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POSSIBILITIES OF EXTENSION OF THE ALGORITHMIZATION AND PROGRAMMING TEACHING AT PRIMARY SCHOOLS

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Abstract

The teaching of algorithmization and programming is currently at the forefront of the interest of many professionals involved in the innovation of educational content within IT subjects. The view of the pupils as well as their acceptance of possible changes in the educational content towards a substantial extension of the teaching of algorithmization and programming, as envisaged in the Strategy of Digital Learning up to 2020, have also partially disappeared from this professional discussion. Although, of course, it is not only up to the pupils to determine the content and focus of the teaching, at the moment of preparation of the concept and content of the lesson thus designed, their views and preferences are among the unavoidable factors which can influence later results and benefits. For this reason, a research survey was conducted, using quantitative methods of exploration, focused on the issue of acceptance of possible changes in the educational content of IT subjects towards a substantial extension of the teaching of algorithmization and programming from the point of view of pupils of the 9th year of primary school. The research shows that algorithmization and programming are both attractive and interesting for the primary school pupils, the best known and most popular tool among the latter being Game Lab Code.

Keywords: Algorithmization, programming, educational content, pedagogical research.

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1. Introduction

At a number of schools, the issue of algorithmization and programming teaching is not a very accentuated topic (Ala-Mutka, 2011). The teaching of this thematic unit seems to be rather a difficult one, both from the pupils' and teachers' point of view, and what is more, there is currently no uniform concept of this teaching (Ferrari, 2013). If it has already been introduced, it often moves between two poles. The first pole is the use of programming languages and development environments designed for education, such as Python or Kodu Game Lab. And the other pole is formed by "real" programming or scripting languages, like Visual Basic or Java, that enable the creation of production applications. For many years, the professional public has been leading a discussion, in which the supporters of one pole argue with the necessity of a didactic approach to the teaching of programming in the form of games, while the supporters of the other pole then argue with the necessity of teaching "real" programming languages, the basics of which will be used by pupils in practical life or in further education (e.g.: Pitner, 2000, Klement & Kubrický, 2009 etc.). All these endeavours and discussions imply a clear need for systemic change that would result in a fundamental innovation of the educational content of IT-oriented subjects at Czech schools and would move closer to the concept of "Computational thinking" (Wing, 2006).

The situation in the sphere of creation and promotion of the innovative curriculum of IT subjects, especially with regard to the development of the concept of Computational thinking, is increasingly being promoted also in the conditions of Czech education (Rambousek, Štípek & Wildová, 2015). A key document for the development of this concept in our conditions has become the Digital Education Strategy for 2020, which elaborates key core areas for the development of digital thinking (Neumajer, 2014) in the conditions of teaching IT subjects. However, the implementation of this strategy is not possible without the current description of the concept of IT teaching within our schools and the identification of some possible barriers which need to be overcome (Zuppo, 2016).

1.1. The concept of teaching IT in the Czech Republic

In the Czech Republic, the school ICT level is monitored from the constitution of National Information Policy in Education (in Czech: *Státní informační politika ve vzdělávání*) Within the framework of the aforementioned school reform of 2005, which introduced a partially decentralized curriculum system in the Czech Republic, a revision of the content and concept of teaching IT subjects was also carried out. In practice, the reform meant that schools gained a partial autonomy in the creation of curriculum documents, but, at a general level, the content of the curriculum was defined by the government, which has established the so-called Framework Educational Programs[1] (hereinafter referred to as the FEPs). The teachers of individual schools participated in the creation of the specific form of the curriculum of individual educational areas, including those focused on IT topics. Based on the FEP, they created the School Educational Programs (hereinafter referred to as the SEPs) meeting the mandatory requirements set out in the FEP and adapting the teaching plans of each subject to the needs of their pupils and schools as much as possible.

[1] see http://www.msmt.cz/vzdelavani/skolstvi-v-cr/skolskareforma/ramcove-vzdelavaci-programy

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The basic idea of the whole concept was to aim the creation of SEP and curricula of all lessons specifically at developing the so-called key competences of pupils. Lifelong learning is also accentuated and it is therefore one of the primary duties of the teacher to prepare pupils for future life and competitiveness in the labour market. The MEYS presents six key competences in the FEP:

- learning competencies,
- problem-solving competencies,
- communication competencies,
- social and personal competencies,
- civil competencies,
- work competencies.

