The Effect of the BYOD Model in Comparison with the Traditional use of ICT In Primary Schools

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Abstract: It is often today claimed in the media and literature that we are in a time of tremendous technological growth, with everything in society being modernised and the dominance of digital technologies on the horizon. In contrast, digital technologies can result in changes in society and greatly affect interpersonal relationships and communication between people. Digital technologies affect all generations, and especially children in primary school. It seems that the use of these devices in education could be beneficial for both parties, schools and pupils. Thanks to their flexibility there is the possibility of using different didactic approaches that directly respond to the specific learning styles and diverse needs of pupils, from the slowest to the most gifted. The aim of this paper is to describe the effect of the Bring Your Own Device (BYOD) model in comparison to the traditional concept of digital technology in the higher primary school classroom. The aim of the research was to compare the effect of the BYOD model on teaching compared to the traditional use of digital technology using a questionnaire and a didactic test. The research was conducted in Czech Republic and utilized pupils smartphones and Ipads. For this finding, thematically identical teaching units were designed and implemented for two groups of pupils. The two experimental groups differed from each other only in the way they used digital technologies. This experiment was conducted in the context of teaching two tribal classes of children 11-12 years old. A total of 42 children participated in the research, of which 18 formed the research group and 24 formed the control group. The design of the thematic units was oriented to one of the modules of the computer science subject. Specifically, the lessons focused on hardware and software. The Nearpod web application was chosen for the BYOD model intervention in teaching, mainly because of its availability, accessibility and ease of orientation in the application. The research results suggest that the BYOD model may not always be effective; however, factors that caused or otherwise influenced this are discussed.

Keywords: ICT, BYOD, Education, Digital technology

1. Introduction

It is often today claimed in the media and literature that we are in a period of tremendous technological growth, with everything in society being modernised and the dominance of digital technologies looming on the horizon. In contrast, digital technologies can result in changes in society and greatly affect interpersonal relationships and communication between people. Digital technologies affect all generations, and especially children in primary school. According to statistics from the Czech Statistical Office in 2023, more than 99% of young people have a mobile phone, with some surveys reporting that parents purchase mobile phones for their children as early as when they start primary school (Pavlicová, 2018).

It seems that the use of these devices could be mutually beneficial for both schools and pupils. The use of mobile technology brings many benefits. Pupils use their phones almost every day, so there is no need to invest time in familiarising themselves with a new device. Using their own device allows pupils to work outside school. Besides, they take better care of their devices than they would of borrowed school equipment. Schools therefore save on expenses such as tablets and can invest the money elsewhere. As the use of mobile technology grows, so does the requirement to modernise the school network.

The benefits of the BYOD model can be applied in all educational areas. Its flexibility offers the opportunity to use different didactic approaches that directly match specific learning styles and the diverse needs of pupils from the slower to the gifted. Being able to work on one's own device, which the user knows well, can increase productivity and activity in the classroom.

The aim of our research is to investigate the effect of the BYOD model in comparison to the traditional concept of ICT in higher primary school education. In the BYOD model intervention, we chose the hardware and software computer topic, which will be the same for both experimental and control groups. To analyse the issue of BYOD in education through the eyes of pupils, we used a questionnaire survey and a didactic test. For our study we set the following research questions:

RQ1: What are the attitudes of higher primary school pupils towards the use of the BYOD model in education?

RQ2: What are the most common concerns in implementing the BYOD model in higher primary school education?

RQ3: What is the impact of using the BYOD model on pupils' learning outcomes and activity in the classroom compared to traditional ICT methods?

RQ4: What are the advantages and disadvantages of using the BYOD model in higher primary school education?

2. Theoretical Background

BYOD, or Bring Your Own Device, is a trend that was originally applied and used in the corporate environment of various companies, but has gradually moved into the field of education, where it has taken root and has been gaining increasing popularity in recent years, and its benefits are unquestionable(Disterer & Kleiner, 2013).

