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Surveying Preschoolers' Computer Use Capabilities

Michael Vitoulis*

Lecturer in Department of Early Childhood Care and Education, Alexander Technological Education Institute of Thessaloniki, Thessaloniki, Greece
Email: vitoulism@gmail.com

Abstract

This study detected computer skills that children have developed spontaneously in their everyday lives and those that have already possessed during their studies at the early childhood education centers. The survey involved 453 children, aged 3 to 5, attending 24 different early childhood education structures. A 25-point computer skill observation form, supported by a corresponding rubric, was used to describe the computer capabilities of preschool children. According to the results of the study, as children registered for early childhood education settings, they brought with them their pre-existing computer skills. These skills could potentially hold a key role in designing future educational programs. The age of children seemed to affect these skills up to the age of 4. Implications of findings, concerning computer skills of preschool children, are discussed.

Keywords: Early Childhood Education; Computer ICT; Preschool; Toddler; Children's Computer Skills; Appropriate Age of Computer Using; New Technologies.

1. Introduction

For decades, computer use in relation to young children has created a great debate among early childhood educators and other professionals. There are doubts and questions by experts like, "Shouldn't children have concrete objects for learning?" "Doesn't computer use amongst young children create passive learners?" or "Don't children have difficulty in handling with computers?". Controversies over the question of the role of technology in young children's learning have polarized the field, and the role of technology is still debated. There are concerns about whether young children should have access to technology and screen media in early childhood programs. The American Academy of Pediatrics [1] discourages any amount or type of screen media and screen time for children under 2 years of age and recommend no more than one to two hours of total screen time per day for children older than 2 [2]. Prior to the above, more reservations did exist, so Hohmann [3] recommends that computers should not be utilized by children younger than 3 years old.

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* Corresponding author.

From the other side, technology and interactive media are tools that can promote effective learning and development when they are Operated intentionally by early childhood educators, within the framework of developmentally appropriate practice to support learning goals established for individual children [4]. Developmentally appropriate computer-based learning experiences have the potential to contribute not only to what young children learn but also to how they learn [5]. Clements [6] maintains that “Technology can change the way children think, what they learn, and how they interact with peers and adults”. He also presents technology as a tool for improving children's learning through exploration, creative problem solving, and self-guided instruction [7]. It is suggested to be of particular importance for young children to develop the early “technology-handling” skills as this fact is related to early literacy development [9]. The challenge for early childhood educators is to make choices that maximize learning opportunities for children, while managing screen time, as these devices offer new interfaces that increase their appeal and utility to young children. Haugland [9] supports technology's implementation by the teacher in the classroom with children of 3 and 4 years old, provided that children are allowed to experiment and explore for a reasonable time frame.

Despite the debate that arise regarding the appropriateness of digital technologies in early childhood education, research is showing that technology use is a typical aspect of many young children’s daily lives [10]. Computers have nowadays an ubiquitous presence in households, including those of very young children. Early enough, it has been pointed out that that 56% of children between the ages of 4 and 6 have used a computer by themselves [11]. In recent years, new technologies found their way into the personal and professional lives of early childhood educators, into early childhood programs serving young children, parents, and families and into the homes of young children [12]. The prevalence of electronic media in the lives of young children means that they are spending an increasing number of hours per week in front of and engaged with screens of all kinds, including television, computers, smartphones, tablets, handheld game devices, and game consoles [13]. Children’s experiences with technology and interactive media are increasingly part of the context of their lives, which must be considered as part of the developmentally appropriate framework [14].

The prevalence of technology and media in the daily lives of young children and their families—in their learning and in their work—will continue to increase and expand in more ways than we can predict. Early childhood educators need to understand that technology and media-based materials can vary widely in quality, and they must be able to effectively identify products that help rather than hinder early learning [4].

Even today, experts are concerned about what is the appropriate age for the child to work with the computer. The National Association for the Education of Young Children (NAEYC) has defined the developmentally appropriate computer use from young children, but not the age of the children. Their position statement (NAEYC 2012) notes that professional judgment is required by teachers to determine whether technology is age appropriate, individually appropriate, and culturally appropriate for the children in their care [14].

