, the rest experiences a stress response for various reasons while others are confused.

In other words, this “fiat” has zero effect on children’s creativity. If one decides to study the ways to develop creativity, they need to start from heuristic methods applicable both to children and adults. Based on the classic categorisation by J. Čáp (J. Čáp, 2001), the classification goes as follows:

- formulating questions – whether or not we are successful when trying to creatively solve a problem depends on how well questions are formulated;
- producing a substantial amount of hypotheses, ideas, and proposals – most of us tend to be economical and concise (a so-called scientific thinking). In practice, though, it is better to produce a large number of ideas and immediately begin the selection process;
- motivation to produce ideas – it is necessary to relieve pupils of their fear to ask questions and engage in creative activities. As they gather experience, the pupils usually begin improving their proposals on their own;
- separating the production of ideas from their critical evaluation – we tend to evaluate an idea as soon as it appears. Waiting a while and putting them down is better;
- organising information, using it, and gathering new data – this concerns depicting data and putting it down, as well as looking for other necessary information;
- restating the problem – it is appropriate to divide a complex problem into partial ones. By synthesizing the partial issues, we arrive at the solution to the original one;
- overcoming the usual view of phenomena – it is, in fact, an inability to perceive things in any other fashion;
- wild ideas – extreme, often provocative ideas are sometimes absolutely vital if one is to come up with a new solution to an issue;
- combining different elements – connecting known elements from one whole in an unusual manner;
- analogy – a frequent approach to problem-solving, drawing on one’s past experiences with solving a similar issue;
- talking loudly – helps one clarify a difficult problem;

- group solution – harnesses different points of view.
- external activities and modelling – a method of simplifying a complex problem;
- involuntary association – a solution is discovered by making an unusual association. It is recommended to postpone solving the issue, focus on something else, and then come back to the problem-solving.

The classification mentioned above is closely related to supporting creativity, and can be used in relation to electrotechnical kits, too. The most important methods for supporting the development of creativity include brainstorming, the HOBOT technique, and the Phillips 66 technique. The works of I. Turek (I. Turek, 1998) emphasize the teaching's effectiveness from the perspective of developing pupils' creativity.

2. Method

Our main research method was an indirect one – questionnaire. Although this technique usually succeeds in making a few respondents react, we decided to deliver the questionnaires to them in several ways – by regular, and electronic mail (if the relevant school offered that option). Thus, the questionnaire and its cover letter were sent to all primary schools in the region. The respondents who did not react were then approached directly. During the survey itself, two types of questionnaire were used:

- of an informative nature – its goal was to examine the state of electrotechnical kits in primary schools, as well as the attitudes adopted by educators to the kits;
- of an analytical nature – used to determine evaluative areas and criteria in relation to electrotechnical kits.

Both questionnaires asked dichotomous questions with only two possible answers: yes – no. For example, when we wanted to find out whether a respondent used electrotechnical kits for teaching, we asked this type of questions to divide the research sample into two groups – those respondents who do, and those who do not. By asking thus formulated questions, we then gathered data about the respondent, their specialization, and opinions.

In the research's first part, 298 schools from the Olomouc Region were approached altogether, 35 of which by means of electronic mail. The total result achieved after the method of direct contact was subsequently employed (i.e. usable questionnaires – considering that some schools were being shut down, other ones merged, etc.) amounts to 265. That constitutes a success rate of 88.9%.

3. Humans and the work world in the primary school curriculum

The Humans and the Work World education area in Czech Republic covers work activities and technologies concerned with user skills in different fields of human

activities, including the formation of pupils' world and professional views. The policy is based on specific situations pupils encounter over the course of their life.

Education in this area focuses on shaping and developing key competences by encouraging pupils to[†]:

- have a positive attitude to work, and assume responsibility for the quality of the results of one's own, as well as collaborative work;
- acquire basic work skills and habits from different work fields, to organise and plan their work, and to use suitable instruments, tools, and aids in their job or regular day life;
- persistently and systematically fulfil assigned tasks, be creative and apply their own ideas when engaged in work activities, and make an effort to achieve quality results;
- recognize that as a prominent component of human culture, technics is always closely related to a person's work activities;
- authentically and objectively learn about the outside world, have the necessary confidence in order to assume new attitudes and values in relation to human work, technics, and the environment;
- understand work and work activities as an opportunity for self-realization, self-actualization, and for developing one's business thinking;
- navigate different areas of human activities, forms of physical and mental labour, and the acquisition of the knowledge and skills necessary to find employment, choose a professional career, and continue their personal and professional growth.