We understand the BYOD model in education as a certain model of an approach to learning, a concept or school policy where pupils or students bring their own mobile devices to school. Such devices include laptops, netbooks, tablets or smartphones. They are used to access school information, applications, services or directly in the classroom as part of the educational process. The development of new mobile devices and their decreasing price, fast internet connection and general digitisation are aspects that lead to an ideal opportunity to use the BYOD model in education(Dixon & Tierney, 2012).

The emergence of the BYOD model in education was preceded in the early 1990s by the 1:1 (one-to-one) model, in which schools tried to provide one PC per pupil. At the root of the models was the substitution of paper and pens with computers and digitisation(Dixon & Tierney, 2012).

Although the 1:1 approach or concept initially primarily concerned desktop computers, the term itself primarily took root with the advent of laptops and is now understood more in relation to mobile digital devices. The typical model for the introduction of the 1:1 approach was that of the school purchasing the equipment, acting as both the provider and security administrator of the equipment, taking care of licences, software and updates, local area network connectivity, maintenance, repairs, insurance or replacement of the equipment when it became obsolete. In the early days this was mainly a matter of equipping the IT classroom to provide one piece of hardware per pupil. Over time, desktop computers were replaced by mobile devices – laptops, tablets, mobile phones. With the development of new types of mobile digital devices, it became clear that pupils preferred different types of devices for different types of tasks, and so the focus on one type of these devices proved inconvenient, giving rise to a phenomenon that replaced one-to-one with a one-to-many approach (Šupicová, 2019).

The BYOD model addresses this issue by integrating both of these models. Above all, the pupil's or student's familiarity with the device itself seems to be most crucial. With the increasing expansion of smartphones owned by most pupils today, their inclusion in education seems vital. Compared to the common use of smartphones by pupils, their inclusion in the educational process aims at harnessing a completely different potential. Within the concept of BYOD, smartphones and other mobile digital devices are used for educational purposes, and thus for acquiring certain skills and competencies that are a prerequisite for both academic and later professional growth, but also for fully-fledged civic employment (Šupicová, 2019).

Advantages of the BYOD model

A well-planned application of the BYOD model in the classroom provides pupils with a whole new experience of using their own devices. At home and outside school, pupils mainly use mobile devices for leisure activities, but implementing them in the classroom can teach pupils to use their own devices for other activities that help them develop and learn new skills. These are usually activities that systematically increase their digital literacy, encourage online collaboration, teach them to critically assess various information sources, communicate purposefully, grammatically and typographically correctly in digital media, and create imaginative multimedia works using their own creativity. All this happens while respecting ethical standards and safety rules. Thus, a leisure device becomes an educational device (Neumajer, 2016).

Another interesting advantage is the economic factor. Buying computer systems or equipping IT classrooms on an already tight school budget is taxing. Of course, it does not end with the purchase of equipment, as these school devices need to be managed, secured, maintained, the software updated, licences purchased and obsolete equipment replaced. The BYOD model solves all of this, as it can save considerable amounts of money or time spent on various organisational matters around IT classrooms.

The variety of devices may seem like a disadvantage, but modern cloud computing allows us to use various services and programs stored on Internet servers to which pupils connect via the school network. Cloud computing also supports connectivity for pupils, teachers and parents by allowing access anywhere, any time.

Disadvantages of the BYOD model

The main disadvantages of this model include security and data protection. What belongs among the drawbacks is the necessary training of teaching staff or even their refusal to implement this model in teaching. The school's expenditure on boosting the internet connection may also fall under the downsides. In practice it might happen that a pupil forgets their device, but this can be solved by borrowing a school device such as a tablet.

According to the official project (Ministry of Education, 2020) called 'Individualisation of teaching and development of digital literacy using mobile devices', the main objective is to train teaching staff, participating partner schools and model schools and spread examples of good practice of model schools in the use of digital technologies in teaching in order to develop digital literacy of children and pupils using mobile technologies. The practices imparted include methods of individualisation in the conventional classroom using mobile devices and the application of the BYOD model.

