VZ (2125/17

Univerzita Hradec Králové
Pedagogická fakulta

Příloha č. 2 k RD č. 34/2016

Výroční / průběžná zpráva projektu specifického výzkumu na rok 2017 – zakázka č. 2125

Název projektu: STAVEBNICE – PROSTŘEDEK PRO ROZVOJ TECHNICKÉHO MYŠLENÍ

Specifikace řešitelského týmu

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Školitelé doktorandů:

Další výzkumní pracovníci:

Celková částka přidělené dotace: **101 409 Kč**

Stručný popis postupu při řešení projektu (max. 2 strany):

Tématem projektu specifického výzkumu je využití stavebnic k rozvoji technického myšlení žáků 2. stupně základní školy. Technické obory v současné době nejsou mezi žáky a studenty vyhledávány. Tato skutečnost se projevuje v praxi, kdy chybí technicky zaměření odborníci. Na školách převažuje teoretické vyučování nad praktickými činnostmi. Od nejútlejšího věku se dítě rozvíjí formou hry. Manipulací se stavebnicemi dítě rozvíjí kreativitu, ale i technické myšlení. Tato činnost dítě nejen uspokojuje, ale také rozvíjí kreativitu, hrubou a jemnou motoriku, vizuo-motorickou koordinaci a technické myšlení. Podle mých zkušeností se žáci se stavebnicemi setkávají zřídka v předmětu Člověk a svět práce. Hodinová dotace Pracovních činností je průměrně na prvním stupni 1 hodina týdně, což je velice málo. Kromě toho ve většině škol chybí kvalitní materiální vybavení. Na druhém stupni základní školy je situace podobná.

V rámci specifického výzkumu byl proveden výzkum na základních školách Královéhradeckého kraje. Cílem výzkumu bylo zjistit: Zda učitelé na prvním a druhém stupni základní školy považují předmět Člověk a svět práce za důležitý. Zda učitelé rozvíjejí technické myšlení u žáků prostřednictvím stavebnic. V rámci výzkumu jsme zjišťovali, zda učitelé používají při výuce předmětu Člověk a svět práce stavebnice. A pokud ano, jaké stavebnice používají. Průzkum také zjišťoval vybavenost škol stavebnicemi. Tento průzkum byl zpracován a na základě výsledků vybavenosti stavebnicemi byl proveden průzkum trhu vhodných stavebnic pro žáky druhého stupně. Pro další práci bylo důležité vybrat takové stavebnice, které svým zaměřením a úrovní budou odpovídat žákům druhého stupně ZŠ. Stavebnici Merkur jsme vybrali proto, že na základních školách se tato stavebnice používá (okolo 40 % škol), je to tradiční česká stavebnice s dlouholetou tradicí a je vhodná pro rozvoj konstrukčních dovedností, technického myšlení, pro rozvoj manuální zručnosti i jemné motoriky. Tuto stavebnici jsme nakoupili přímo od výrobce za akční cenu. Druhou stavebnici „Fischertechnic" jsme vybrali na základě průzkumu trhu. Tato stavebnice není tolik známá, na základních školách ji nepoužívají, ale pro rozvoj konstrukčních schopností a technického myšlení je velice vhodná. Edukační řadu stavebnice Fischertechnic má pouze jeden prodejce, u kterého jsme tyto stavebnice nakoupili. Studenti zapojení do SV připravují metodické listy, jak tyto stavebnice využít v předmětu Člověk a svět práce.

Výsledky výzkumného šetření byly publikovány a prezentovány na konferenci APSAC 2017 v Dubrovníku a na konferenci ICERI 2017 v Seville.

Kontrolovatelné výsledky řešení:

B. Publikační výstupy D (sborník) – bude indexace v databázi WoS:

1. HUBÁLOVSKÁ Marie, BARTOŇ Martin, JANOUCH Jan, KREJČÍ Pavel. Development of Polytechnic Creativity of Primary School Pupils. Springer Velrag for the conference Proceedings, APSAC'17, Dubrovnik, 2017 – sborník bude vydán v roce 2018 – nelze zadat do OBD.
2. HUBÁLOVSKÁ Marie. The Constrktion Kids as a Tool for Development of Pupils Technical Literacy and Technical Creativity – case study. ICERI 2017 (10th International Conference of Education, Research and Innovation), Sevilla, 2017, s. 4764-4770, ISBN 978-84-697- 6957 - 7.