The Humans and the Work World education area, as well as the corresponding education field of the same name, is closely related to the content of other education areas and their fields, especially in regard to natural-scientific knowledge and skills. Basic knowledge of natural science greatly asserts itself and acquired skills become reinforced when the need to solve problems caused by our engagement in chosen work activities is confronted. The connection between this education area and social-scientific knowledge is manifest in the fact that the area relies on the awareness of history and uses the context of learning about individual historical eras in order to facilitate the recognition of continuity in the development of technical advancement and economic circumstances of life in our society. It also reveals the context of technics and human cognition, which underscores the development of selected materials, tools, and technologies. Last but not least, it joins forces with civics and opens the door for pupils to view their actions and those of others in the context of their own participation in the

[†] Source: <http://www.msmt.cz/file/41216/>

work process, in social division of labor, and in the job market. The association with the job market follows up on the government's role in the employment domain.

Technics, technical devices, and common appliances, especially those related to electricity, are a normal part of our life and constitute an integral definite sphere, commonly known as technosphere (J. Stoffa, 1997). Today, technical equipment is developed at a pace never seen before, and thus radically transforms the way we live. Any human activity requires technical equipment, technical procedures, or both. This well-known rule is usually viewed as a matter of course, yet despite this – or maybe because of it – is also considered to be completely natural from the psychological point of view, from the perspective of our regular perception and experience. How else could we explain that the most fundamental technical knowledge has been absent from the process of educating future generations for decades; that authors of curricular documents place greater emphasis on so-called “soft competences”? In this respect, we frequently encounter such terms as humanization, the acquisition of general knowledge, universal school-leavers, etc. The consequence of all these “humanization” efforts is that modern children lose their manual dexterity, and their technical skills are not only insufficient, but borderline useless in normal life.

Table 1 The educational content of the Humans and the Work World education area – junior stage‡

Junior primary school stage	
Curriculum (shortened)	
Working with small materials	<ul style="list-style-type: none"> • material properties; • work conditions and tools – functions and application; • simple work operations and procedures; work organisation; • folk customs, traditions, crafts.
Construction	<ul style="list-style-type: none"> • kits (areal, spatial, structural), model assembly; • working with a manual, template, simple sketch.
Cultivation	<ul style="list-style-type: none"> • basic conditions for growing plants; • growing indoor plants; • toxic plants, plants as drugs; allergies.
Food preparation	<ul style="list-style-type: none"> • basic kitchen equipment; • selecting, purchasing, and storing foodstuff; • simple table preparation, proper dining; • technics in the kitchen – history and significance.

If we wish to talk about electrical engineering or electronics in the context of primary education, we need to take an interest in the Humans and the Work World education area whose content is listed in Tables 1 (for the junior stage of primary schools) and 2 (for

‡ Source: <http://www.msmt.cz/file/41216/>

the senior stage of primary schools). These Charts emphasise the use of kits in the education process.

In relation to electrical engineering, assuming that primary education creates a system of literacy which includes the so-called technical literacy, it is the duty of primary schools to introduce pupils to this area, to the principles and laws it relies on, and to the rules for safely using and operating common electric household appliances. This goal was set before framework education programs ever came into effect, i.e. before 2004, as a part of teaching Practical Implementation Activities, a subject incorporated into the Electrical Engineering Around Us programme. When this subject was still taught, pupils familiarised themselves with selected electro technical phenomena, principles, and electric appliances in an illustrative fashion. Conscious application of the acquired knowledge involved a mediation of methods to protect oneself from electrical injuries in normal life. The subject also prepared pupils for a future occupation of an electro technical nature which would follow after the completion of a relevant secondary or tertiary education.

Analyses performed by the National Institute for Education show that businesses involved in the so-called secondary sector, i.e. industry, have struggled for a long time to find qualified workers. The Ministry of Education, Youth, and Sports of the Czech Republic has set three main priorities to increase the effectiveness of educating future technicians:

- 1) Supporting disciplines according to the needs of the job market, and use predictions to decide which fields are worth supporting;
- 2) Adjusting the funding of the vocational training system by, for example, granting tax concessions to employers who award scholarships to students;
- 3) Improving the quality of the vocational training system, i.e. implementing practical education in real practical settings.

In the context of the facts mentioned above, we can infer the systematic nature of omitting and suppressing primary vocational training, especially in regard to electrical engineering as e.g. the Working with Laboratory Equipment thematic group is essentially not taught in primary schools (M. Havelka, 2010).

We can agree that this factor is also affected by the necessity to have a certain minimum amount of equipment at one's disposal (e.g. in the form of electro technical kits, measuring instruments, etc.). The problem is exacerbated by the unsatisfactory circumstances in primary schools which, owing to the past reformation efforts, have essentially eliminated the laboratories and workshops established in the 1980s'. True, the facilities were already outdated in the modern context and would not have met current safety requirements, but it would have been much easier to renovate them than build new ones.