The project was implemented from January 2020 to December 2021 and consisted of two key activities. The main outputs of the project were professionally supported teachers of partner schools and model schools, model lessons for each participating teacher, methodological materials, video recordings of good practice examples and improvement of technical equipment of schools through the purchase of new digital technologies.

This project has increased the effectiveness of education in terms of measurable outcomes. Mobile devices have been shown to increase the measurable effectiveness of pupils' learning, particularly through the possibility of adaptability, individualisation, time optimisation and immediate feedback. It provided support to the fixation phase of learning. The supported schools were equipped with a mobile device classroom, which allowed them to apply the skills acquired without major changes in teaching organisation and building modifications. The schools also received a basic kit to provide wireless network coverage in selected classrooms, which they can expand at will. Thanks to this project, pupils are able to tap into the potential of their mobile devices. What was particularly innovative in this project was the natural integration of mobile devices into the functioning organisation of the school and the development of pupils' digital literacy. From the perspective of the teachers, there has been a simplification of lesson preparation procedures, an active integration of digital technologies and mobile devices into teaching, and easier support to pupils with special educational needs. Teachers have also seen a significant increase in their own digital literacy and digital competencies.

According to Silva (2020), who applied the BYOD model in teaching in Portuguese schools, an overall SWOT analysis of this model was created using questionnaires, in which 95.65% of the students responded that they would like to continue using mobile devices in learning and that they worked well during the BYOD model intervention. The majority of the students (60%) would welcome this method as a helper in daily education or other activities. The author's conclusion mentions an increase in activity in the classroom with improved results.

According to Attewell (2015), it is estimated that up to one-third of Australian schools encourage pupils to bring their own digital devices. The Softlink organisation concluded that pupils want to learn with digital technologies they are familiar with and use at home, forcing schools to implement the BYOD policy. In 2013 they reported great progress in upgrading the school network and equipping schools to support e-learning and improve access to resources through digital devices. Laptops for schools will likely mean a mass application of the BYOD model across the country, as was reported by ZDNet. In 2013 the NSW Department of Education also released the 'BYOD Policy' and 'BYOD Implementation Guidelines' for schools.

Alberta Ministry of Education (Canada) released a 'BYOD Concept Guide for Schools' in 2012, stating that schools in Alberta had applied BYOD for over five years and that schools currently using the BYOD model had found the system beneficial. They see the application of the BYOD model as providing immediate access to digital technology to fully meet the educational needs of pupils (Attewell, 2015).

Due to the organisation of the American school system at the school district level, it is difficult to ascertain the current situation in all districts; however, it is true that mobile devices or even the BYOD concept are being utilised by a growing number of districts. In 2011 US mobile learning experts found that the successful application of the BYOD model in elementary and high schools, given the sophistication, prevalence and accessibility, should make up a large part of US education by 2015. They estimated that a pupil would have a mobile device available for educational purposes. For most schools, the 1:1 ratio would be achieved as they

applied a BYOD policy to help relieve the financial strain on public schools as they could not afford to purchase digital devices for every pupil (Attewell, 2015).

3. Methods

We chose a quantitative strategy for our research. To analyse the issue of BYOD in education through the eyes of pupils, we used a questionnaire and a didactic test as the research tools. In our research we observed several factors such as the opinions about the use of BYOD model in the educational process, the pupils' attitudes, the impact of the BYOD model on the pupils' results and activity and the advantages and disadvantages perceived by the pupils when using this model. A specially designed satisfaction questionnaire was tailored to the needs of this research. The questionnaire contained a total of 12 questions, scaled as 1 = yes, 2 = probably yes, 3 = do not know, 4 = probably no, 5 = no. The scale was replaced by 'emoticons', which were circled by the pupils to make it more suitable for the selected age group. The didactic test created was adapted to the needs of this research and contained 10 questions based on the material covered. The test and the questionnaire were anonymous. The main target group of the questionnaire was sixth-grade pupils in primary school. Responses were collected from 42 pupils.