The development of these competencies was reflected in all nine educational areas. The field of Information and Communication Technologies has become one of the key areas of education. While the other educational areas occupy up to nearly ten pages in the curriculum of the FEP PE, the area of Information and Communication Technologies is described—with its characteristics, objectives, expected outcomes and subject matter—without any problems only on three pages. In the several paragraphs dedicated to the characteristics of this educational area (MŠMT [MEYS], 2017, p. 38) is, for example, stated:

- pupils must be able to achieve a basic level of information literacy,
- pupils will acquire elementary skills in using computers, they will orientate themselves in the world of information and will work with information in a creative manner,
- the skills acquired when working with computer technology are a pre-condition for the effective development of professional and leisure activities,
- the ability to quickly find and process information using ICT resources takes the burden off memory,
- the skills acquired in this educational area can be applied in all other areas, and ICT thus becomes part of all educational areas of basic education.

1.2. FEP PE for primary schools: Stage 1

For Stage 1 of primary schools, the curriculum of the thematic area Information and Communication Technologies is divided into three sections: *The Basics of Working with a Computer, Information Searching and Communication,* and *Information Processing and Application*. Each section specifies the expected outcomes that focus on what the pupil can achieve at the end of a given period. For a better idea, as an aid for the creation of SEP, there is also mentioned the curriculum that relates to the outputs (MŠMT [MEYS], 2017, p. 39):

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The Basics of Working with a Computer: expected outcomes	
Pupils will:	• use the basic, standard functions of computers and their most common peripheries, • respect safety rules when working with hardware and software, and proceed in an informed manner if a defect occurs, • protect data from damage, loss or misuse.
Subject matter:	• basic concepts for working with information – information, information sources, information institutions, • structure, functioning and description of computers and peripheral equipment, • operating systems and their basic functions, • introduction to file formats (doc, gif), • multi-media use of computers, • simple computer maintenance, procedures for addressing common problems with hardware and software, • principles of work safety and prevention of health risks related to the long-term use of computer technology.
Information Searching and Communication: expected outcomes	
Pupils will:	• use simple and appropriate ways of searching for information on the Internet, • search for information on web portals, in libraries and in databases, • communicate using the Internet and other common communication equipment.
Subject matter:	• the social flow of information (generation, transfer, transformation, processing, dissemination), • basic means of communication (e-mail, chat, telephone), • methods and tools for information retrieval, • formulating search requests on the Internet, search attributes.
Information Processing and Application: expected outcomes	
Pupils will:	• work with text and pictures in text and graphic editors.
Subject matter:	• basic functions of text and graphic editors.

Teachers have a fair amount of freedom in creating SEP, as some points of the content of this field of study are given very briefly. For example, the whole section of Information Processing and Application is described in two short sentences: "*Pupils will work with text and pictures in text and graphic editors*." And the subject matter here is the "*basic functions of text and graphic editors*".

1.3. FEP PE for primary schools: Stage 2

In FEP PE, the contents of the educational area for Stage 2 is summarized in two thematic sections: *Information Searching and Communication* and *Information Processing and Application*. These thematic sections are conceived as a superstructure of the subject matter studied within Stage 1, which is now to be extended with new possibilities of application. Unfortunately, there is no need to extend the educational content to other areas and therefore only the existing themes are elaborated. Also these thematic sections are divided into Expected outcomes and Subject matter (MŠMT [MEYS], 2017, p. 40):

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Information searching and communication: expected outcomes	
Pupils will:	• verify the credibility of information and information sources and assess their relevance and mutual linkages.
Subject matter:	• development trends in information technology, • the value and relevance of information and information sources, instruments for their verification, • the Internet.
Information Processing and Application: expected outcomes	
Pupils will:	• master work with text and graphic editors and spreadsheets, use suitable applications, • apply basic aesthetic and typographic rules for working with text and images, • work with information in line with legislation on intellectual property rights, • use information from various information sources and evaluate simple relationships between data, • prepare and present information using text, graphics and multi-media forms at a user level.
Subject matter:	• computer graphics, raster and vector software • spreadsheets, designing tables, comparing data, simple formulae • presenting information (websites, presentation software, multimedia) • protection of intellectual property rights, copyright, information ethics