Přehled realizovaných výdajů:

a) osobní náklady (mzdy, odměny, odvody na zdravotní, sociální a úrazové pojištění, tvorba sociálního fondu, dohody o provedení práce a dohody o pracovní činnosti) a jejich stručné zdůvodnění

0,00 CZK

b) stipendia a jejich stručné zdůvodnění

15 000,00 CZK Janouch Jan: P16P0389 (ČÚ:35-335590217/0100), Krejčí Pavel: P15P0541 (ČÚ:2876103003/0800), Bartoň Martin: P15P0582 (ČÚ: 107- 2881460267/0100) - studenti spolupracovali na příspěvku na konferenci APSAC 2017 v Dubrovníku, spolupracují na vytváření metodického materiálu.

c) materiálové náklady (výdaje na pořízení drobného dlouhodobého hmotného majetku, nehmotného majetku – software, kancelářské potřeby, ostatní materiál) a jejich stručné zdůvodnění

41 744,00 CZK Stavebnice Fischertechnik (31 744,00 CZK)

Stavebnice Merkur (10 000,00 CZK)

tyto stavebnice byly zakoupeny pro účely vytváření metodického materiálu pro učitele ZŠ pro předmět Člověk a svět práce (Design a konstruování).

d) poplatky konference nebo výdaje na služby a jejich stručné zdůvodnění

26 475, 46 CZK:

11 834, 25 CZK – konferenční poplatek Konference APSAC'17, Dubrovnik - (bez účasti)

11 641, 21 CZK – konferenční poplatek Konference ICERI 2017, Sevilla

e) náklady nebo výdaje na služby a jejich stručné zdůvodnění

0,00 CZK

f) doplňkové (režijní) náklady nebo výdaje v souladu s příslušným řídícím aktem UHK

1 344, 41 CZK

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639, 91 CZK – kurzové ztráty

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g) cestovné a jeho stručné zdůvodnění

17 004, 00 CZK:

17 004, 00 CZK – Cestovné Konference ICERI 2017, Sevilla, 14. 11. 17 – 19. 11. 17

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Podpis odpovědného řešitele

Marie Hubálovská

Development of Polytechnic Creativity of Primary School Pupils

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Abstract. The article deals with the technical literacy and implementation of the Industry 4.0 at elementary schools. It deals with the importance of construction kit in development of children's technical thinking. The article presents the results of research taken at elementary schools in the Hradec Králové Region. The research is dealing with the problematic of teaching the subject "Polytechnic creation" and is dealing with the use of construction kits during that subject.

Keywords: Technical Literacy, Primary School, Building Kits, Pedagogical Research, Polytechnic Creation.

1 Introduction

We live in times of so called "The Fourth Industrial Revolution" [1]. The technique is developing at tremendous speed. The words digitalization or automation appear in almost every sphere of our lives. A billion people are connected by mobile devices. Access to information and knowledge is unlimited. The Fourth Industrial Revolution is characterized by the development of artificial intelligence, robotics, 3D printing, nanotechnology, biotechnology, material science, energy storage and quantum computing [2]. People have higher needs for quality of life. They quickly became accustomed to the comfort that technology brings them. In developed society, a preschool child can control a computer, tablet, smart phone, and other technical facilities of today. On the other hand, there is still a lack of technically educated people [3]. Education has to respond to this current trend. The priority of primary education is to attract interest in the pupils and to motivate them to study these technological disciplines [4].

2 Theoretical background

2.1 Technical literacy

It is necessary, in today's world of ever-evolving techniques and computer science, to understand these disciplines. With the increasing complexity of machines and information technology, it is very important to improve our technical literacy. The term of technical literacy has become more and more used in recent years. Some authors

tend to be more general in defining this term, for example [5], who defines technical literacy as "Eligibility to use technical knowledge and information in everyday life or work. This literacy is gained through technical or polytechnic education." Other authors [6] emphasize that: "the definition of technical literacy should include a knowledge, skill and attitude component." The author Dyrenfurth defines technical literacy as „A summary of competences, including awareness of key processes in the technology, the ability to handle technical devices, ability to develop our own technical knowledge, skills and habits, ability to use and evaluate technical information."[6]. The areas of technical literacy are defined by Pecina [7]. According to his view, it is important for pupils to understand the meaning and characteristics of traditional and modern materials and the importance of energy and natural resources. The most important aspects of technical literacy include: the basic orientation in the various branches of technology, knowledge of the history of the technology, knowledge of the nature, functions and construction of the technical object, knowledge of the used technologies and materials, ecological, economical, aesthetical and security information, knowledge and ability to handle information stored in electronic form and more. This includes spatial imagination and basic logical thinking [8].