To carry out our research we used Computer Science lessons, where we discussed the topic of 'Hardware and Software' with the pupils. The aim of the teaching unit was to fulfil the expected outcomes of the Framework Curriculum for Primary Education of Czech Republic, namely:

I-9-4-01 describe how a computer works in terms of hardware and operating system; discuss the functioning of digital technologies that set trends in the world;

I-9-4-04 deal with typical computer malfunctions and error conditions.

Teaching unit without using the BYOD model – Group A

The teaching unit without using the BYOD model consisted of several parts. We started with a lecture, which was supported by a presentation created in the internet application prezi.com. This was followed by a fixation activity where pupils matched pictures of components to their names in the presentation. During the lesson the pupils were provided with disassembled computer kits (including individual components such as a processor, RAM, etc.), which we showed and described. In the next part of the lesson, we assigned each pupil one term from the topic discussed, about which they had to find one or two pieces of information on the Internet that had not been mentioned so far. During the lesson there was lively communication and interaction with the pupils. At the end of the lesson the pupils took a didactic test and an evaluation questionnaire.

Teaching unit with BYOD intervention – Group B

The teaching unit with the BYOD intervention itself also consisted of several parts, with the introductory activities identical to Group A. It was based on a lecture, which was supported by a presentation created in the web application prezi.com. This was followed by a fixation activity where pupils matched pictures of components to their names in the presentation. During the lesson the pupils were provided with disassembled computer kits (including individual components such as a processor, RAM, etc.), which we showed and described.

For the BYOD model intervention in the classroom, we chose the web application Nearpod, mainly because of its availability, accessibility and ease of navigation. The Nearpod app is accessible from any device whether it is Android, iOS or any other device platform. It is a free web app that does not need to be pre-installed on the device. The teacher can observe the entire course as an observer and can directly formatively evaluate or correct.

The pupils took out their mobile phones and scanned the prepared QR code to access the Nearpod web app. Several activities awaited them in the app, such as matching correct pairs, drawing information into a picture and answering a quiz. The main activity was a gamified 'Time To Climb' task, in which pupils used the correct answers to progress towards the goal.

During the Nearpod activities, the pupils were informed of what was going to happen and what the next task was. During the lesson there was lively communication and interaction with the pupils. At the end of the lesson the pupils took a didactic test and an evaluation questionnaire.

4. Results

The research asked several key questions regarding pupils' perceptions and attitudes towards the BYOD model and its use in the classroom. The results can be used to discuss the modernisation of the educational process, to adapt to new technological trends in the field of pedagogy and especially information technology. In the research part we focused both on the overall perspective of the pupils and on the subgroups, which were divided according to the following criteria.

The research was carried out with pupils of the sixth year of primary school. Group A was used as a control group in which we did not apply the BYOD model. The class consisted of twelve boys and twelve girls. Group B was the class with the BYOD model intervention. The class consisted of eight boys and ten girls.

Didactic test results

In this section we will discuss the results of the didactic test from different perspectives. We will compare the test results between Group A and Group B and also take the gender aspect into account.

First, we will look at the scores in both groups. The total score in Group A was 177 out of 240 possible points; in Group B, it was 120 out of 180 possible points.