As can be seen from the above list of measures, now is a good time to implement measures, at the end of which there may be a systemic change, eliminating the current absence or inconsistency of the IT content of the curriculum. The reasons for the absence of IT content in the school curriculum at primary schools and the lack of support for teachers in teaching IT topics can be seen mainly in the continuing orientation of school education towards the consumption of digital technologies, or the user access (*Lankshear & Knobel, 2008*). When applying this obsolete orientation, in which digital technologies are only used, there is no targeted training for a group of people who should develop and deeply understand technology, be capable of research and innovation in this area (The Royal Society, 2012).

The reasons are given by the historical orientation of the educational area of ICT, based on the UNESCO 2002 design of the model of the ICT development in the curriculum that favoured user access and rejected IT education for the general population. At the current level of knowledge, it is becoming increasingly clear that computer science, just like other natural sciences, has a great contribution to understanding the current world and many applicable findings. IT subjects, even the more complex ones, such as algorithmization, can be taught (proportionally to the pupil's abilities) from an early age, just like other disciplines (Melichar, 2006). And just like other sciences, computer science has its concepts, principles and rules that need to be understood, which is more important than just using such tools. In line with this, UNESCO's current proposal (EDUsumMIT, 2017[2]) points out that focusing solely on digital literacy is a thing of the past. The current maintained state is also caused by the existing, obsolete FEPs, which have not been upgraded for almost 10 years, and which, to some extent, bind teachers and direct them to a model of teaching in this educational area that has long been overcome in the world (Benvenuti, Van Der Vet & Van Der Veer, 2011).

[2] see http://unesco.unibit.bg/en/EDUsummIT17

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In the previous section were described some of the developmental trends related to the development of content and forms of IT subjects teaching within the educational system of the Czech Republic. We also attempted to indicate some pitfalls or challenges that determine this development. However, it is not possible to determine the extent to which these trends, pitfalls or challenges are significant without examining this issue using pedagogical research methods. This examination, aimed at finding the current state of acceptance of the teaching contents of IT subjects taught at primary schools in the Czech Republic, was carried out on the basis of a research survey that took place at 35 kindergartens, primary and secondary schools during 2017.

2. Purpose of the study

The presented research was primarily focused on *the area of acceptance of possible changes in the educational content towards a substantial extension of the teaching of algorithmization and programming,* as envisaged in the Strategy of Digital Learning up to 2020. Subsequently, the issue of digital competences and their development in the context of the contemporary concept of digital literacy with an overlap to the possibility of modernization of the educational content accepting the need for the development of pupils' digital thinking has become a subject of research activity. The subject of the research was broken down into two relatively separate research areas:

- The aim of the first research area was to identify the current awareness and knowledge of pupils in the field of algorithmization and programming, including the mapping of the use of specific tools for the realization of teaching oriented in such a way.
- The aim of the other research area was to find out the interest in the teaching of the so far not so widespread thematic unit focused on algorithmization and programming in the conditions of primary schools.

An important factor for evaluating the overall situation in the area of acceptance of the teaching content of IT subjects taught at primary schools in the Czech Republic is also the independence of the obtained results from some significant features of the respondent groups, such as their gender. Although the use of gender in the research is sometimes rightly criticized, there are some substantial reasons why this comparison should be used in this specific case. This important feature of the group of 9th year pupils could not be overlooked, as the explanation of a state that is completely dependent on gender could not be described as fully valid. For these reasons, the intention was to subject the obtained results to analyses that would verify relative independence from some important characteristics of the research sample. Thus, the following research hypothesis was formulated:

- The pupils of the 9th year of primary school – girls declare a higher interest in the teaching of the thematic unit focused on algorithmization and programming than the pupils of the 9th year of primary school – boys.