Some author emphasized, that pupils should have not only technical and technological knowledge, it is also important to have the necessary manual skills [7]. In addition to these areas, it is important to develop technical thinking and creativity among pupils. It is necessary to form a relationship between children and polytechnics, from the earliest age.

In recent years, education is trying to promote technological subjects at primary schools. Pupils visit companies, workshops, technology and informatics high schools. It is step into the right direction, but the level of supports is still not high enough. At the second level of primary schools, it is necessary to increase the number of lessons which are focused on technics and workshops. It is necessary to connect technology and informatics, to focus on the basics of technology, informatics and robotics.

One of the possible ways to increase the level of technical literacy in primary schools, is to use the building blocks. Depending on the type of building kit, pupils can practice compliance with the plan, or use their imagination to build whatever they want. While working with construction kits, they will also improve their gentle hand motoricity. On the electro-technical kits, pupils can try the theory and experiments, which they know from their physics classes to better understand and memorize it. On other kits, they will learn the basics of programming and robotics [8].

The development of polytechnic thinking and creativity is supported by the Industry 4.0 which is characterized by the unprecedented development of automation and digitization of production. Detailed information can be found e.g. in [9, 10]. The Industry 4.0 brings to labor market fast changes. New branches will need employees who are able to learn new things, to improvise, who are able to be creative and who are flexible. People, who are able to solve problems in a comprehensive way, control people management and are able of critical thinking, will be needed.

Education has to react to these changes. Neumajer [10] pointed out the reality of the current era: „children and young people are surrounded by digital technology every time". Most of children are naturally familiar with tablets, smartphones or social

networks [11]. Our job, the task of the educators, is to guide and point them into the right direction. So they would not only play games or watch movies on these devices, but they would discover that there are numbers of useful applications that can help them in their personal development. It is no longer enough for primary schools to teach only the subjects like computer science or and work activities separately. This system has to be interconnected and thoroughly developed to ensure that traditional technical subjects will not disappear, but that innovative polytechnic subjects are going to be developed.

2.2 Construction/building kits

Construction kits are a very effective way to improve creativity and technical thinking. In the kindergarten, children have a lot of space to play and work with construction sets. Children in kindergarten build, on daily basis, their own products or they work on joint projects. Playing with building kits can be spontaneous, without any supervision, or it can be controlled by a teacher, who can influence and direct that play into a certain direction for a particular purpose. Through building kits, children can, for example develop perception, memory, imagination, thinking, spatial orientation or perceptually motoric area [12]. Using the kit, the child discovers and begins to understand the basic principles of mechanics and discovers elementary laws of physics. The kit has not only a wide use in kindergartens, but it also has a place at primary schools. In primary schools it is once more important for the development of technical thinking and it can be used to demonstrate the basic principles and rules of mathematics, physics, mechanics, statics, electricity, informatics and robotics. The most commonly used kits are wooden blocks, mosaics, Lego, Merkur, Seva, Cheva.

3 Research

The research was carried out at elementary schools in the Hradec Králové Region in the Czech Republic. The research dealt with the development of polytechnic thinking in primary school students. We focused on the subject Polytechnic creation and found out whether the teachers are trying to improve the technical thinking of their pupils by using construction kits. The research was carried out at the first level of primary school (1^{st} class - 5^{th} class) and at the second level of primary school (6^{th} class - 9^{th} class).

3.1 Questionnaire survey among teachers from the first to the fifth class of primary school

This research was carried out in January 2017 among teachers who teach the subject Polytechnic creation from the first to the fifth class of primary school. The content of this subject is: working with tiny material, constructional activities, growing works and food preparation. The document "Framework educational program for primary schools" determines the weekly hourly allowance of 5 hours of work from the first to fifth class of primary school. There is, in each grade, one hour of working activities taught weekly. When compared to the number of hours of working activities taught in pre-school

education, we assumed that there are not enough hours of working activities taught at primary school. However, this is only a presumption that was verified with the primary school teachers. 238 schools were addressed by the questionnaire surve. We received 99 questionnaires from the first grade of primary school and 51 from the second grade of primary schools.

The questions as well as the response of questionnaire survey are stated in the Tables 1, 2 and 3:

Table 1. The response the questionnaire question No 1.

Do you think whether the work activities for pupils is?	The number of answers:	In %
Unimportant	0	0
Less important	2	2
Important	50	50
Very important	39	39
As important as Czech language, mathematics, ...	9	9

Table 2. The response the questionnaire question No 2.