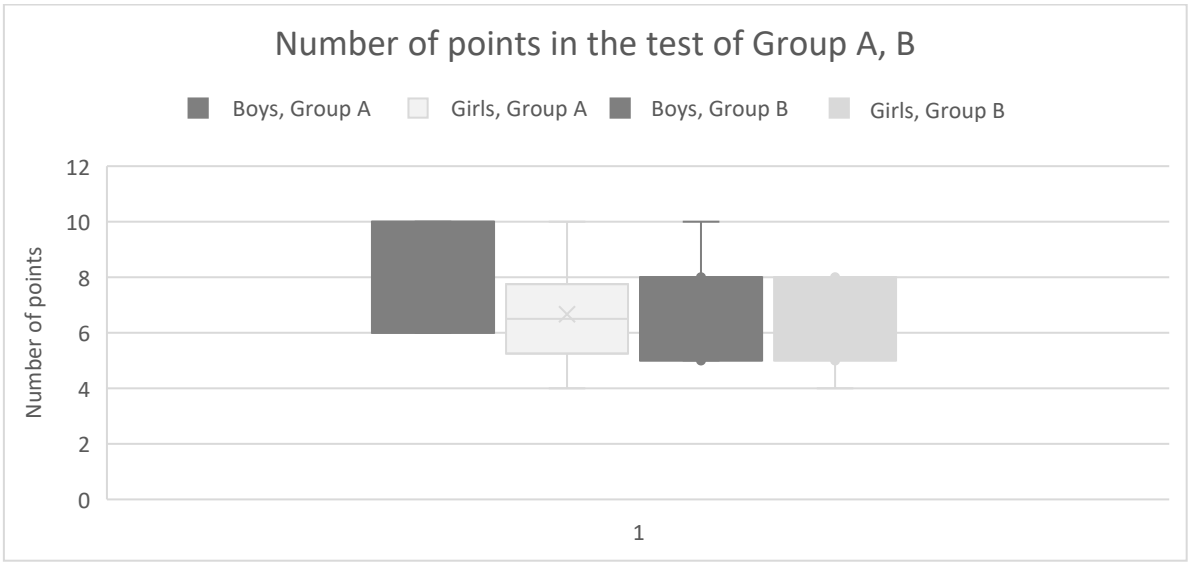

Figure 1: Didactic test scores of Group A, B, divided by gender

In the comparison of the test success rates, Group A was in the forefront with a 73.75% success rate compared to Group B, which was 66.66% successful.

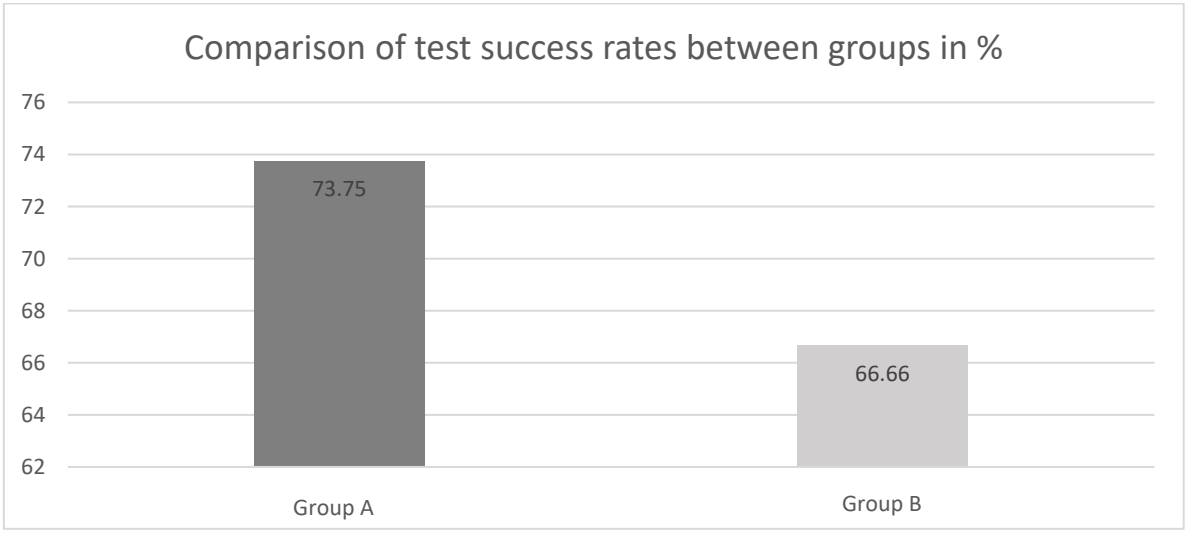

Figure 2: Overall didactic test success rate between the groups

As far as the comparison of the success rate of girls and boys in each group is concerned, the boys in Group A were better overall in the didactic test, achieving a success rate of 80.83%. The girls managed to pass the test with a success rate of 66.66%. In Group B, boys were better oriented in the test overall, with a 71.25% success rate. The girls managed to pass the test with a success rate of 63%.

