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Developing Critical Thinking in Younger Pupils Using ICT

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Abstract: *A methodology for developing critical thinking in younger pupils using information and communication technologies (ICTs) has been developed based on the study of the pedagogical experience of O. Diachuk, a teacher from M. Ostrovsky comprehensive school No 1 (I-III levels) in Shepetivka (Khmelnytskyi Region), and O. Svystak, a teacher from specialized school No 30 (I level) in Khmelnytskyi. The paper determines its goals, objectives, stages (problem statement, information search, clear argumentation, decision-making) and results from using it. Also, it presents the results obtained from the study of its effectiveness based on the observation of younger pupils' educational and cognitive activities, their questionnaires, surveys of primary school teachers, as well as the study of pupils' compositions. It states that the use of the developed methodology helps to enhance the activity of primary school pupils, their thinking skills and abilities to justify their decisions, search for new information using digital devices and develops their communication skills. At the same time, the paper points out the following disadvantages and difficulties in using the developed methodology: potential problems in using it due to technical bugs and slow Internet connection; a long preparation for those stages of the lesson during which this methodology is applied; certain difficulties in supervising pupils' search activities in case there are more than 30 pupils in the class. Further research should aim to study the characteristics of implementing the methodology for developing critical thinking in younger pupils using ICTs during adaptation-and-game-related (Grades 1 and 2) and main (Grades 3 and 4) stages of pupils' learning.*

Keywords: *three-way interaction; digital competence; pedagogical experience; primary school.*

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Introduction

Primary education is given a special place in the structure of general secondary education since this stage marks the beginning of children's educational activities, as well as their acquisition of the necessary key competencies for further successful learning. O. Savchenko (2008) indicates, "primary school is at the heart of the entire school education, and the more powerful it is, the more preconditions there are for children's success in school life" (p. 1). However, the practice of modern primary school shows a significant decrease in the level of younger pupils' motivation to study and their loss of interest in school as a source of knowledge. One of the significant reasons behind this is the use of outdated teaching methods and forms by teachers.

Nowadays, researchers have conducted numerous studies on the use of ICTs in education (Androshchuk et al., 2014; Morze, 2006); psycho-pedagogical and organizational principles of using ICTs (Bykov, 2013; Dolmatova, 2016; Telezhinskaia & Dudareva, 2016); the use of ICTs in primary school (Pietukhova & Spivakovskyi, 2007; Ponomarenko, 2010; Spivakovskyi et al., 2011).

It must be noted that Ukrainian (Batrun, 2018; Navolokova, 2014; O. Pometun et al., 2010) and international (Halpern, 2000; Scriven & Paul, 1987) scholars have paid much attention to the problem of developing critical thinking in schoolchildren. O. Barabash and N. Hlynianiuk (2018) and R. Matonina (2013) have analyzed the technologies for developing critical thinking in younger pupils.

In Ukraine and worldwide, the so-called Generation Y, or "Millennium Children," born between 1990 and 2000, whose views on lifestyles are fundamentally different from those of older generations, is gaining momentum (Ministry of Education and Science of Ukraine, 2016). Critical thinking is one of the important 21st-century skills that should be developed in education, including primary school. Today, it is vital to teach pupils to quickly manage the information flow, think independently and make informed decisions. The development of critical thinking should become the basis of learning, as well as the main prerequisite for acquiring key competences (Ministry of Education and Science of Ukraine, 2016).

Today's reforms in Ukrainian education focus on the search for innovative pedagogical technologies that can enhance educational and cognitive activities of pupils in general secondary education, in particular, primary school, and develop their critical thinking. Such technologies include information and communication technologies (ICTs).

The introduction of ICTs in primary school is a natural and appropriate process. Indeed, younger pupils think in images and are keen on gadgets. Due to ICTs, an educational environment is complemented by sound, video and animation. All of this significantly influences the emotional sphere of younger pupils, enhancing their cognitive activity and reinforcing the educational process.

Besides, ICTs significantly expand the teacher's opportunities. Instead of being a knowledge transmitter, the teacher facilitates educational and cognitive activities of his or her pupils and can create a productive educational environment for younger pupils to develop critical thinking using ICTs.

However, primary school practice shows that ICTs are seldom used to develop critical thinking in younger pupils. Most frequently, these technologies only help to illustrate individual stages of the lesson.

Therefore, it is important to study the methodology for developing critical thinking in younger pupils using ICTs.

Moreover, the paper finds that there are not enough scientific findings on the use of ICTs to develop critical thinking in younger pupils.