3. Research methodology

A questionnaire was used as the basic means of obtaining the data needed to conduct a research survey. In the classification structure of research methods, the questionnaire is an indirect – investigative

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method. The questionnaire can be characterized as "*a specific means by which people's opinion on individual phenomena is examined*" (Chráska & Kočvarová, 2015). From the point of view of an individual (respondent), the examined phenomena can relate either to external phenomena or to internal processes. For the purposes of the research, a structured questionnaire—based on the research questions and hypotheses described above (Gavora, 2010) - was created to help determine the opinions of pupils of the 9th year of primary school about the phenomena under investigation. The questionnaire contained both closed questions with the answer offered, semi-closed questions with a range of answers (using the four-step scale), but also open questions, in which the respondents could record the varied status of the observed phenomena. To ensure the clarity of the individual questions, the questionnaire was supplemented by an explanatory text defining the terms used. The research questionnaire contained 9 questionnaire items focused on the phenomena under investigation, as well as an information apparatus that was used for the identification of some significant features of the respondents, such as the gender and age of the pupils, or the location of the school they attended. The research questionnaire was distributed, in the period from April to June 2017, among the pupils of the 9th year of a total of 35 primary schools located in three regions of the Czech Republic (Olomouc, Moravian-Silesian and Zlín regions). Altogether, the questionnaire was filled in by 342 respondents—pupils of the 9th year of primary school. A detailed description of the research sample is given in Table 1.

Table 01. Structure of the research sample

Characteristic	Group	Frequency	Relative frequency in %	Overall frequency
Gender	boys	144	42.1%	342
	girls	198	57.9%	
Age	14 years	130	38.0%	342
	15 years	212	62.0%	
Location	in the city	195	57.0%	342
	in the village	147	43.0%	

For the determination of the power of the individual groups of respondents answering in the same way, basic descriptive statistics and their visualization with graphs were used. Furthermore, these results were subjected to an analysis, which monitored the importance of responses for individual groups of respondents broken down by significant features (such as gender). For this verification, the parametric Student's t-test for independent groups was used, which compares the averages of one variable in two groups (Chráska & Kočvarová, 2015).

The following discussion presents some partial outcomes of the conducted research, which was primarily focused on the issue of acceptance of the educational content of IT subjects taught at primary schools in the Czech Republic, and whose target group was formed by pupils of the 9th year. A part of the research was also the area of acceptance of possible changes in the educational content towards the substantial extension of the teaching of algorithmization and programming.

4. Finding Out the Actual Level Of Knowledge In The Thematic Unit Of Algorithmization And Programming

The aim of the first research area was to identify the actual awareness and knowledge of pupils in the field of algorithmization and programming, including the mapping of the use of specific tools for the

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realization of teaching oriented in such a way. The aim was to find out in what spectrum and level it is possible to determine the existing awareness and knowledge related to algorithmization and programming in pupils of the 9th year of primary school, as one of the main elements of the development of digital thinking.

For this reason, we wanted to analyse the current level of knowledge, skills and interest in this thematic unit using three questionnaire items: "*How would you describe your level of knowledge and skills in programming?*", "*What specific programming environment or programming language have you encountered?*" and "*What would you most like to program?*". The set of these questionnaire items enabled us not only to find out the current level of knowledge of this thematic unit, but also to determine what specific programming language or development environment the pupils have encountered, whether within or outside the classroom. A part of the research was also an effort to find the pupils' realistic idea regarding the purpose for which they would most like to use this knowledge and skills, because without a realistic idea of the usefulness of the acquired knowledge, the motivation of pupils in teaching is very difficult. We assumed that this is one of the typically "non-traditional" IT topics which is not developed more systematically within the FEP for the area of Information and Communication Technologies, and therefore the pupils probably will not have a greater knowledge or awareness of this issue as it is normally not taught at their school. However, we also assumed that pupils could be attracted by the possibility of creating software applications, either because of its relative novelty, or because of the need to increasingly penetrate into the secrets of modern digital technologies, which this topic certainly makes possible.

Based on this reasoning, the following research assumption was set: *pupils of the 9th grade of primary schools have limited knowledge in programming, and only a part of them have encountered some of programming tools or development environments, but they can imagine their practical use*.