It has been also suggested that executive functioning ability is important in young children’s development of computer skills and that parents adapt their verbalizations to match the abilities of their children and the tasks that they are doing [15]. Executive functioning is a complex cognitive regulatory system that helps guide behavior in a goal-directed manner [16]. Executive functioning includes processes such as: working memory (the ability to hold information in mind in order to complete a task), inhibition (the ability to refrain from performing an action, particularly those that are incompatible with the task at hand), and the ability to shift attention between two competing tasks.

Given that the most popular means of manipulating computers is the mouse, it is argued that cognitive maturation may have a stronger influence than age on the ability to use the mouse [17]. It has been scientifically supported that immaturity in the development of key visual-motor skills in preschool children has significant influence to the ability of hadling the mouse.

Examination of the role of age on the speed and accuracy of children’s mouse use, confirms that older children are faster and commit fewer errors than younger ones [18], also they appear to be more accurate with mouse sub-movements when approaching the targets [19]. An important role in the ease of using the mouse from young children play the visual-motor coordination and visual perceptual skills [20]. More recent research shows that speed and accuracy in mouse performance follows a developmental pattern that mirrors development in likely underlying motor control components [17]. Children who had better executive functioning abilities were more likely to control the mouse [15]. More generally, it is suggested that frequency of use of the mouse is important for speed and accuracy in mouse use [17]. Children should be exposed to frequent, repeated mouse experiences in order to promote skill development.

According to the impact of socio-economic disadvantage on computer use competences that young children are developing at home , it was found that these competences are not affected by the income, but mainly are affected by the profession of parents and the time they deal with their children [21]. Another research seems to be influenced by “the child’s age, socio-economic status and cultural resources within families” [22]. Although children in families with fewer resources may have little or no access to the latest technologies in their homes [23], the overwhelming majority of children have contact and interact with technology, which may be earlier.

Children nowadays, even without prior acquaintance, have the potential to interact with computers because of the spontaneous interaction that they have with technology in their everyday life [24]. Surveys reveal widespread use of ICT in homes from which learning emerges which is indirectly and directly supported by family members [25]. Studies also demonstrated that although parental scaffolding is important, children are able to develop computer skills with minimal or no adult guidance, and access to computer technology can promote children’s computer literacy [15].

Furthermore, it is noted that there is few research on what children learn about ICT in the extracurricular environment [21], particularly with regard to early childhood.

As it is apparent from the above, children come to early childhood settings, bringing from home their computers’ use experience. Children’s computer skills emerge from spontaneous and informal contact with computers in their family environment. Describing these computer skills that spontaneously develop, preschoolers or even toddlers can provide useful data for the prospect of using computers in the learning process in the context of early childhood education.

This paper aims at describing the computer skills that children bring to the early childhood settings from the spontaneous and uncontrolled use of computers in the environment of their families without having previously received any specific training. It is intended to create a framework that will describe the pre-existing children's representations for computers, as well as the computer skills of preschoolers. This study aims to contribute to the planning of educational activities by early childhood educators, which will exploit the computers.

The questions posed by this study could be identified as follows:

- To what extent do children from early childhood develop spontaneous computer skills in their daily lives without having received previous targeted practice?
- What basic computer skills are children of this age able to perform?
- Does the age and gender factor affect the above possibilities?
- Are computer skills, obtained in the children's family environment and brought by them into the early childhood education settings, enough to be taken into account so as to exploit computers in future education programs?