The paper aims to verify the validity of the methodology for developing critical thinking in primary school pupils using ICTs.

Material and methods

A particular methodology for developing critical thinking in younger pupils using (ICTs) has been developed based on the study of the pedagogical experience of O. Diachuk (2017), a teacher from M. Ostrovsky comprehensive school No 1 (I-III levels) in Shepetivka (Khmelnytskyi Region), and O. Svystak (2018a; 2018b; 2018c), a teacher from specialized school No 30 (I level) in Khmelnytskyi. It covers certain ways of developing children's intellectual and communication skills using ICTs, which are an organic element of the educational process. It can be used at different stages of the lesson and extracurricular activities.

This methodology aims to develop younger pupils' ability to solve problems using ICTs and digital devices (smartphones, tablets).

The following tasks should be accomplished to achieve the main aim:

1. To teach pupils to find the information they need to solve a problem using technical devices.
2. To develop their ability to analyze, synthesize, compare, summarize and evaluate the obtained information.

3. To teach them to make individual or collective decisions.

4. To teach them to justify their decisions.

The role of a primary school teacher involves helping pupils solve problems and find the necessary information, manage the flow of information and three-way (pupil – teacher – environment) interaction.

This methodology can be regarded as effective if pupils learn how to make informed decisions and are at sufficient levels of digital competence.

The development of critical thinking includes raising a problem that needs to be addressed, searching and capturing information, building compelling arguments, making informed decisions to solve the problem (Shkvyr, 2019). This research considers each stage of the methodology for developing critical thinking using ICTs.

Problem statement. Pupils start to think critically, given that questions and problems are thought-provoking. A problem means those statements (thoughts) that can be doubted (Ponomarenko, 2010, p. 30). At this stage, the teacher needs to prepare multimedia support (presentation) for lessons or extracurricular activities using Microsoft PowerPoint or other programmes that should include problematic situations (questions or tasks) that can encourage pupils to test their knowledge, search for new information, compare, analyze, synthesize, summarize and evaluate educational material. The teacher should not just pass on some knowledge to younger pupils but motivate them towards thinking. He or she includes problematic situations in the order of presenting educational material, complementing it with images, photos, animations, audio or video. For one, when primary school pupils study water properties (natural sciences), the teacher first talks about water, its importance in human life, using slides with pictures, photos, and then demonstrates a slide with such words as "fluid", "colourless", "transparent". He or she asks pupils: "Which word do these refer to?"; "What do they mean in general?"; What water properties are missing?".

During the interaction with pupils, the teacher can also question some statements, creating a problematic situation that involves all the pupils in the class. The teacher might say, "Do you think that these water properties should also include such words as "tasteless", "odourless", "shapeless"? Let's check it".

Besides, it is essential to encourage pupils to ask the teacher and formulate the problem on which everyone is going to work (Shkvyr, 2019).

Information search. Before one starts solving the problem, he or she needs to collect relevant information about it. Knowledge creates the basis for critical thinking. Pupils need to process (analyze, compare, summarize)

vast arrays of information (facts, ideas, theories, rules, life experiences), based on which they can prove and express their opinions (Shkvyr, 2019, p. 30). At this stage of developing critical thinking, the teacher can instruct pupils to work with online guides, which should be carefully analyzed and selected by the teacher and downloaded to pupils' smartphones or tablets. Also, it is necessary to teach pupils to work with online resources to obtain the necessary information. Gadgets enable children to quickly learn how to interpret different concepts, information about animals, plants, famous people, landmarks of history and culture. The mission of the primary school teacher is to encourage younger pupils to search for information and develop their ability to obtain and process educational material.

Independent work can be done in groups, pairs and individually. Primary school teachers need to monitor how quickly and correctly younger pupils search for information and, if necessary, assist them. They can display the results of the search on the demonstration screen. If there is an interactive whiteboard in the classroom, the teacher can log in any computer application, open an online tutorial or web page and provide the necessary information. Working with interactive whiteboards, pupils learn information not only through audio and visual channels of perception but also through a kinaesthetic one. A large screen on which information is displayed is visible to everyone and, thus, all pupils can review the results of the search. For one, the teacher can ask pupils to explain the meaning of such words as utility, digging, minerals (natural sciences). Pupils can do it using their smartphones. After that, they can check their answers and results of the search using the teacher's slides.

