

COMPARING TABLETS (TOUCHSCREEN DEVICES) AND PCs IN PRESCHOOL CHILDREN' EDUCATION: TESTING SPATIAL RELATIONSHIP USING GEOMETRIC SYMBOLS ON TRAFFIC SIGNS

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Abstract Touchscreen devices have dramatically increased the accessibility and usage of technology, causing escalating usage, especially by very young children. Although the effects of screen time have been shown to produce serious (negatively effects on executive functioning, attention problems, school difficulties, sleep and eating disorders, and obesity) and even life-threatening consequences (due to radiation emission), technology can be beneficial if it is carefully used. Child-centered technology is especially designed to be as entertaining and captivating as possible. In order to examine how touchscreen devices, influence the acquisition of some important spatial concepts and provide exciting opportunities for learning new abilities, an experimental research was conducted aimed to determine whether the type of device used (computers or tablets) in the natural kindergarten environment influences young children performances. For the purpose of this work, geometrical symbols on traffic signs were used to test spatial relationships – left/right, and longer/shorter relations. The test was carried out on a sample of 30 pre-school children. The results show significant differences between the two-testing media for identifying the longer vs. shorter relationships in favor of Tablet PC. Based on the results obtained, it can be concluded that the kinesthetic characteristics of tablets, the novelty factor and the opportunity to learn through playing, provide a positive approach to the early childhood education. Besides, the interactive environment created in a kindergarten by using tablets contributes to introduce new teaching methods which are expected to amplify the pedagogical capacity, changing the way of spatial concepts acquisition, as well as, children traffic education take place within.

Keywords: Touchscreen devices; testing, education, preschool children, traffic signs.

1. INTRODUCTION

Contemporary lifestyle that is inextricably linked to the use of new technologies in almost all areas of human life. Initially, computer use is granted to adults who are trained to use hardware and software, primarily for business purposes. However, with the expansion of both hardware and software, new technologies have become more and more accessible, leading to the enormous size of their various applications.

The development of hardware and software has had a very well-trained pathway, leading to a higher level of adaptation to people both in terms of their needs and in the way they are using it. This way of development, contributed to the fact that today almost no special training is required for the use of most devices (Trifunović et al., 2014; Trifunović et al., 2017). Regarding software that is in daily use, the situation is similar, while those specialized require additional efforts to be overcome. One of the

curiosities in the development of hardware is that modern devices are becoming increasingly stronger, and on the other hand, they are increasingly smaller physical dimensions.

There is a wide range of people who will use the devices present in the marketplace for business purposes, for everyday needs, games and entertainment. The stated purpose is the main reason for the increasing use of digital media (primarily touchscreen) by children. Due to the impact of technology children's play has given a completely different dimension, and access to learning has changed considerably. In addition, new technologies are accepted by children as a completely natural and indispensable means of communication. The view that children must reach the level of concrete operations in order to be ready to use the computer has been overcome (Clements & Nastasi, 1992).

A growing number of children are at the earliest age encountering digital technologies, through the "use" of computers, tablets and mobile phones. The above facts, as well as the fact that children learn best through the game, represent a strong basis and potential for the use of new technologies in their education.

The first knowledge that children acquire at the earliest ages is recognition of colors. It is known that in pre-school and early elementary school, physical development occurs before the psychic. In this period characteristic is the sharpened sense of sight and hearing, which changes the perception of the three-dimensional space surrounding them. The differentiation of spatial relationships, their separation and spatial knowledge which is orientation-dependent, begins to develop in pre-school age based on the differentiation of spatial relationships of their own body. The child first begins to properly distinguish its right arm. Based on the distinction of the right and left hands, it begins to differentiate the right and left eye or right and left ear.

Similarly, the child determines the position of objects arranged around him. In the sphere of symbolic thinking, a child of this age should understand and use the words above, below, above, down, smaller, bigger, shorter, longer, thicker, and thinner. By knowing these words, the child starts to perceive relations between objects and knows how to describe them verbally (Čičević & Trifunović, 2016).

The above facts are significant and should be taken into account when forming an approach to educate children using new technologies. Accordingly, one of the guidelines may imply the use of educational content based on geometric shapes of different dimensional characteristics and color. These contents can be reproduced in a certain way on devices and accompanied by appropriate explanations, questions and tasks. An adequate approach based on modern technologies and content upon geometric shapes of different characteristics can be one of the ways for successful education and testing of pre-school children.