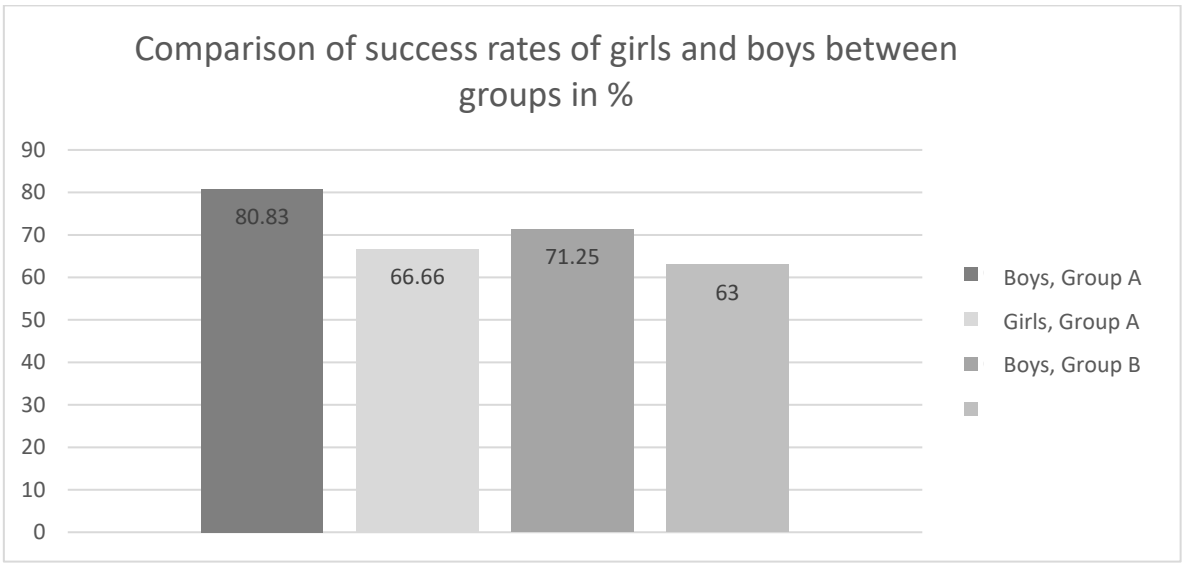

Figure 3: Comparison of success rates between Groups A, B, divided by gender

Questionnaire results

In this section we discuss the responses collected in the evaluation questionnaire. For statistical processing of the data, we converted the five different emoticons into verbal expressions of the type 'yes', 'rather yes', 'do not know', 'rather no', 'no'. Closed questions are shown in the chart, open questions are labelled and discussed in words.