2. Methodology

The purpose of this survey was to detect computer skills that children develop spontaneously in their everyday life and that already have possessed during their studies at the early childhood education centers. Early childhood educators, during their apprenticeship, have been interacting with children by using computers, seeking to observe and describe specific skills that children have with the computer. They have been jointly trained for this project, seeking to achieve the greatest possible homogeneity in the recording of observations. For this purpose, a rubric was created in order to assess their observations, which was used by all the participating educators. The reliability of the implementation of the rubric was checked through Cronbach's Alpha statistical control (.857). The software used for the interaction between pedagogues and children were some activities from the GCompris. GCompris is a software suite comprising educational entertainment software for children aged 2 to 10 and it is free and open-source software. The research was conducted in Greece and this makes the results of the research more interesting as they refer to a country which is ranked in the last three countries of Europe, as far as digital development is concerned [26]. The survey was carried out during the period of October 2014 to June 2015, pertained to children aged 3 to 5 years attending early childhood settings in Northern Greece, in urban and semi-urban areas. The survey involved 453 children who were enrolled in 24 different early childhood structures, while their distribution by age of children was 3 years 20.5%, 4 years 48.4% and 5 years 31.1%. Sampling was random and within the limitations of research. The interaction between educators and children through the exploitation of the computer, took place before any organized activity that would include computers, in order to record their pre-existing computer oriented capabilities that the children brought from their family environment. The observations were performed in the context of a playful activity where children were motivated to participate. Children used a laptop with a connected external mouse. Educators, working in the framework of participant observation, recorded the behavior of children by using the rubrics to evaluate children's computer skills. The observation sheet supported by the rubric contained the gender, age, and 25 computer-skills variables that were evaluated on a five-step scale. The observations were collected as a whole for the sample, were coded and recorded in SPSS 21.0 for statistical analysis. For the analysis of the results, descriptive and inferential statistics were used and as a minimum level of significance the * p <0.05 was taken into account.

3. Results

It was found that children recognize the computer as an object and perceive the concepts of the computer's components (S1). Children at a good level recognize and discern concepts such as “mouse”, “click”, “enter”, “keyboard”, “screen”, “speakers”, “microphone”, “printer”, “camera” and "cd-player". So, early enough, children become familiar with different concepts of technology through their family environment. Relatively, boys seem to possess the specific knowledge to a greater extent than girls. It is remarkable the fact that children seem to accept the computer as a particular object which is ho is carefully handled (S2). They are familiar with the ability to turn on/off the computer and shut it down (S3), a skill that boys have more than girls. Also, children are able to handle the mouse (S6), perform “clicking” (S8) skills with ease, a skill in which boys look more familiar than girls. They appear to hold the required capacity to hand-eye coordination (S7). So, they are able to meet the requirements of computers’ control through mouse. It is a skill that emerges from their pre-existing experience with computers in their everyday life. This is the main indication that children in early age come into contact with computer use. However, it is found that when additional parameters are added to the manipulation of the mouse they face some difficulty in procedures such as the succession of the right / left click (S9) or the Drag & Drop process (S10). In the Drag & Drop process, boys have less difficulty, as they seem to be more familiar with computers. Moreover, children appear to be able to use the touchpad as well, however not with the same comfort as the mouse (S22), with which they seem to be familiar from their experience.

Table 1: Mean of Children’s Computer Skills

Computers skills	**Total**	**Mean by age**			**Compare means (age 4)**		
		5	**4**	**3**	**Boy**	**Girl**	**Anova**
S1. Recognizes and discerns the concepts: mouse, click, enter, keyboard, screen, speakers, microphone, printer, camera, cd-player	3,02	3,08	3,10	2,75	3,37	2,86	X2=14,016 F=11,274, P=,001
S2. The computer is treated as an important special, object that is different from any other object and is handled carefully	3,99	4,00	4,01	3,91	3,95	4,07	X2=,753 F=,793, P=,374
S3. Turns on/off the computer and shuts it down	2,81	2,99	2,95	2,20	3,17	2,75	X2=9,125 F=4,309, P=,039