Do you think that one hour of work activities weekly is enough?	The number of answers:	In %
Definitely yes	0	0
Rather yes	2	2
It is not enough	50	50
It is definitely not enough	48	48

Table 3. The response the questionnaire question No 3.

Do you use construction kits during work activities?	The number of answers:	In %
No	15	15
Yes – not very often	64	64
Yes – very often	21	21

The results of the question No 4 "What kind of construction kits do you use during work activities?" are Merkur (41 answears), Lego (37), Seva (25), Cheva (15). Construction kits like the Variant, Geomag, various mosaics, wood cubes and electrotechnics were mentioned as well, but less often.

3.2 Questionnaire survey among teachers from the sixth to the ninth class of primary school

The content of the subject Polytechnic creation on the second grade of primary school (from sixth to ninth class) is based on the theoretical and practical knowledge which can be used by pupils in their everyday life and during the selection of their future profession. The subject Polytechnic creation is divided into eight areas: Working with technical materials, Design and construction, Gardening and breeding, Operation and maintenance of household, Food preparation, Working with laboratory technology, Usage of digital technology, World of work. The areas are chosen by schools according to their educational intentions and their school equipment.

The questions as well as the response of questionnaire survey are stated in the Tables 4 and 5:

Table 4. The response the questionnaire question No 1.

Do you think that one hour of work activities taught weekly is sufficient?	Number of answers	In %
Definitely yes	0	0
Rather yes	2	2
It is not sufficient	50	50
It is definitely not sufficient	48	48

Table 5. The response the questionnaire question No 2.

The subject "Man and his world" is divided into 8 optional areas which are taught 3 hours per week. Write into the table the number of hours for each area and year as they are taught at your school.	The number of hours				
	6th class	7th class	8th class	9th class	Total
Work with technical materials	35	25	22	20	102
Design and construction	8	12	10	11	41
Growing and breeding	29	15	11	11	66
Household operation and maintenance	10	19	19	21	69
Food preparation	15	31	18	12	76
Work with laboratory equipment	6	3	16	16	41
Usage of digital technology	12	18	14	17	61
World of work	6	6	18	30	60

4 Conclusion

The research carried out among teachers in primary schools in the Hradec Králové region confirmed our assumption: both first grade and second grade primary school teachers agree that there are not enough hours in education program for the subject

Polytechnic creation [4]. Teachers of both grades answered identically and agreed that the subject Polytechnic creation is very important for pupil´s development. Interesting information were found out from the survey that teachers use construction kits when teaching. The construction activities are neglected and underestimated in the both grades. Only 21% of first grade teachers use construction kits during the subject Polytechnic creation. At the second grade, the areas Design and construction, together with the area Work with laboratory equipment are taught the least. As has been mentioned - new disciplines will need employees with the ability to learn new things, improvise, be flexible and be creative [9]. Based our opinion, one way how to improve pupils´ creativity and develop both critical and creative thinking is through the work with the construction kits. Under this concept we understand construction kits from the simplest ones to the ones that integrate the knowledge of electricity, mechanics, informatics and cybernetics. It is necessary to teach pupils how to look at the problem in a comprehensive way and how to use all the knowledge and skills in problem solution. Education has to implement requirements of the "Fourth Industrial Revolution".

Acknowledgement

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CONSTRUCTION KITS AS A TOOL FOR DEVELOPMENT OF PUPILS' TECHNICAL LITERACY AND TECHNICAL CREATIVITY – CASE STUDY

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Abstract

The technology and technique are deeply implemented in everyday life. The technology development influences the overall quality of the society as well. Although almost every person has the latest technical means and can handle digital technologies, there is still a lack of technically educated people. The deficiency of technical literacy and technical creativity is manifested by the scarcity of technical experts caused by reluctance and insufficient interest of students to study technical disciplines. Experts have confirmed that the problem needs to be solved from primary education through the development of technical literacy and technical creativity. The case study describes the possibilities of the development of technical literacy and technical creativity in primary schools, which is also the scope of this paper. The main principle of developing the technical literacy and creativity is based on use of the construction kits. The kits mentioned in the paper develops not only the technical creativity but they support development of thinking also in the fields of science, ICT and mathematics. Moreover, the paper presents the results of a research investigating change of pupils' attitudes towards technical disciplines. The task was given to primary school pupils from the sixth grade. They had to construct a model of a robotic hand from the Fischertechnik Robotic kit. The pupils worked in three-member groups. The qualitative research has identified pupils' ability to work according to the instructions manual, their ability to work in a team, their creative skills. The difference between girls and boys was investigated as well. The quantitative research has monitored the quality of the resulting model. The questionnaire survey outlined the pupils' interest in creative activity, satisfaction from creative activities and interest for further creative activities. The study has demonstrated that activity with a construction kit is interesting for pupils. Pupils were satisfied with creative activities. Pupils demanded continuation and were interested in creation of more complex technical models. Some pupils were motivated to create their own models without any instructions. The results of the research are discussed in the paper in detail. The results of the presented research confirm that pupils' technical literacy and technical creativity can be supported by the use of a construction kit during technical education.