A summary of the answers of pupils of the 9th year is given in Figure 1, on the basis of which it was also possible to proceed with the verification of the established research assumption.

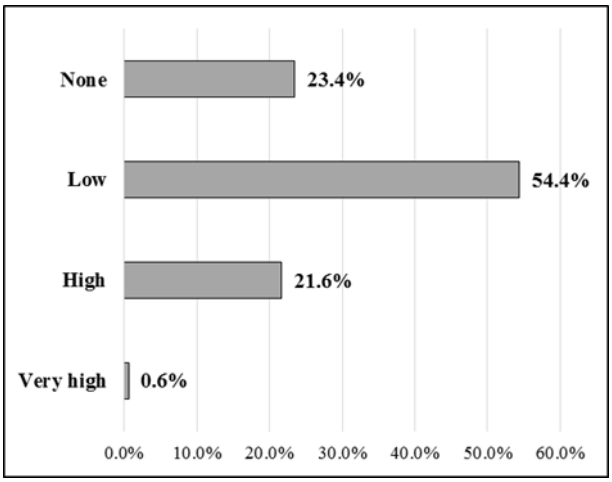

Figure 01. Declared level of knowledge in the field of programming and algorithmization

As can be seen from Figure 1, the majority of the 9th year pupils, namely 77.8%, declare low or no knowledge in the area of programming and algorithmization (answers: Low and None). Only a small part of pupils, namely 22.2%, declare high level of knowledge in this area (answers: Very High and High).

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Therefore, it is clear that the teaching of programming and algorithmization is not a thematic unit that would penetrate deeper into the teaching of IT subjects at primary schools, which is probably caused by the real absence of this topic in the FEP for the area of Information and Communication Technologies.

However, the fact that a relatively high percentage of pupils declared the knowledge of this issue has led us to find out which specific programming languages or development environments they know and use. A summary of the answers of pupils of the 9th year is given in Figure 2.

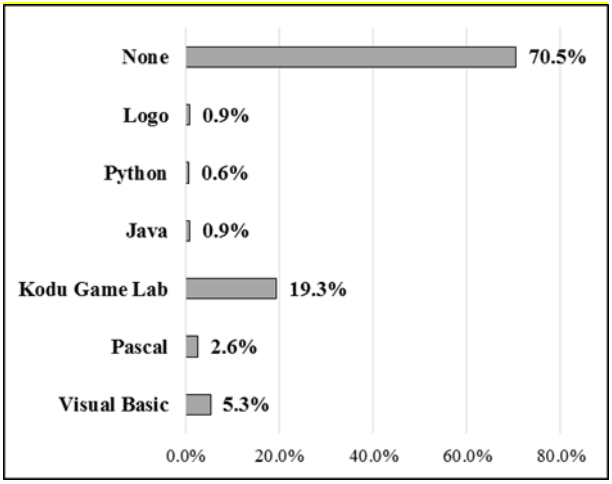

Figure 02. Knowledge of a particular programming language or development environment

Again, we can state that the result shown in Figure 2 confirms the earlier findings. A total of 29.6% of pupils stated that they had knowledge of or prior experience with a particular programming language or development environment. The most commonly used tool is the Kodu Game Lab development environment, which was chosen by a total of 19.3% of pupils. It is a tool for visual programming with a special focus on game development (see https://www.kodugamelab.com/). Another relatively popular tool is the full-fledged Visual Basic programming language, which was chosen by 5.3% of pupils. This is an event-driven, object-oriented programming language that integrates a development environment (IDE) and is manufactured by Microsoft (see https://docs.microsoft.com/en-us/dotnet/visual-basic/). Furthermore, programming, scripting, or learning languages Pascal (2.6% of pupils), Python (0.6%), and Logo (0.9%) are also marginally represented. A total of 70.5% of the 9th year pupils said they had no experience with or real knowledge of any programming language or development environment.

As can be seen, if the teaching of programming and algorithm has already been introduced, rather entertaining forms and content of teaching are preferred, as the best known and among the pupils the most popular tool is Kodu Game Lab, which primarily focuses on the development of games and entertainment applications. Real programming languages, enabling productive application development, are somewhat in the background, which, however, does not have to be counterproductive. The teaching of programming and algorithmization is certainly one of the more difficult thematic units, and it is therefore appropriate to motivate pupils, for example, by letting them develop computer games instead of complex real applications. The possibility of transferring and practical application of the knowledge gained through the teaching of algorithmization and programming is one of the important factors that can stimulate pupils to study this area.