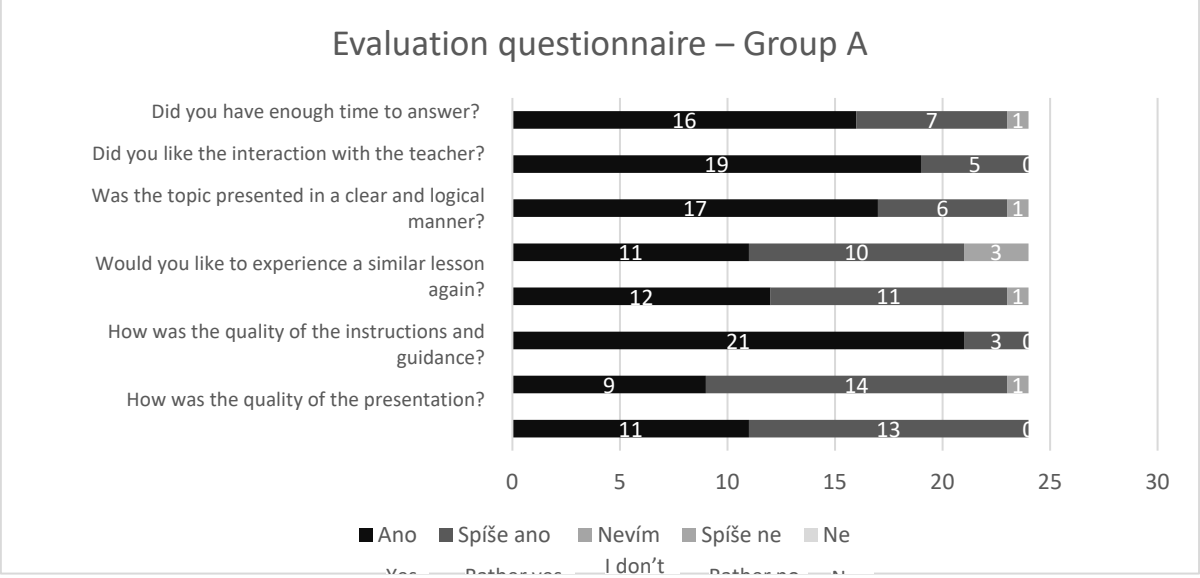

Figure 4: Responses to the questionnaire questions in Group A (without using the BYOD model)

Is there anything you would like to change about the lesson?

- The pupils answered almost unequivocally 'no' to this question. One pupil answered that he would like to try assembling a PC and one answered that he would like me to speak louder.

What did you like most about this lesson?

- The most repeated term was 'prezi', or a new style of presentation that they were unfamiliar with. They also liked the introduction of the PC and the individual components, and the work itself.

What did you like least about this lesson?

- Most pupils here answered 'no, nothing', but individuals answered, for example, that they did not like the 'frontal teaching', the 'information search', or the 'test' itself.