1 INTRODUCTION

The education system in the Czech Republic starts in kindergartens. The kindergartens educate children aged three to six years. The kindergarten education is followed by elementary education. The elementary education is divided into primary and secondary levels. The primary level is from the first grade to the fifth grade, the secondary level is from the sixth grade to the ninth grade. The elementary education is followed by the high school education and then higher, tertiary, education. The paper deals with education at the secondary level of elementary schools. The paper focuses on the development of technical education. In the curriculum of the elementary education, there is only a few lessons devoted to technical education. The education system is more focused on the humanities rather than technical subjects [1]. This fact is also reflected in practice. Currently, there is a rather substantial shortage of technically skilled professionals. Technical education is also currently considered to be essential for sustainable development [2]. There is a only few lessons of technical subjects at elementary schools in the Czech Republic, as mentioned above, thus the pupils are very little acquainted with technical issues. From our own experience, we know that there is very little time in the classes of technical subjects to develop pupils' autonomy and lead them to creativity. Pupils should not only get an overview of various technical fields; they should mainly acquire a relation to the technical fields in the course of technical subjects at elementary schools. The school has to develop pupils' interest in regard to technical fields. The school should develop technical literacy for all pupils, and the school should facilitate acquisition of following basic knowledge and skills:

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- understand the importance and characteristics of traditional and modern materials
- understand the importance of energy and natural resources
- introduce basic technical systems and equipment used in all areas of human activity
- enable each pupil to **develop technical skills and develop creative activity**
- develop a positive attitude towards modern technology
- develop technical interests and develop professional interest in the technology

One of the ways of developing technical skills and creative activity of pupils is the use technical kits in teaching of technical subjects.

2 THEORETICAL BACKGROUND

2.1 Technical creativity

Creativity is generally defined as the ultimate way to solve problems [3]. Another formulation defines creativity as the making of new original creations in all areas of human activity [4]. Most definitions define the term creativity as a process where something new, original is created. Some authors [5] define creativity as a phenomenon, which in most cases is associated with originality and usefulness. Author Pecina [6] shows the relationship between originality, usefulness and creativity, Fig. 1.

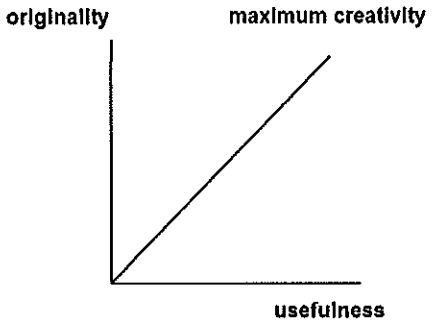

Figure 1. The relationship between originality, usefulness, creativity [6].

Technical creativity is a specific type of creativity. "Technical creativity can be defined as the ability to change the world around us to create new useful values in the technical area." [7]. The authors [8] understand the creative activity related to the technology, fully engaging the pupil with the technical objects and developing active, independent activity of the pupil. Kožuchová [7] presents the requirements that are necessary for the development of pupils technical creativity:

- use of knowledge from technical and natural sciences
- knowledge of methods and procedures to help students solve problems of technical nature
- motivate pupils to technical creativity
- age adequacy and pupil abilities.

The development of technical creativity can be understood in two levels [6]:

- problem solving of a technical nature
- solving a practical task when working with technical materials, building kits etc.

2.2 Fischertechnik Robotic kit

Developing technical creativity and technical thinking can be supported by the use of building kits. Children in kindergarten have a relatively large space for work with building kits and by doing so children develop the abilities of assembling and disassembling. Children discover and begin to understand basic principles of mechanics using the building kit. Children can also discover elementary laws of physics, mainly mechanics. The building kit is not only widely usable in pre-school age, but it also has a significant place at elementary schools. As stated above, it is important to develop pupils'

technical thinking. The basic principles and rules of mathematics, physics, mechanics, statics, electricity, informatics and robotics can be demonstrated through the building kit. The Fischertechnic has a special building kits for use in schools. This series is labeled "education".