Table 2 The educational content of the Humans and the Work World education area – senior stage §

Senior primary school stage	
	Curriculum (shortened)
Working with technical materials	<ul style="list-style-type: none"> • material properties, practical use (wood, metals, plastics, composite materials); • work tools, instruments, and manual processing aids; • simple work operations and procedures; • work organisation, important technological procedures; • technical drafts and drawings, technical information, manuals; • the role of technics in human life.
Design and construction	<ul style="list-style-type: none"> • kits (structural, electrotechnical, electronic); model assembly; creating construction elements; assembly and disassembly; • manuals, templates, draft, plan, pattern, simple programmes.
Cultivation and breeding	<ul style="list-style-type: none"> • basic conditions for cultivation; • vegetables; • foliage plants; • fruit plants; • breeding.
Household operation and maintenance	<ul style="list-style-type: none"> • finances, household operation and maintenance; • electrical engineering in the household – wiring, electric appliances, electronics, communication technology, functions, operation, and use, protection, maintenance, safe and economic operation, risks of electrical injury.
Food preparation	<ul style="list-style-type: none"> • kitchen; • foodstuff; • meal preparation; • table preparation and dining.
Working with laboratory equipment	<ul style="list-style-type: none"> • basic laboratory procedures and methods; • basic laboratory instruments, devices, and aids.
Using digital technologies	<ul style="list-style-type: none"> • digital technics; • digital technology – wireless technology, navigation technology, technology convergence, multiplexing; • computer programmes for processing voice and graphic information; • mobile services – operators, tariffs.
The work world (mandatory for years 8 and 9. can be implemented from year 7)	<ul style="list-style-type: none"> • job market; • choice of occupation; • education possibilities; • employment; • entrepreneurship.

§ Source: <http://www.msmt.cz/file/41216/>

The facts stated above show that the current curricular conditions make it possible for electrical engineering – or electronics – to be taught in primary schools, though it is necessary to adopt certain minimum measures in regard to this area:

- 1) Including lessons about electrical engineering in the Humans and the Work World education area on the level of the School Education Programme;
- 2) Material equipment in the form of at least electro technical and electronic kits, basic measuring instruments and aids;
- 3) Teachers who are well-versed in the issue, and capable of didactically imparting basic knowledge and skills to their pupils.

Apart from human and material resources, combining theory and practice can also be considered important as pupils become interested in presented theory only through practical activities. Electro technical kits are one such illustrative tool which contributes mainly to forming and supporting the development of technical literacy, thinking, and user skills. By combining theory and practice, they also play a role in the professional-career sphere when one chooses an occupation related to electrical engineering. The point is, most of all, to encourage pupils to take interest in technics, to support active learning, and to bring elements of playing into the education process.

The application of training aids facilitates the use of more effective teaching methods and makes it possible to accomplish goals, set by the teacher and accepted by pupils, in a better and more effective manner. The investigative mobilising approach enables pupils to directly and purposefully examine various phenomena and objects – it allows them to experiment. This is precisely what happens when teaching includes the use of electro technical kits (J. Dostál, 2015).

Transforming curricular documents on both the state, and school level is only one possible prerequisite for the necessary changes to happen unless the proclamations about the lack of technicians and about the essential measures to rectify this situation remain just that. However, if this field starts experiencing a true change, then electro technical kits will constitute one of the tools for managing electrical engineering in the guidance-education process. There are many reasons for incorporating kits into theoretical and practical classes, but what is indeed crucial is observing the rule of illustration on which the construction of kits is based, as well as the ability to develop pupils' creativity, thinking skills, independent work, and decision-making when solving assigned tasks. The ability to internalise important work habits and occupational safety rules when working with kits is also significant. For teachers, electro technical kits can be a tool for motivating pupils, for bringing elements of playing into teaching, and at the same time not only explaining and practicing theoretical knowledge in an interesting, attractive way, but also easily testing how well the pupils retained it.

4. Electrotechnical kits and modern technology

The hypothesis *H* - *Young male teachers prefer electro technical kits in combination with computer technology, while young female teachers and elderly educators (men and women) do not*, concerns younger men’s preference for electro technical kits in relation to modern technologies. To confirm the hypothesis, we worked with the ranking of the individual areas for evaluating electro technical kits. By consulting Table 3, we learn that *men* and *women* jointly rank “use of computer” last.

Evaluation areas as ranked by *men*:

1. Technical aspects;
2. Method of use;
3. Didactic aspects;
4. Psychological aspects;
5. Overall concept;
6. Use of computers.