S4. Distinguishes the areas of the keyboard (letters, numbers, function keys, cursor control keys)	3,04	3,40	3,00	2,54	3,26	2,77	X2=12,951 F=10,359, P=,001
S5. Moves the cursor with cursor control keys	2,98	3,26	3,03	2,41	3,24	2,84	X2=8,193 F=5,702, P=,018
S6. Mouse performance, speed, accuracy and ease	3,46	3,66	3,50	3,07	3,71	3,33	X2=7,767 F=6,745, P=,010
S7. Hand-eye coordination	3,65	3,88	3,62	3,36	3,66	3,59	X2=,299 F=,293, P=,589
S8. Use of the mouse, single clicking and double clicking	3,16	3,50	3,16	2,63	3,35	3,00	X2=6,665 F=5,213, P=,023
S9. Distinguishes the right click from the left click	2,71	3,05	2,74	2,12	2,86	2,63	X2=2,908 F=1,607, P=,206
S10. Click and Drag	2,61	2,91	2,64	2,07	2,84	2,46	X2=8,203 F=5,664, P=,018
S11. Understands that different icons in the desktop correspond to different options / programs	2,55	2,59	2,55	2,47	2,63	2,49	X2=1,067 F=,716, P=,399
S12. Inserts a disc into cd-rom drive	3,23	3,31	3,34	2,84	3,54	3,16	X2=7,874 F=3,819, P=,050
S13. Finds specific letters or numbers on the keyboard	3,23	3,60	3,28	2,58	3,37	3,19	X2=1,714 F=1,296, P=,256
S14. Run or Open (Startup) and Exit or logout a program (Click on the “x” icon)	2,10	2,50	2,07	1,57	2,28	1,88	X2=8,913 F=6,160,

							P=,014
S15. Types some single letters or numbers	2,95	3,50	2,94	2,16	2,96	2,91	X2=,122 F=,088, P=,767
S16. Selects a file (from icon) and move it on Desktop	2,05	2,37	2,00	1,67	2,12	1,91	X2=2,450 F=2,001, P=,159
S17. Uses tools of “Photo Viewer” to view images and to navigate through the pictures	2,88	2,76	3,02	2,74	3,17	2,89	X2=4,501 F=2,357, P=,126
S18. Uses Start/Stop button to play a video on Media Player	2,63	2,64	2,68	2,50	2,88	2,49	X2=8,388 F=3,733, P=,055
S19. Uses drop down menus (open/select)	1,76	1,76	1,83	1,55	1,93	1,72	X2=2,158 F=2,038, P=,155
S20. Switches tool palettes (GCompris)	2,10	2,46	2,05	1,60	2,13	1,98	X2=1,149 F=,788, P=,376
S21. Uses the different tools of painting software (GCompris)	2,76	2,99	2,83	2,26	2,89	2,77	X2=,847 F=,634, P=,427
S22. Uses touchpad instead of mouse	2,61	2,78	2,68	2,19	2,82	2,56	X2=3,553 F=1,976, P=,161
S23. Saves a file by saving icons	1,53	1,48	1,57	1,50	1,64	1,50	X2=1,133 F=,973, P=,325
S24. Prints a painting (from Print.. icon)	1,54	1,52	1,53	1,56	1,55	1,51	X2=,083 F=,072, P=,789
S25. Types his/her name	2,63	3,21	2,64	1,68	2,63	2,65	X2=,013 F=,008, P=,931

Despite the cognitive requirements, it was ascertained that children are able to move the cursor on the screen with cursor control keys (S5). This indicates that children of this age have developed the visualization skill required in order to be able to understand the two-dimensional screen. It is noticeable that boys show, in a higher degree compared to girls, the above mentioned ability .

It is based on children's abilities to distinguish the areas of the keyboard (letters, numbers, function keys, cursor control keys), a skill in which boys perform better than girls (S4). Also , they can find specific letters or numbers on the keyboard (S13), as they possess the necessary ability to observe. To a smaller extent they can type these letters or numbers according to their fine motor development (S15). In addition, children can easily insert a disc into a cd-rom drive (S12), as it seems to be a familiar process, in which boys once more show a greater skill. Moreover, children are able to utilize properly formatted painting software, such as Tux-paint (S21), and create their own paintings on the screen. It appears, as well, to fall within children's capabilities the constant perception of symbolic icons, such as the multimedia toolbar, for example the buttons "Start/Stop, pause, next, back" (S17 & S18).