3 RESEARCH PROJECT

3.1 Methodology

The aim of the research was to find out the pupils' ability to work in accordance with the instructions for work, their ability to work in the team, their creative skills and we also subsequently evaluated the quality of the resulting model. A questionnaire survey outlined the pupils' interest in creative activity, creativity satisfaction and interest in other creative activities. The research was conducted on the sixth grade pupils at the primary school in Hradec Kralove, Czech Republic. There were 26 pupils in this class. The pupils were divided into two groups in the subject called "work activities". The first group of thirteen pupils worked with a building kit, the second group of pupils had other lessons, the following week the two groups swapped their tasks. The pupils were divided into three-member groups, in one group there were four pupils. One pupil was missing. Four groups of pupils were boys only, three groups were girls only, and one group was mixed (two boys and two girls). Pupils worked with the Fischertechnik Robotic kit. They had to construct a model of robotic hand.

3.2 Qualitative research

Qualitative research in the form of observation of pupils was conducted while the pupils were working with a construction kit. The groups have been scored from one to six for each of the observed actions. Six was the best result and one was the worst. The research evaluated following:

- ability to work in a team
- the ability of pupils to work with instructions
- assembly skills

3.3 Quantitative research

3.3.1 Evaluation of model quality

Quantitative research was focused on the quality of the resulting model. The pupils in a group evaluated the quality of the models of other groups. The model was evaluated by a grade from 1 to 5. The results of the research are shown the Table 1.

3.3.2 Questionnaire

The other stage of the quantitative research was realized in the form of a questionnaire. The questionnaire asked following questions:

1 Scale from 1 to 6:

Did you understand the model assembly instructions? (6 - fully understand, 5 - understand, 4 - rather understand, 3 - sometimes did not understand, 2 – rather did not understand, 1 – did not understand at all).

2 Scale from 1 to 6:

Did you build the model alone? (6 – completely alone, 5 - rather alone, 4 – with a little help from classmates, 3 – with a great help from classmates, 2 - sometimes I helped, 1 – I just watched).

3 Scale from 1 to 6:

Were you interested in the work with the kit? (6 - maximally interested, 5 - mostly interested, 4 - interested, 3 – rather not interested, 2 - not interested, 1 - interested at all).

4 Scale from 1 to 6:

Did you like the construction lesson? (6 - absolutely liked it, 5 - liked it, 4 - rather liked it, 3 - rather did not like it, 2 - did not like it, 1 - did not like it at all).

5 Scale from 1 to 6:

Do you want more of these lessons? (6 - definitely yes, 5 - yes, 4 - rather yes, 3 - rather not, 2 - not, 1 - definitely not)

3.4 Research results

3.4.1 Qualitative research - Results of observation

Pupils groups were monitored during construction activities. Four groups consisted of only boys (groups No. 1, No. 2, No. 5, No 6), three groups consisted of only girls (No. 3, No. 4, No. 7) and one group consisted of two girls and two boys (No. 8). There were 5 groups, where one pupil became a leader and organized activities of other pupils (No. 2, No. 3, No. 5, No. 6, No. 8). They were mostly students who already had some experience with construction activities. There were two groups, where the roles were not divided, but these groups worked well (no. 1, no. 4). Group No. 7 often led disputes during lesson. Among the groups there were significant differences in their design abilities. Working with the instructions was a big problem in certain groups (namely groups No. 1, No. 7, No. 8). It took a lot of time for these groups to start the work with instructions. The assembly of the model was mainly done by pupils experienced in constructions. All pupils were not involved in this activity, because some pupils merely watched. Based only on the observation, it is not possible to say whether there is a difference between girls and boys in their ability to construct.

3.4.2 Quantitative research – Evaluation of quality of resulting model

The result of the research are shown on the Table 1.

***Table 1.** Evaluation of quality of resulting model.*

Group Number	Grade
Group No. 1	1
Group No. 2	2
Group No. 3	2
Group No. 4	3
Group No. 5	2
Group No. 6	1
Group No. 7	1
Group No. 8	2

3.4.3 Quantitative research – Questionnaire

The results of the Question 1 (Fig. 3) show that 21 pupils (84%) understood the model construction instructions. Problems with understanding the instructions had 4 pupils (16%).