Clear argumentation. Critical thinking needs cogent reasoning. There are several ways of solving one particular problem. Therefore, the correctness of the decision should be proved by convincing and clear arguments (statements), formulated based on the information pupils found (Shkvyr, 2019, p. 30). At this stage of developing critical thinking, primary school teachers need to teach pupils to prove their points of view. They can offer younger pupils to choose and prove which of the animal feed chains given on the slide is the right one (natural sciences).

Most practical and often conflicting questions can be answered using the multi-step problem-solving approach:

1. Analyzing the problem (What happened? Why? How can it be fixed? What information do I need to recall or find? Where can I find it?).

2. Searching for solutions (What are the ways to solve it? What are their pros and cons?).

3. Choosing one way to solve it (Which solution is best in terms of practicality, effectiveness or simplicity?) (Ponomarenko, 2010, p. 19).

4. Here are some examples of conflicting questions for primary school pupils (language and literature): What would you do if you were a fairy-tale character?, Why do you not like such an ending of the story? Suggest your options".

Decision-making. The stage of problem-solving ends in decision-making. It is determined not only by the information pupils found or recalled but also by their personal qualities, mental attitudes and, to a great extent, their beliefs, including a reflective attitude towards oneself, moral and social responsibility, respect for individual characteristics of other pupils (Batrun, 2018, p. 10). Therefore, primary school pupils should be taught to express their opinions regarding other children's thoughts.

Decisions can be made by pupils individually, in pairs or a group. It should be expressed verbally or in writing (for example, in the form of an essay). Here are some examples of essay topics for primary school pupils: What invention does humanity need?, Should we do good deeds?, Do smartphones pose a threat to children?.

In the case of verbal communication, other pupils can either agree with such a decision or refute it or suggest another option.

The authors of the paper have conducted this research at the premises of M. Ostrovsky comprehensive school No 1 (I-III levels) in Shepetivka in Khmelnytskyi Region (Grade 4a – 32 pupils; O. Diachuk (2017) – their teacher) and Khmelnytskyi specialized school No 30 (I level) (Grade 4b – 33 pupils; O. Svystak (2018a; 2018b; 2018c) – their teacher) to prove the effectiveness of the developed methodology. The research lasted from September (2019) to March (2020). Research methods included the following: empirical methods (observations, questionnaires for teachers and pupils; a study of pupils' compositions) and theoretical methods (analysis, generalization).

Results

To begin with, the authors of the paper conducted a targeted pedagogical observation of educational and cognitive activities of primary school pupils (55 individuals). They found that using the developed methodology enhanced activity of primary school pupils and helped to develop their thinking, ability to justify their decisions, search for new information using digital devices, realize that gadgets could quickly find the information they needed and develop their communication skills.

The questionnaires for pupils have confirmed the results of the observation. According to question 1 (Do you often have to search for new information?), 67.3% of pupils answered yes (37 individuals), 25.4% of them were not sure how to answer (14 individuals) and only 7.3% of them answered no (4 individuals) (see Figure 1).

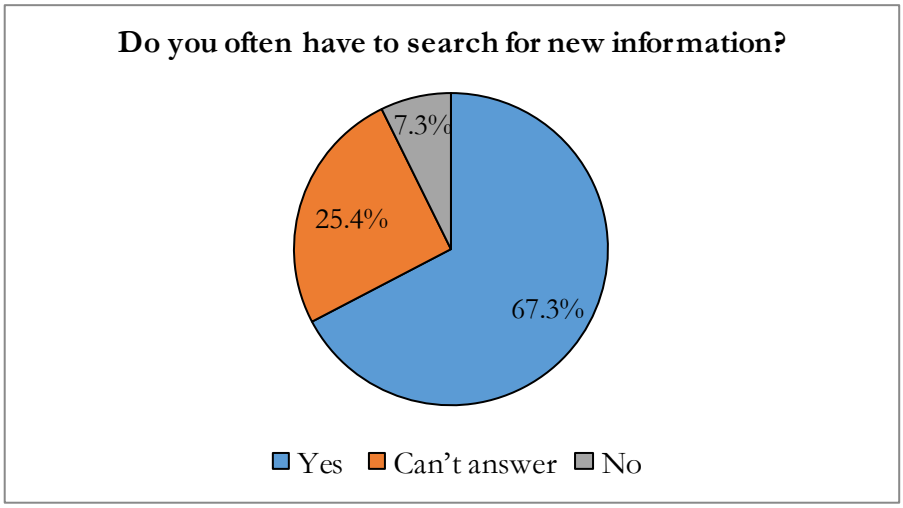

Fig. 1. Pupils' evaluation of the need to find new information

The analysis of answers to question 2 (If you need to find new information, you use or ask…?) has helped the authors of the paper to determine what devices pupils use to obtain new information. The results of the questionnaire indicate that 69.1% of primary school pupils (38 individuals) use the Internet. The least popular among them are textbooks and other literary sources – only 7.3% (4 individuals). As an option, they suggest using an e-guide – 3.6% of pupils (2 individuals). The summarized data are presented in Figure 2.