Furthermore, children show that with little difficulty they can perform functions that are not directly exposed to their field of view, such as to use drop down menus (open/select) (S19), or to switch between tool palettes (S20). Given the emerging literacy to a remarkable extent, some of the children seem to be able to type their name (S25). This also highlights the importance that typing could play in the literacy of children of this age.

Additionally, children do not seem to understand the logic of Windows that is associated with complicated handling of more than one movement such as to select a file (from icon) and move it on Desktop (S16), to startup or logout from a program (S14), boys have less difficulty, or to save a file (S23). This happens since they have not been taught the functions of Windows but discovered it spontaneously. They are also not familiar with printing something (S24), which indicates a lack of prior relevant experience. However, through the process of discovering Windows, they show that they begin to understand that different icons in the desktop correspond to different options / programs (S11).

Given that the average age of boys was 4.17 years and girls 4.05 years in our sample, it was chosen to be compared the gender performance only to children aged 4 years (excluding from the comparison those who were 3 years or 5 years old). Through that, it was intended to isolate the effect of gender from the influence of the age of children. It is noted that boys in most of the computer capabilities perform better than girls. However, this difference is mainly related to the skills associated with familiarity resulting from experience. It is therefore concluded that for boys of pre-school age, the computer is a more desirable object compared to girls.

The variable "age" is seen to have a distinct effect on computer capacity, especially for the period from 3 years to 4 years (Table 1). For children older than 4 years, age does not seem to have the same effect, as their performance does not seem to change greatly. The exception is the capability of typing their names as it is influenced by the literacy process (S25). Consequently, it was observed that at the correlation level ($r>0.30$), the "age" variable only significantly affects the capabilities of computers defined by the literacy stage (Table 2). Children's computer skills are therefore determined by age, particularly the ones which are consistent with literacy such as the ability to find specific letters or numbers on the keyboard (S13), to type some single letters or numbers (S15) or to type their names (S25).

Table 2: K-Cluster Analysis / and Correlations with Age

Computers skills	**K-Mean Cluster** **Final Centers**		**Cluster**	**Correlations with Age**
S1. Recognizes and discerns the concepts: mouse, click, enter, keyboard, screen, speakers, microphone, printer, camera, cd-player	2	3	4	r=,097 , p=,039
S2. The computer is treated as an important special, object that is different from any other object and is handled carefully	4	4	4	r=,027, p=,572
S3. Turns on/off the computer and shuts it down	2	3	4	r=,185 , p=,000
S4. Distinguishes the areas of the keyboard (letters, numbers, function keys, cursor control keys)	2	3	4	r=,273 , p=,000
S5. Moves the cursor with cursor control keys	2	3	4	r=,249 , p=,000
S6. Mouse performance, speed, accuracy and ease	3	4	4	r=,191 , p=,000
S7. Hand-eye coordination	3	4	5	r=,177 , p=,000
S8. Use of the mouse, single clicking and double clicking	2	3	4	r=,263 , p=,000
S9. Distinguishes the right click from the left click	2	3	4	r=,240 , p=,000
S10. Click and Drag	2	3	4	r=,244 , p=,000
S11. Understands that different icons in the desktop correspond to different options / programs	2	3	3	r=,037, p=,440
S12. Inserts a disc into cd-rom drive	2	4	4	r=,110 , p=,020
S13. Finds specific letters or numbers on the keyboard	2	3	4	r=,300 , p=,000
S14. Run or Open (Startup) and Exit or logout a program (Click on the "x" icon)	1	2	3	r=,282 , p=,000
S15. Types some single letters or numbers	2	3	4	r=,388 ,

				p=,000
S16. Selects a file (from icon) and move it on Desktop	1	2	3	r=,234 , p=,000
S17. Uses tools of “Photo Viewer” to view images and to navigate through the pictures	2	3	4	r=,001, p=,980
S18. Uses Start/Stop button to play a video on Media Player	2	3	4	r=,036, p=,449
S19. Uses drop down menus (open/select)	1	2	3	r=,078, p=,107
S20. Switches tool palettes (GCompris)	1	2	3	r=,265 , p=,000
S21. Uses the different tools of painting software (GCompris)	2	3	4	r=,211 , p=,000
S22. Uses touchpad instead of mouse	2	3	4	r=,151 , p=,001
S23. Saves a file by saving icons	1	1	2	r=-,002, p=,964
S24. Prints a painting (from Print.. icon)	1	1	2	r=-,006, p=,895
S25. Types his/her name	2	3	4	r=,401 , p=,000
Percentage in each Cluster	37,5%	38%	24,5%	