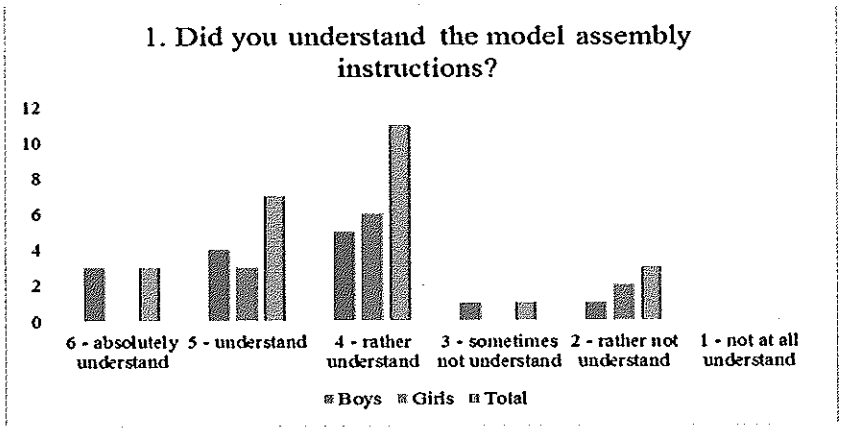

Figure 3. Did you understand the model assembly instructions?

Figure 4 represents the cooperation among pupils in the group. The model was created by 7 pupils (28%) alone or with little help from classmates. The classmates helped to 9 pupils (36%) with the creation of the model. Four pupils (16%) helped occasionally and 5 pupils (20%) were only watching.

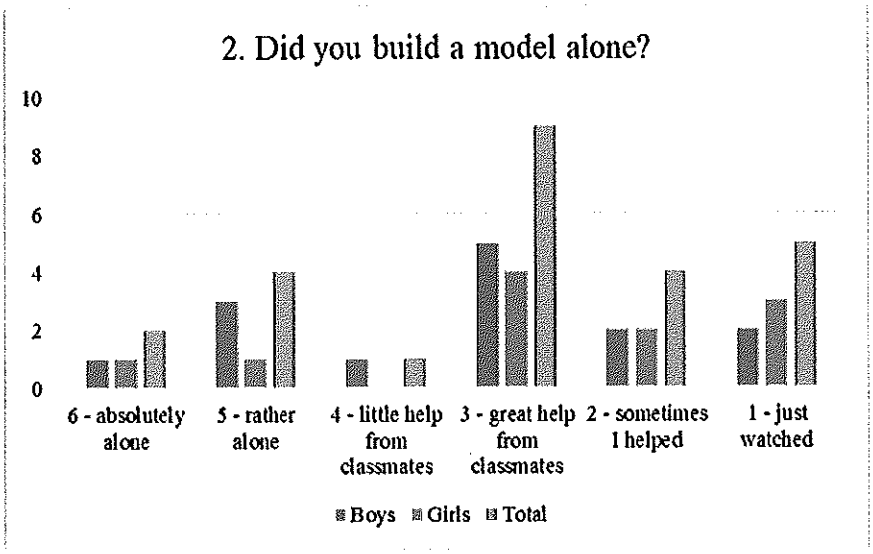

Figure 4. Did you build the model alone?

The question 3 (Fig. 5) established whether the pupils were interested in the work with the building kit during the lesson. Seven pupils (28%) stated that the work with the kit is maximally interesting, eleven pupils (44%) stated that the work with the kit is mostly interesting, four pupils (16%) stated that the work was interesting. Twenty two pupils (88%) – 86% of boys and 90% of girls positively evaluated the design activities.

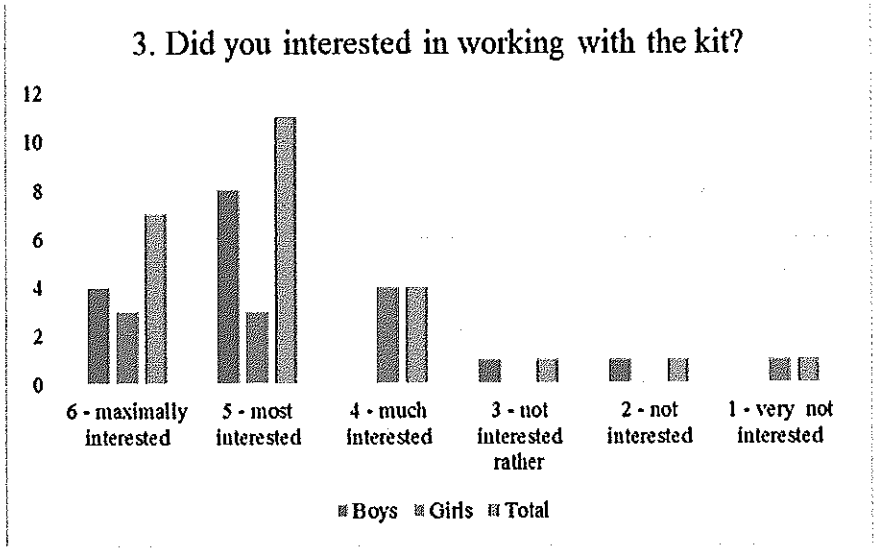

Figure 5. Were you interested in the work with the kit?