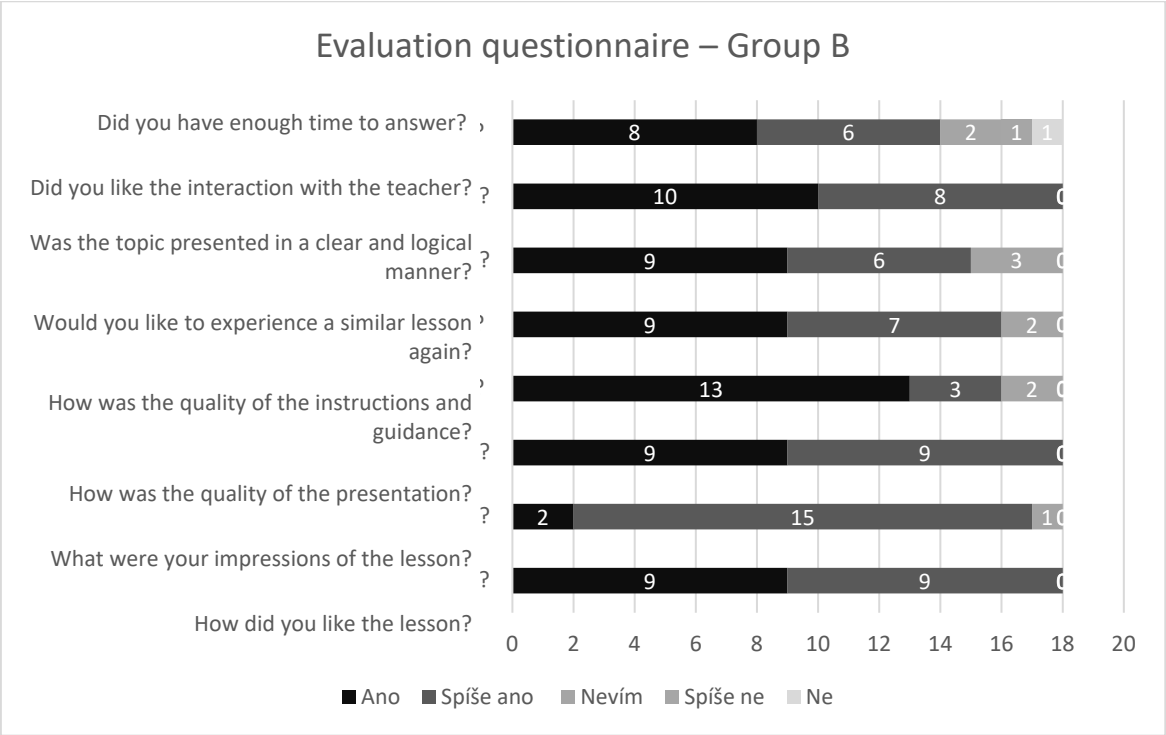

Figure 5: Responses to questionnaire questions in Group B (using the BYOD model)

Is there anything you would like to change about the lesson?

- The majority of pupils answered 'no'.

What did you like most about this lesson?

- Here the answer 'game' was clearly predominant – this term was mentioned in half of the answers. Other answers were 'nearpod', 'quiz', 'communication', 'prezi'.

What did you like least about this lesson?

- Most pupils here answered 'no, nothing', but some mentioned 'working with terms' or 'questionnaire'.

5. Discussion

Given the research results, which do not correlate with professional studies, we might wonder why Group B, the group in which BYOD was used, did not show a higher success rate in the test or why their subjective impression of the lesson was weaker than Group A, which did not use BYOD. Group B is objectively weaker. They are generally not as interested in information technology and generally the subject of ICT in education is not one of their favourites.

I would attribute the fact that boys were more successful than girls in both groups in the test to the boys' interest in computer games, as this was a lesson that was not very engaging for the girls; the boys were significantly more active in both classes and were interested in the different components or workings of computers.

Group A is very active, altruistic and calm. They enjoyed the class itself very much and were active throughout, raising their hands when I asked a question and answering correctly.

Group B, on the other hand, seemed 'tired' and inactive. We had to repeat all the questions and motivation to work often and get the correct answers from them with extra help. Group B also includes one pupil with special educational needs, so a teaching assistant was present during the whole lesson. The pupil did not have the

slightest problem to complete the whole lesson without any limitations, so we can say that the BYOD model is also suitable for pupils with special educational needs.

As a limitation in the research, we would mention the insufficient number of pupils to whom the BYOD model was applied in the lesson. As there were only two classes with a total of 42 pupils – 24 as control and 18 with the BYOD model intervention. Another was the length of the lesson, 45 minutes, in which we had to fit in the teaching, the questions, the actual application of the BYOD model, and even the final 15 minutes set aside for the completion of the test and questionnaire.

Risks of the BYOD model in practice

We registered some risks associated with this model. The pupils were informed in advance of the lesson to bring their mobile phones; however, three pupils had left their mobile phones at home. Thanks to the excellent resources of the primary school, we were able to provide these pupils with school iPads, and so the problem was relatively easily solved.

Furthermore, we noticed that for some Android device users, the Nearpod app did not display well, with the diacritics in the sentences particularly displayed with errors, and the pupils thereby had to often puzzle out what the assignment was.

6. Conclusion

The aim of the research was to determine the effect of the BYOD model compared to the traditional concept of ICT in higher primary school education. We established four research questions, which we successfully answered. We determined the pupils' attitudes towards the use of the BYOD model in education, which was rather positive. When the BYOD model was implemented, the concerns related to forgetting one's own device were confirmed. The impact of the BYOD model on pupils' performance and activity was rather negative. In the use of the BYOD model, the undeniable benefits of the model were confirmed, but so were the challenges associated with its use. We applied the BYOD model in a lesson designed in correlation with a control lesson with the traditional use of ICT in education. On the basis of the developed evaluation questionnaire and didactic test, we analysed the results of the use of the BYOD model in the teaching of sixth grades in primary school.

We analysed the results using charts. The research turned out negatively for the BYOD model, but in the discussion we mention factors that caused or otherwise influenced the research. Studies on the application of the BYOD model in the classroom show positive effects on pupils in classes using the model.

Given the limitations of our research in terms of class size or teaching hours, we would like to follow up on this issue in future research.

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