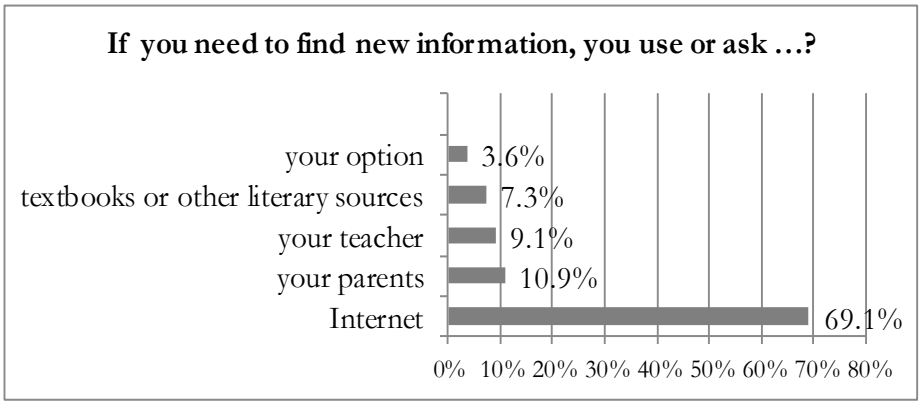

Fig. 2. What pupils do when they need to search for new information

The answers to question 3 (How do you know that your decision is the right one?) shows that most children understand how to make decisions. Indeed, 54.5% of pupils (30 individuals) chose the answer "I can explain it", 38.2% of them (21 individuals) – "I consulted with others"; 7.3% of them (4 pupils) – "I can't answer" (see Figure 3).

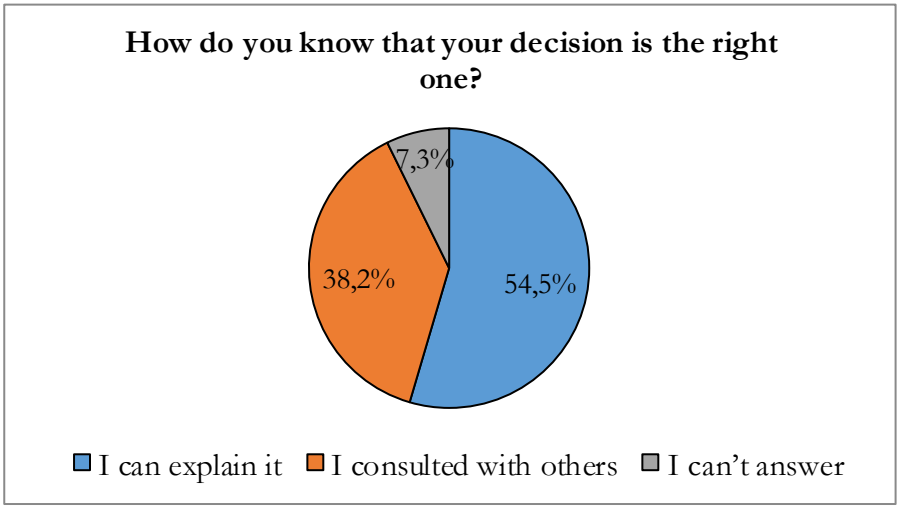

Fig. 3 How primary school pupils understand the role of intellectual and communicative techniques for making the right decision.

The authors offered pupils to write an essay on the following topic "Svitiaz – is it a lake or a sea?" to check whether they could justify their decisions. They were allowed to use textbooks, online manuals and the

Internet. The analysis of their essays shows that 80.0% of them (44 individuals) not only gave the correct answer but also proved their opinion using arguments they recalled or found using certain learning aids; 12.7% of them (7 individuals) gave the correct answer but failed to prove it; 7.3% of them (4 individual) gave the wrong answer.