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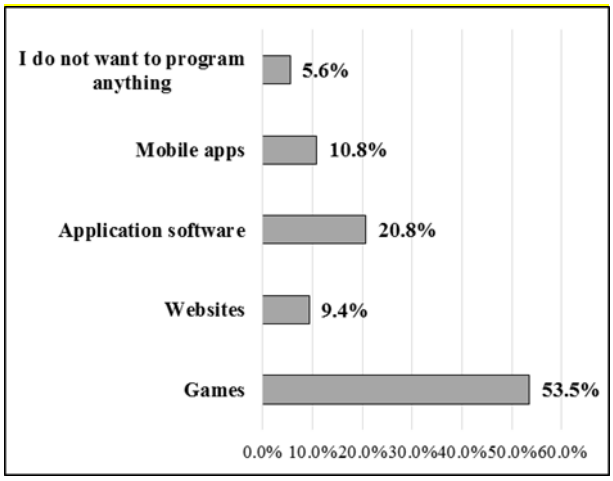

Figure 03. Specific pupils' idea of the practical application of knowledge from the area of algorithmization and programming

The level of pupils' real idea of the possibilities of this practical application was also the subject of our last analysis in this area of research, in which pupils were given the opportunity to express their preference for what they would prefer to program or develop. A summary of the answers of pupils of the 9th year is given in Figure 3 above.

It is clear from the above graph that the most preferred application of knowledge from the area of algorithmization and programming is the development of games, which was chosen by 53.5% of the 9th year pupils. Another relatively frequently chosen area was also the development of application software, i.e. of applications usable in the real world (20.8% of pupils) and applications for mobile devices (10.8% of pupils). Also, the area of use of scripting languages is not overlooked as 9.4% of pupils said they would like to apply the knowledge in the field of algorithmization and programming to the area of website development. Particularly pleasing is the fact that only 5.6% of pupils said they did not want to deal with programming or development of software applications at all.

5. Finding Out the Actual Interest Rate In The Teaching Of The Thematic Unit Of Algorithmization And Programming

The aim of the other research area was to find out the interest in the teaching of the so far not so widespread thematic unit focused on algorithmization and programming in the conditions of primary schools. The aim was to find out the interest of primary school pupils in the thematic unit focused on algorithmization and programming as one of the important factors for their further development and implementation into the teaching, educational environment and school life.

For this reason, we wanted to analyse the rate of pupils' interest in the thematic unit of algoritmization and programming using four questionnaire items: *"Did you have lessons focused on programming at your school?"*, *"Would you like programming to be taught at your school (if it is already being taught, are you glad)?"*, *"Are you actively engaged in programming also outside the classroom?"* and *"Do you think the knowledge of programming would be useful for you in your future life?"*. The set of these questionnaire items enabled us not only to find out the actual rate of interest in the teaching of this thematic unit, but also to find the pupils' realistic idea regarding the possible usability of the acquired knowledge and skills, because without a realistic idea of the usability of the acquired knowledge, the

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motivation of pupils in teaching is very difficult. Again, we assumed that pupils could be attracted by the possibility of creating software applications or games, either because of its relative novelty, or because of the need to increasingly penetrate into the secrets of modern digital technologies, which this topic certainly makes possible.

Based on this reasoning, the following research assumption was set: *pupils of the 9th grade of primary schools are interested in the teaching of the thematic unit focused on algorithmization and programming*. A summary of the answers of pupils of the 9th year is given in Figure 4, on the basis of which it was also possible to proceed with the verification of the established research assumption.