Children should learn functional and applied knowledge. The use of computers in education for younger children emphasizes the importance of active use of technology, both in the learning of drawing, writing and recognizing geometric shapes, as well as in decision making, problem solving and illustration of ideas. Engagement during learning is directly related to motivation, which is enhanced when classical instructions are combined with the use of computers (Haugland, 1999).

Various studies show that children have an intrinsic motivation for using computers, which is reflected in the fact that they are much more focused and spend longer time with the computer than in other activities where he and similar devices are missing (Guthrie & Richardson, 1995). Children educated using new technologies show better structural and conceptual knowledge, better non-verbal skills, better language skills, troubleshooting skills, long-lasting memory, better coordination of movements and better intellectual abilities in comparison with those children in whose education new technologies have not been used (Clements & Sarama, 2003).

In addition to these facts, motor skills, mathematical and geometric thinking are enhanced, creativity encouraged, and better results are achieved in critical thinking tests (Nastasi & Clements, 1994). Expressed benefits are achieved when preschoolers use Tablet PCs in pairs or when adults participate in the work. In these cases, children develop co-operation in communication and interaction with other members of the group, as well as positive attitudes toward learning (Čičević & Trifunović, 2013).

On the other hand, it is necessary to pay attention to the negative effects of the use of new technologies by children, which are also present. Consequently, a number of research themes are being opened, which aim to find the most effective way to achieve and implement a modern way of education.

The subject of this study is to explore the possibility of using new technologies and content based on geometric shapes in the education and testing of children of pre-school age (symbols on traffic signs were used to test spatial relationships – left/right, and longer/shorter relations). The goal is to determine if the type of device (PC and Tablet) used is also influencing the success of the educational and testing process through the interaction with the medium and the examiner, as well as the perception and response of children to such an approach.

2. METHODOLOGY

2.1. Experiment procedure

The test was performed with children attending Pre-school, aged from 5 to 6. The geometric symbols on traffic signs selected for testing were the signs which children perceive every day on the way from home to school, which are made up of elements that are close to children of this age (circle, square, rectangle, color, symbols, arrows) (Zedda et al., 2013). For the purpose of this work, geometrical symbols on traffic signs were used to test spatial relationships – left/right, and longer/shorter relations. Testing was done in two ways. The first manner includes presenting the traffic signs to children on Tablet computers (Touchscreen devices). The second method involved the use of PC computers. Each slide showed a single traffic sign. Examiners turned each slide on the tablet and PC computer, when the child responded to the question. Half of the respondents first did the test on the Tablet PC, and then on the PC computer, while the other half the respondents worked in the reverse order. The primary objective of this experimental setting was to examine the potential impact of the differences of PC and Tablet computers test modes. This kind of experiment settings provides answers to possible applications and contributions of tablet and PC computers in the testing and education of pre-school children about spatial relationships.

2.2. Geometric symbols on traffic signs used in the experiment

Children's understanding the meaning of the symbols presented on traffic signs was registered. Eight traffic signs that children are faced every day when walking in the street were chosen as stimuli. The first part of the test, included questions based on determining the relations left / right, was followed (Figure 1).

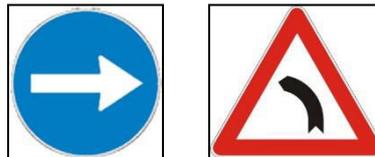


Figure 1. Traffic signs for left-to-right asymmetry testing: "Mandatory direction" and "Dangerous left curve".

The second part of the test involved identifying the longer/shorter relation (Figure 2). Standardized traffic signs (Traffic Signaling Regulation, 2017) were used for testing the above relations.



Figure 2. Traffic signs for longer/shorter relations testing: "Priority over oncoming" and "Traffic in both directions".

For the first two traffic signs, children have to demonstrate the side (right or left) to which the arrow on the traffic sign indicates, while for the last two traffic signs children reported their answers verbally. The answer sheet is scored by counting the number of correct responses and incorrect answers for each sign. Each correct answer is worth one raw point (Trifunovic et al, 2017).

2.3. Data analysis

Statistical data processing was performed using IBM SPSS Statistics v. 22. Based on the distribution of frequencies and cross-tabulation, the results will be displayed using a diagram (Pallant, 2013). The null hypothesis (H_0) was: There is no statistically significant difference between user groups, with alternative hypothesis (H_a) being: There is significant statistical significance between user groups. The threshold for statistical significance (α) was set to 5%. Consequently, if probability (p) is smaller or equal to 0.05, H_0 is rejected, and H_a is accepted. On the contrary, if $p > 0.05$, H_0 is not rejected. As the Kolmogorov-Smirnov test has determined that results do not significantly deviate from a normal distribution, the decision was to use Student's T-test.