Besides, the authors of the paper have surveyed those teachers whose teaching experience they studied to identify the disadvantages and difficulties in using the developed methodology. They included potential problems in using it due to technical bugs and slow Internet connection; a long preparation for those stages of the lesson during which this methodology is applied; certain difficulties in supervising pupils' search activities in case there are more than 30 pupils in the class. The teachers also note that using this methodology should take into account age characteristics of pupils during adaptation-and-game-related (Grades 1 and 2) and main (Grades 3 and 4) stages of pupils' learning (Ministry of Education and Science of Ukraine, 2016).

Discussion and Conclusions

Digital competence is one of the ten key competences which Ukrainian schools should teach pupils. It implies a confident and critical use of ICTs to create, search, process and share information (Ministry of Education and Science of Ukraine, 2016).

In pedagogy, information and communication technology is regarded as a type of modern pedagogical technology. The authors of the paper agree with those researchers (Dubaseniuk, & Ivanchenko, 2003; Padalka et al., 1995; Piekhota, Kiktenko & Liubarska, 2003; Savchenko, 2002), who consider pedagogical technologies as a system of teachers' and pupils' actions aimed at achieving the set goal. Therefore, they mean to clarify that ICT is a system of teachers' and pupils' initiatives towards using didactic methods and technical devices based on computer networks aimed at achieving the set goal.

ICTs can provide the visual learner with visual images necessary for his or her perception in the form of illustrations and diagrams, video clips and Flash models; the kinaesthetic learner – with the opportunities to manipulate objects of cognition while using interactive models; the auditory learner – with audio associations while listening to audios, watching videos. All of this enhances the impact of ICTs on the effectiveness of the educational process at school.

The use of ICTs requires the teacher to ensure a three-way interaction (pupil – teacher – environment), and the pupil should be an active participant in the educational process. The term "three-way didactics" is defined by L. Pietukhova and O. Spivakovskyi (2007) and O. Spivakovskyi, L. Y. Pietukhova and V. V. Kotkova (2011) as one of the areas of pedagogy on the most general patterns, principles and ways of organizing education, which ensures a conscious and strong acquisition of the knowledge, abilities and skills within equal relationships between the pupil, the teacher and the information and communication pedagogical environment.

This research interprets ICT as an effective way of developing younger pupils' thinking. According to O. Sukhomlynskyi (1976), making pupils thinkers implies teaching them to discover the truth independently (p. 454). The Ukrainian pedagogical dictionary indicates that thinking is the highest form of reflecting reality in mind, an ideal activity, which results in objective truth (Honcharenko, 1997, p. 200).

Critical thinking is one of the types of thinking which "exposes the difference between the computer and human brain" (Barabash, & Hlynianiuk, 2018, p. 3). The concept of "critical thinking" has been used in scientific and pedagogical literature since 1956. It was at this time that B. Bloom developed a taxonomy of thinking and determined what operations the human brain could perform at each level of thinking (Shkvyr, 2019). The study of the scientific and pedagogical literature shows that today, there are different approaches to clarifying the concept of "critical thinking". The authors of the paper have defined critical thinking as logical thinking, aimed at making a decision using intellectual and communicative techniques, based on O. Shkvyr's previous research, which specified stable features of this concept using the content analysis (Shkvyr, 2019, p. 30).

In pedagogical mentality, the concept of "critical thinking" is associated with searching for certain disadvantages. When they say that "a person is thinking very critically", they refer to his or her excessive suspiciousness and unwillingness to accept others' views. However, it is necessary to distinguish critical thinking from the so-called "criticism". Critical thinking does not imply criticizing drawbacks but the ability to identify a problem and develop an optimal strategy for solving it (Barabash, & Hlynianiuk, 2018, p. 3).

One of the main factors affecting the quality of life is one's ability to make decisions under non-standard situations, that is one's ability to find the necessary information, process it and make an informed decision (this is the result of critical thinking). Only ICTs can help to do it at the speed required

in modern society and, therefore, primary school pupils should be taught using different methods.

Thus, the methodology for developing critical thinking in younger pupils using ICTs requires the teacher to ensure a three-way interaction (pupil – teacher – environment). The main stages of this methodology include problem statement, information search, clear argumentation and decision-making. This research proves the effectiveness of the developed methodology. Indeed, it enhances pupils' educational and cognitive activities, develops their intellectual and communication skills necessary for decision-making, as well as their digital competence. At the same time, the research reveals some difficulties and disadvantages which should be taken into account by the teacher in the preparation and implementation of this methodology in the educational process in modern primary school.

Further research should aim to study the characteristics of implementing the methodology for developing critical thinking in younger pupils using ICTs during adaptation-and-game-related (Grades 1 and 2) and main (Grades 3 and 4) stages of pupils' learning.

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