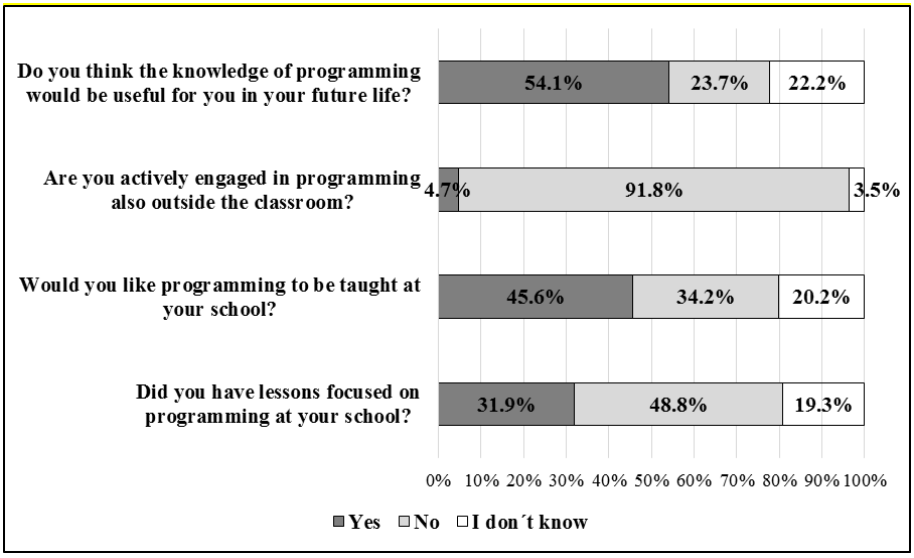

Figure 04. Declared rate of interest in the thematic unit of algorithmization and programming

Based on the results shown in Figure 4, we can state that only 31.9% of the pupils of the 9th year of primary school stated that they have IT subjects focused on programming at their school. This is a particularly interesting result, as this thematic unit is not very accentuated in the FEP for primary schools. The result also corresponds to the previously reported results regarding the declared level of pupils' knowledge in this thematic unit, where 21.6% of pupils evaluated their level of knowledge as high.

A considerable part of pupils, a total of 45.6%, said they would be happy if programming was taught at their school. A smaller part (34.2%) declared that the possibility of extending the teaching of IT in this way is unacceptable from their point of view. Again, it can be stated that this result correlates with the declared rate of interest in the thematic unit of algorithmization and programming introduced in the previous text, where 46.5% of pupils stated that they were interested or enormously interested in the teaching this thematic unit. It is also possible to state that only a minimum number of pupils in the 9th year of primary school deals with the issue of programming even within their extra-curricular activities, when only 4.7% of them have mentioned this fact. An overwhelming majority, namely 91.8% of them, said they did not deal with programming outside the classroom.

A pleasing result is that a large part of pupils of the 9th year of primary school, namely 54.1%, realizes that knowledge of programming will be useful to them in their future lives. The vast majority of pupils understand the need to teach this thematic unit and only a minority of pupils (23.7%) do not recognize this need. The reasons for this may vary from ignorance, through internal barriers to negative experience,

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but it is, of course, possible to speculate about other reasons and limitations. It is therefore the task of other scientific but also fieldwork to analyse these obstacles and look for ways to overcome them, so that this part of the pupils understands the added value of this thematic unit. Here, it is necessary to make further efforts in the field of research, project and field work, and try to create a concept of teaching of this thematic unit at the appropriate depth, but also with an overlap to the practical application from the viewpoint of pupils. The obtained results were then subjected to further analyses, focusing on the fact whether they are not dependent on individual significant features of the respondent groups. On the basis of this, the following research hypothesis (H3) was created, together with its null hypothesis ($H_{0,3}$) and alternative hypothesis ($H_{A,3}$).

- H3: The pupils of the 9th year of primary school – girls declare a higher rate of interest in the teaching of the thematic unit focused on algorithmization and programming than the pupils of the 9th year of primary school – boys.
- $H_{0,3}$: There are no differences between the rate of interest in the teaching of the thematic unit focused on algorithmization and programming declared by the pupils of the 9th year of primary school – boys and girls.
- $H_{A,3}$: The pupils of the 9th year of primary school – boys declare a higher rate of interest in the teaching of the thematic unit focused on algorithmization and programming than the pupils of the 9th year of primary school – girls.