3. RESULTS

The rest of this paper will present the results of the comparative statistical analysis of performances working with tablet and PC computer.

The traffic sign indicating the Mandatory direction served only for testing whether children recognized the direction right. 47.25% of children show correct answers identifying the right side, which was presented by an arrow sign. When the children responded to the question using a PC computer, they show 41.2% of correct answers, while working with Tablet computer they had 51.3% of correct answers. The results of Student's T-test did not show statistically significant differences between and tablet computers mode of testing ($t=0.671$, $p=0.641$). Regarding the traffic sign Dangerous left curve, children recorded a total of 49.4% of correct answers. When the children responded to the question presented using the PC computer, they had 44.6% of correct answers, while answering the same question when using Tablet computer they show 54.2% of correct answers (Figure 3.). The results of Student's T-test did not show statistically significant differences between the two testing devices ($t=0.693$, $p=0.657$). However, although there were no statistically significant differences between the two mediums which were used for testing, the percentage of correct answers was higher when children were tested using a tablet computer, as opposed to when the testing was done using PC computer.

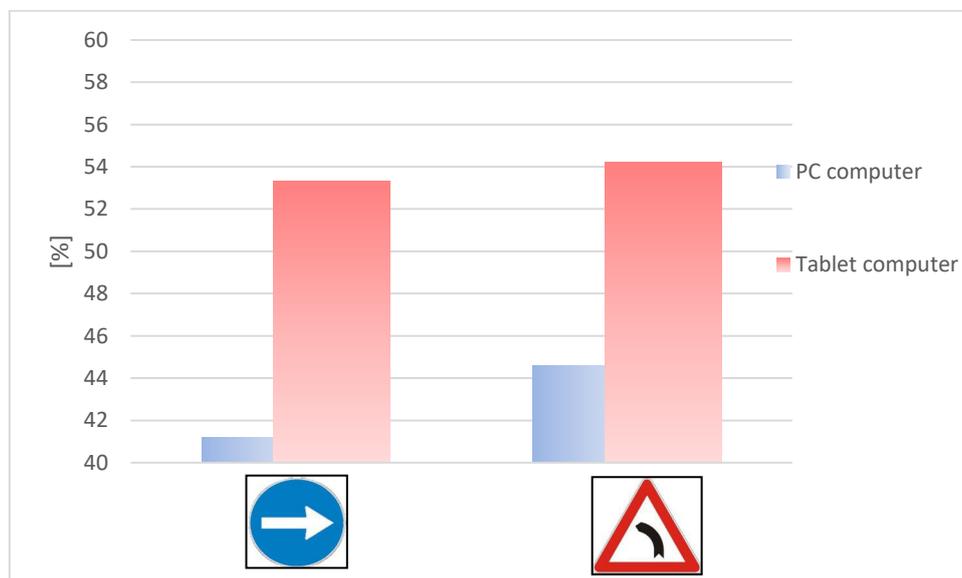


Figure 3. Understanding the directions left and right.

When it comes to the signpost arrow, which is designed to examine the knowledge of the relationships longer/shorter, the children recorded a total of 63.55% of correct answers. When the children responded to the traffic sign using the PC computer, they had 52.9% of correct answers, while in case of the same question asked using Tablet computer they show 74.2% of correct answers. The results of Student's T-test showed statistically significant differences between PC and Tablet mode of testing ($t=2.489$, $p=0.002$). For the fourth traffic sign children had 72.55% of correct answers while identifying the equal-length arrows. When the children responded to the question using PC

computer, they had 58.8% of correct answers, while using Tablet computer they show 86.3% of correct answers (Figure 4). The results of Student's T-test show statistically significant differences in achievement using PC versus tablet computers ($t=2.142$, $p=0.002$). The percentage of correct answers was higher when children were tested using a tablet computer, in comparison to the situation when testing was done using PC computer.