The question "Did you like the construction lesson?" was answered by most of the pupils positively. – This answer was given by 20 pupils (80%), 12 boys (86%) and 8 girls (73%), see Fig. 6

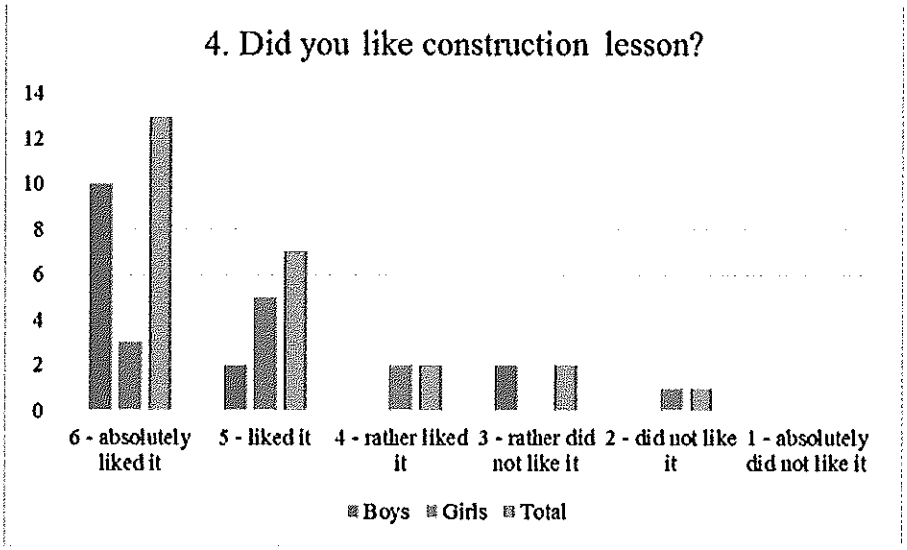

Figure 6. Did you like the construction lesson?

Question 5 "Do you want more of these lessons?" was answered with definitive yes by 20 pupils (80%) – 12 boys (86%), 8 girls (73%), see Fig. 7.

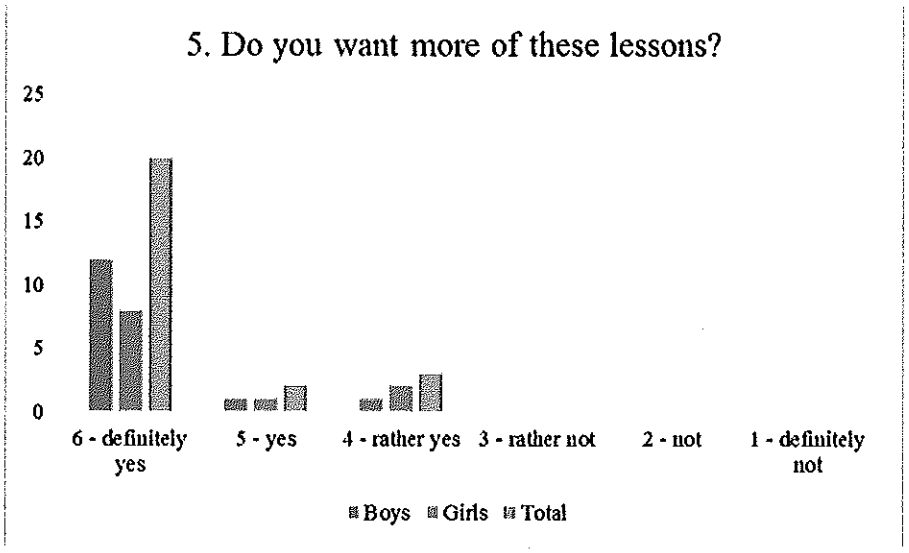

Figure 7. Do you want more of these lessons?

4 CONCLUSION

The research results show that pupils are interested in practical lessons. It was ascertained that pupils would like to have more practical lessons in the course of school education. Both boys and girls were interested in constructive activity almost without any differences. It is impossible to unequivocally determine whether the boys or girls are better in constructive activities based on the observation. The construction abilities depends on the individual abilities of pupils. The presented paper confirms the necessity of realization of further research in this area.

ACKNOWLEDGEMENTS

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