Evaluation areas as ranked by *women*:

1. Didactic aspects;
2. Psychological aspects;
3. Technical aspects;
4. Method of use;
5. Overall concept;
6. Use of computers.

Table 3 The order of importance of evaluation areas, divided by the respondents’ gender

	Men						Women					
	Technical aspects	Didactic aspects	Psychological aspects	Overall concept	Method of use	Use of computers	Technical aspects	Didactic aspects	Psychological aspects	Overall concept	Method of use	Use of computers
1	20	12	0	11	2	2	4	16	0	12	2	6
2	8	4	11	5	14	5	5	1	20	1	8	4
3	10	17	3	2	10	9	18	4	3	6	3	9
4	6	1	12	11	3	11	6	5	1	4	20	2
5	0	12	11	13	9	1	1	14	2	13	7	3
6	3	1	10	5	9	19	6	0	14	4	0	16
Σ	47	47	47	47	47	47	40	40	40	40	40	40
Max	20	16	12	13	14	19	18	16	20	13	20	16
Rank	1.	3.	4.	5.	2.	6.	3.	1.	2	5.	4.	6.

This result is relatively surprising, especially nowadays in our “information” society. It may be caused by the fact that computer technology remains somewhat of a novelty in the primary school context, and that teachers use it mostly in specialised subjects of an informative nature rather than for conducting laboratory experiments with electro technical kits.

The age of respondents is another area which might reveal some facts about using computer technology in combination with electro technical kits in schools. To assess the

age division, the respondents were divided into two categories – *younger* (up to 36 years), and *older* (above 36 years). This division was based on the respondents' average age, i.e. 36 years.

The *younger men* category included 20 respondents, aged 23–36 years, while the *older men* group contained 27 respondents aged 39–60 years. The procedure was similar in case of women: younger women had 26 respondents, aged 23–36 years, while older women included 14 respondents, aged 37–51 years.

Now, let us look at the ranking of individual areas, taking into consideration the age perspective. Table 4 ranks evaluation areas for *men* and *women*. Based on this chart, we can once again say that both *younger men* and *women*, as well as *older men* and *women*, jointly place “use of computers” last.

Table 4 The order of importance of evaluation areas, divided by the respondents' age – comparison between men and women

Men	23-36 of age (20 respondents)						39-60 of age (27 respondents)					
	Technical aspects	Didactic aspects	Psychological aspects	Overall concept	Method of use	Use of computers	Technical aspects	Didactic aspects	Psychological aspects	Overall concept	Method of use	Use of computers
1	10	3	0	6	0	1	10	9	0	5	2	1
2	2	1	3	4	8	2	6	3	8	1	6	3
3	4	9	1	0	4	5	6	8	2	2	6	4
4	3	0	3	6	1	4	3	1	9	5	2	7
5	0	6	7	2	4	1	0	6	4	11	5	0
6	1	1	6	2	3	7	2	0	4	3	6	12
Σ	20	20	20	20	20	20	27	27	27	27	27	27
Max	10	9	7	6	8	7	10	9	9	11	6	12
Rank	1.	3.	5.	4.	2.	6.	1.	3.	4.	5.	2.	6.
Women	23-34 of age (26 respondents)						37-51 of age (14 respondents)					
	Technical aspects	Didactic aspects	Psychological aspects	Overall concept	Method of use	Use of computers	Technical aspects	Didactic aspects	Psychological aspects	Overall concept	Method of use	Use of computers
1	3	9	0	9	1	4	1	7	0	3	1	2
2	4	0	11	1	6	3	1	1	9	0	2	1
3	9	3	1	4	3	8	9	1	2	2	0	1
4	6	3	1	3	12	0	0	2	0	1	8	2
5	0	11	2	6	4	3	1	3	0	7	3	0
6	4	0	11	3	0	8	2	0	3	1	0	8
Σ	26	26	26	26	26	26	14	14	14	14	14	14
Max	9	11	11	9	12	8	9	7	9	7	8	8
Rank	3.	5.	2.	1.	4.	6.	3.	1.	2.	5.	4.	6.

Hypothesis H - *Young male teachers prefer electro technical kits in combination with computer technology, while young female teachers and elderly educators (men and women) do not* could not be proven. Based on the results of the research, we can conclude that neither *men*, nor *women* prefer computer technology in relation to electrical engineering.