In order to identify relatively homogeneous groups of cases based on selected computer skills, the statistical test of K-Mean cluster has been applied, in the case of three clusters. According to cluster analysis, there are three groups of children who have similar computer skills profiles. The first group, which interprets 37.5% of the total, is characterized by limited computer capabilities and encounters particular difficulty in using a computer. These are children who are supposed to have little or no experience of using computers in their daily lives. It could be argued that these children are still unable to interact with a computer at this stage of their development, however, it is difficult to adopt this interpretation as we do not know whether these children had computer interaction experiences and still have difficulty in using it. The second group, which interprets 38% of the total, is characterized by moderate computer capabilities, but they do not appear to have difficulty in interacting with the computer. This is the most widespread group where children seem to be able to interact with the computer and with little practice they can use it. Finally, the third group which interprets 24,5% of the total, is characterized by computer skills at a sufficient level that allows children to use computers. These are children who seem ready to use the computer in their learning process as they come into the early childhood education settings with a lot of computer use experience and adequate skills. Given the early childhood and the lack of prior computer education, the percentage of this group is considered important so that it can be taken into account in the planning of future programs.

4. Conclusion and Recommendation

Nowadays, technology's influence in society is growing rapidly, and the debate concerning the integration of new technologies into the early childhood education goes on. The area of early childhood education is subject to great concern regarding the use of computers in children's education, mainly because of the reservations related to their early age. At the same time, the importance of pre-existing knowledge in the learning process of early childhood children is accepted [27, 28]. It is therefore very important for preschool educators to hold the pre-existing knowledge of computers that children bring from their family environment. This research has shown that even in a country lagging behind in digital development, children from a young age develop spontaneous computer capabilities. It was found that children, despite the fact that they were not trained for this purpose, they had developed computer skills from their family environment. Most of the children were able to interact with some basic computer skills to an extent that could be considered educationally exploitable. It seems that children of this age have the degree of development that would allow them to use a computer. Although children are able to interact with the computer, they do not seem to have yet conquered the logic of Windows, given that these skills are not the result of their training, but they spontaneously developed them from their everyday environment. These are pre-existing skills that could be used by early childhood education. If we assume that they were developed spontaneously, then it can be concluded that with their proper practice, there are good prospects for the use of computers in the early childhood education.

The factor "age" appears to affect the development of these skills, up to the age of 4, but at this age it does not seem to play a role. As for the effect of factor "sex", it seems that for boys the computer is an object more popular as they seem to be more familiar and bring more computer experience. The improved performance of boys compared to girls is not documented as an appeal, but it is more likely to be the result of greater PC experience in the family environment.

The contribution of this research is mainly providing an initial framework describing basic computer skills in early childhood. Its results indicate that preschool children obtain from their family environment experiences related to the computer use which they bring with them into early childhood education settings. This research also provides information on computer skills that children of this age hold, and which could be taken into account when designing computer-aided educational programs. Its results also serve to inform educators of preschool children about the pre-existing representations regarding computer use held by children of this age, thus providing them with a stimulus for the use of computers in learning activities. Moreover, it provides data concerning the consultation on whether children in their early childhood can interact with computers.

5. Limitations of The Study

Limitations in this research work are the relatively small number of the children's population, the reduced representativeness as it concerns a specific region of Greece and the absence of a commonly accepted tool for describing computer skills for preschool children. Restrictions on resources and the lack of a pre-existing research tool to detect computer skills in preschool children, have led us to adjustments on our study which are noted in order to be taken into account when the results are being studied. However, it is argued that the results of this introductory research succeed in forming an initial reference framework, which needs further research.

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