The established hypothesis was verified on a sample of 342 respondents, pupils of the 9th year of primary school, using the Student's t-test for independent groups, with the grouping variable being the gender of the respondents, as shown in Table 02.

Table 02. Declared rate of interest in the thematic unit of algorithmization and programming versus gender

Statement	**Student's t-test; grouped by gender, number of respondents: 342** Interest in the thematic unit of algorithmization and programming								
	Group 1 (girls)	**Group 2 (boys)**	**p**	**Valid responses of. Group 1**	**Valid responses of Group 2**	**Std. deviation of Group 1**	**Std. deviation of Group 2**	**F – ratio**	**P – variance**
Did you have lessons focused on programming at your school?	1.106061	1.152778	0.546054	198	144	0.743065	0.651190	1.302083	0.094101
Would you like programming to be taught at your school?	1.136364	1.416667	**0.000844**	198	144	0.744926	0.779995	1.096370	0.547923
Are you actively engaged in programming also outside the classroom?	0.979798	1.055556	**0.015476**	198	144	0.200497	0.369800	3.401884	0.000000
Do you think the knowledge of programming would be useful for you in your future life?	1.232323	1.437500	**0.021235**	198	144	0.828775	0.781953	1.123342	0.461261

Since $p < 0.05$ was achieved in three out of the four observed features (with the exception of experience with lessons focused on programming, where $p = 0.546054$), we can, on the predefined threshold of probability and with certain reservations, reject the null hypothesis and accept the alternative hypothesis. It is therefore possible to state, with a relatively high probability, that *the pupils of the 9th year of primary*

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school – boys declare a higher rate of interest in the teaching of the thematic unit focused on algorithmization and programming than the pupils of the 9th year of primary school – girls.

6. Summary and interpretation of the results

On the basis of the analyses carried out, it can be stated that the predefined research assumption could have been verified and refined in the following way: *The pupils of the 9th year of primary school are interested in the teaching of the thematic unit focused on algorithmization and programming and a total of 54.1% of them declare the benefit of such teaching for their future lives. However, the obtained result is gender-dependent, with boys declare a statistically significantly higher interest rate in the teaching of the thematic unit focused on algorithmization and programming than girls.*

The obtained results are rather positive and point to the pupils' interest in the teaching of the area of algorithmization and programming. Consequently, pupils understand that basic knowledge of algorithmization principles, or of one of the programming languages or development environments, is now becoming—even for an average user of digital technologies— increasingly necessary. The main goal of the teaching of algorithmization and programming should not only be the education of programmers who can deal even with demanding algorithmic tasks but also the acquisition of pupils and students who will be able to use the acquired knowledge and programming experience for the creation of educational or entertaining applications refining the overall conception of modern learning as well as their personal development (Klement & Lavrinčík, 2014).

The teaching of programming has a significant impact on the development of logical, sequential and abstract thinking, which is perhaps also the reason why many pupils perceive programming as challenging and intended only for a handful of exceptional individuals, especially from the point of view of girls.

7. Conclusion

Based on the obtained results, we can state that the area of algorithmization and programming teaching, although it is one of the typically "non-traditional" IT topics, which is not systematically developed within the FEP for the area of Information and Communication Technologies, is not completely rejected by the pupils of the 9th year of primary school. Our assumption that pupils can be attracted by the possibility of creating software applications, either because of its relative novelty, or because of the need to increasingly penetrate into the secrets of modern digital technologies, has been verified.

Although the real level of pupils' knowledge in this area is relatively low, which is probably caused by the real absence of this topic in the FEP for the area of Information and Communication Technologies, a significant part of them have already encountered some of programming languages or development environments and can also imagine a real application of the obtained knowledge.

The results also showed that, if the teaching of programming and algorithm has already been introduced, rather entertaining forms and content of teaching are preferred, as the best known and among the pupils the most popular tool is Kodu Game Lab, which primarily focuses on the development of games and entertainment applications. Real programming languages, enabling productive application development, are somewhat in the background, which, however, does not have to be counterproductive.

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The teaching of programming and algorithmization is certainly one of the more difficult thematic units, and it is therefore appropriate to motivate pupils, for example, by letting them develop computer games instead of complex real applications, which was confirmed by the pupils themselves.

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