5. Discussion

Authors A. Piltz and W. J. Gruver (1963) presents: “In evaluation, the educational philosophy and principles, either implicit or explicit, in the makeup of the kit and manual are of primary importance. Before any purchase in quantity is made, a kit should be tried in several classes so that teachers may discuss and compare results. It is generally possible by these subjective means to find out whether a given kit contributes to the effectiveness of instruction. More objective guidance may be obtained by setting up experiments to test the comparative usefulness of different kits of the same type in a given teaching-learning situation”.

An elementary general, comprehensive perspective of electro technical kits from a terminological and didactic point of view, including their application to teaching, is offered by M. Křenek (1988), D. Novák (1997), and later by J. Dostál (2015-2). These authors also discuss the above-mentioned issues from the perspective of mutual conversions between function and assembly patterns, as well as of introducing electro technical kits into education.

So far, the field of using kits and incorporating them into the education process has not been substantially explored, not even in regard to electro technical kits (not by the above-mentioned authors). That is why this study tries to at least partially close this gap in the sphere of training aids, presenting readers with the area of electro technical kits in primary schools, with a special focus on the issue of evaluating such kits. The area is analysed comprehensively and in detail, from the view of using kits in primary schools as well as from the perspective of comparing theoretical starting points with practical effects that electrotechnical kits have in regular pedagogical practice.

The main goal is to create a system of evaluation of electrical kits. The aforementioned authors suggest this system, but do not proceed as comprehensively as it is conceived here by designing and validating evaluation areas that can be used by the widest group of users.

6. Conclusions

Applying electro technical kits in the context described above and to the concept of a general technical education in primary schools is supposed to not only provide pupils with practical skills, knowledge, and habits, but also to develop their intellectual skills

and abilities. Using knowledge of the sphere of technical creativity and subject didactics, we can accomplish this goal and develop such pupils' skill as problem formulation, general approach to problem solving, or the ability to look for solutions and optimising them in any situation. This applies both to the field of technics, and to our normal lives.

A certainly interesting idea, it would be beneficial to compare this work with a similar research in future years in order to find out how electro technical kits are being employed as the role of technics in schools' education process continues to grow.

Electro technical kits are undoubtedly an interesting technical system, intended to be used for educational activity. This earns them the right to be integrated into the material-technical foundation of all school types and stages where pupils acquaint themselves with the issue of electrical engineering, in theory and practice.

References

- Čáp, J. (201). *Psychologie pro učitele*. Praha: Portál
- Dostál, J. (2015). *Inquiry-based instruction: concept, essence, importance and contribution*. Olomouc: Univerzita Palackého v Olomouci.
- Dostál, J. (2015-2) *Elektrotechnické stavebnice a jejich význam pro vzdělávání*. Olomouc: Univerzita Palackého v Olomouci
- Havelka, M. (2010). Dílčí posouzení stavu realizace výuky vzdělávací oblasti Člověk a svět práce na základních školách na základě analýzy školních vzdělávacích programů. *Journal of Technology and Information Education*, č. 2/2010, vol. 2, s. 33-39
- Honzíková, J., Bajtoš, J. (2004). *Diadaktika pracovní výchovy na 1. stupni ZŠ*. V Plzni: Západočeská univerzita
- Hunter, M. C. (1999). *Účinné vyučování v kostce*. Praha: Portál
- Kožuchová, M. (1995). *Rozvoj technickej tvorivosti*. Bratislava: Univerzita Karlova
- Křenek, M. (1988). Elektrotechnické a elektronické stavebnice. *Výroba škola*. Roč. 33, 1988, č. 6, s. 239-241
- Novák, D. (1997) *Elektrotechnické stavebnice v technické výchově*. 1. vyd. Praha: UK
- Lokšová, I. (2003). *Tvořivé vyučování*. Praha: Grada
- Marszałek, A. (2001). *Elektronika w edukacji technicznej dzieci i młodzieży*. Rzeszów: WSP
- Petrová, A. (1999) *Tvořivost v teorii a praxi*. Praha: Vodnář
- Petty, G. (1996). *Moderní vyučování: [praktická příručka]*. Praha: Portál
- Piltz, A. and W. J. Gruver (1963) *Science Equipment and Materials: Science Kits*. U.S. Department of Health, Education and Welfare, Bulletin 1963, No. 30
- Průcha, J., Walterová, E., Mareš, J. (2013). *Pedagogický slovník*. Praha: Portál
- Stoffa, J. (1997) *Pojem technosféra v terminologickom systéme vedného odboru technická výchova*. In *Technické vzdelávanie ako súčasť všeobecného vzdelania*. Banská Bystrica: Univerzita Mateja Bela
- Turek, I. (1998). *Zvyšovanie efektívnosti vyučovania*. Bratislava: Metodické centrum

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the Journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (**CC BY-NC-ND**) (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).