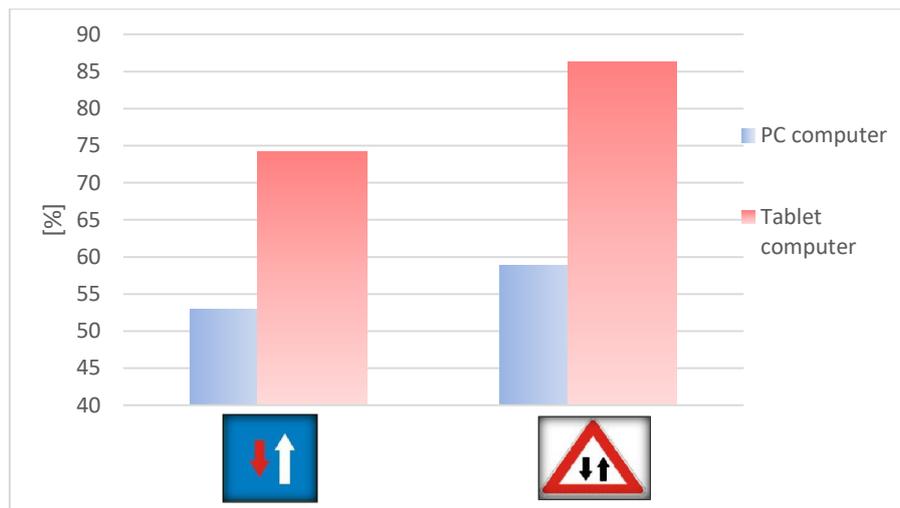


Figure 4. Understanding the longer/shorter relation.

When analysing the overall performance on all tasks, the children had 67% of correct answers when tasks were solved using a tablet computer, while they had 49.38% of correct answers when the same tasks were solved using PC computer (Figure 5.). The fact that there are differences between two ways of training and testing is also confirmed in the results of Student's T-test, which showed statistically significant differences in performances for PC and tablet computers ($t=6.231$, $p=0.001$).

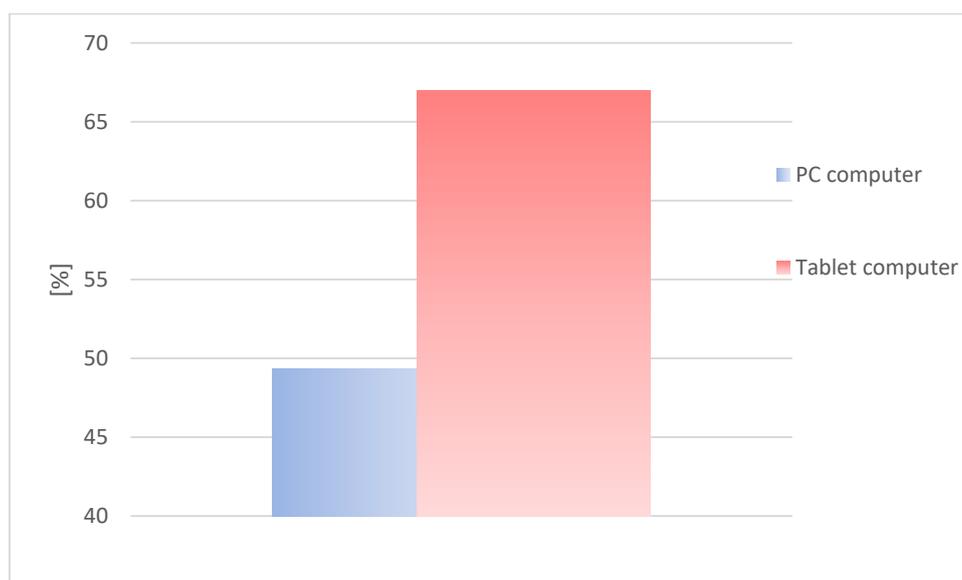


Figure 5. The overall achievement for the PC and Tablet computers.

4. CONCLUSION

Based on the results of the research, the following general conclusions can be derived:

- Children show better understanding of the direction right and left when tested using tablet computers;
- For the relationships longer/shorter, children show a higher percentage of correct answers when tested using a tablet computer;
- In general, a higher percentage of correct answers was recorded when the children were tested with the tablet computer, in comparison to the situation when testing was performed by using PC computers.

Taking into account the above mentioned, the use of a tablet computer has been proven to be useful in testing and educating children in terms of their knowledge of traffic signs, primarily due to the interactivity and autonomy. Hence follows the conclusion and practical recommendation that testing and educating using Tablet computers tailored to the individual characteristics of learner can significantly improve the awareness and knowledge of children by establishing, practising and interacting with the medium.

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