

## Sources of Pupils' ICT Knowledge and Skills – Differentiating Factors

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### Abstract

The article presents a part of diagnostic and correlative research of quantitative and qualitative character, locating pupils' information skills in the use of ICT in the context of new technology trends and the accompanying civilizational changes. The considered issues seek answers to the question on the sources of knowledge and skills acquired by pupils in the field of using new technologies. A diagnostic survey (questionnaire and interview) and statistical methods were used. 2,510 pupils were examined and it was established that: 1) numerous pupils' indications, obtained through an open question, allowed for distinguishing as many as 14 categories of sources of information; 2) The pupils mainly locate the sources of ICT knowledge and skills in informal education (61.9%), by the same token diminishing the weight of organised, formal education and the influence of didactic institutions (38.1%); 3) the calculation of differentiating factors revealed statistically significant differences between the sources of ICT knowledge and skills in relation to gender, stage of learning, and place of learning.

**Keywords:** *ICT in education, diagnostic and correlative research, information sources, knowledge building, differentiating factors*

### Introduction

Technological progress is conducive to the development of the media, which gives pupils a wide range of choices of information sources, which in turn form a basis for the construction of knowledge and for the shaping and developing of

skills. Children and adolescents, in addition to traditional sources of information, such as printed materials (books, magazines), radio, television, use a variety of 'new new media' (Levinson, 2013). The development of the path is set by the cultural imperative of global participation in the process of constructing and negotiating symbols, values and meanings, where techniques, machines and tools become pupils' main partners (Gabriel, Röhrs 2017). The cognitive value of the media depends, among other things, on their content, as well as on the transmitters of information. In determining the sources of knowledge and skills, both the tools (the question of "what" is the source, i.e., the cognitive aspect) and the person (the question: "who" communicates information, i.e., the personal aspect). Thus, the question *What are the sources of pupils' knowledge and skills in the use of new technologies?* is very important for educational practice: The answer is important for the understanding of the process of building knowledge, especially in the context of preparing pupils for the functioning in the information society as "creators of knowledge".

## **Research Methodology**

The accepted theoretical basis emphasises one of the possible proposals for shaping and developing information literacy, recognising the foundations of modern teaching and learning in the constructivist theory (with special emphasis on the socio-cultural perspective), pointing to one of the ways of thinking about the formation of knowledge, i.e., learning about ICT methods and tools by means of ICT (Henson, 2015). The theoretical standpoint is determined by: 1) the concepts of critical pedagogy, assuming "the constant opposition to the obvious", visions and goals open to social dialogue; 2) a postmodern approach, including ambiguous emancipation – "ambiguous modernity" and "fluent modernity"; 3) indications for self-education, self-realisation, self-determination and open education. When attempting to identify the pedagogical practice, efforts were made to present educational reality in confrontation with contemporary dominant scientific theories drawing the image of a "new pupil," who exists and realises him/herself in the Internet cyberspace, in the world of ICT tools, enabling multi-sensory information and multi-sensory learning, i.e., a "connected", online pupil with unlimited opportunities of using the new space of e-education. It was assumed that we can speak about the success of teaching when pupils feel accepted and are aware that their problems are noticed and understood. It is then that their minds "open up"

to fully use their potential with which they came to school (Rasfeld, Breidenbach, 2014: 109–115).

At the conceptual stage of the project, it was decided that the undertaken activity would assume the form of quantitative-qualitative, diagnostic and correlation tests (Ferguson, Takane, 1989: 32, 226–246), mainly embedded in media pedagogy. Two techniques were used: 1) a survey based on a questionnaire (Babbie, 2016: 247, 255–264); 2) an open interview directed by dispositions for individual interviews (Frankfort-Nachmias, Nachmias, DeWaard, 2015: 240–265). In the research procedures, in addition to quantitative research, procedures and techniques involving the analysis and qualitative/quantitative explanations were used. Such triangulation created an opportunity to learn more fully, to eliminate cognitive errors and to capture problems (on the borderline of education, technology and computer science) from two different points of view. While developing the results of empirical research and formulating the resulting conclusions, it was necessary to also use statistical methods. By using the chi-square test of independence, the calculations allowed for determining the factors differentiating the studied class of phenomena.

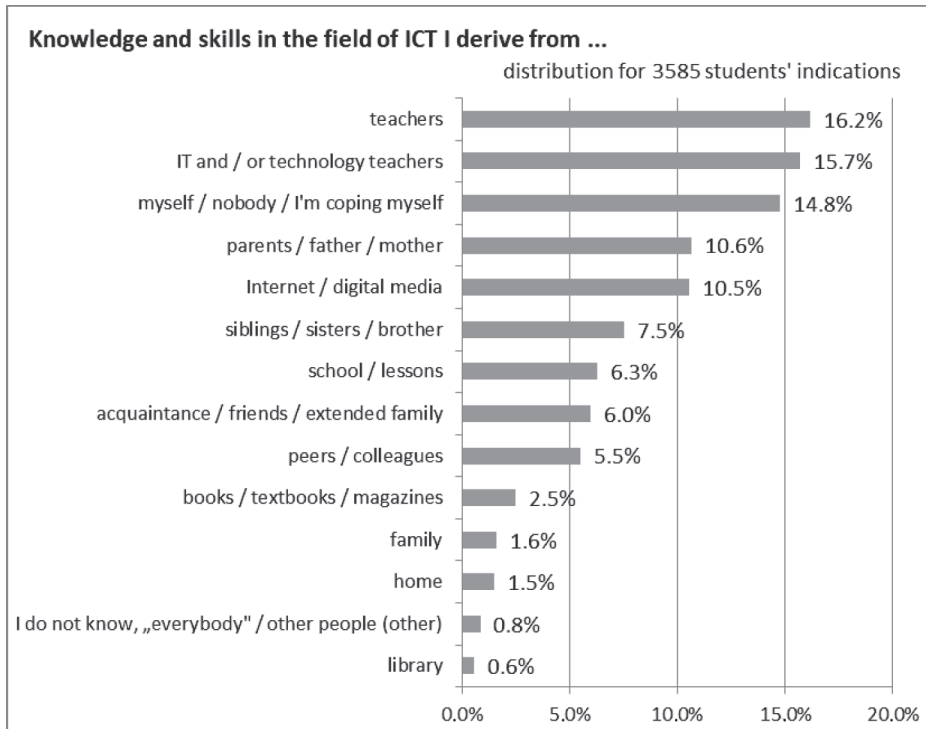
The 2015 research (questionnaire) was applied to pupils in Zielona Góra and some selected facilities of the Lubusz Province and the neighboring provinces, including pupils at four stages of education. Interviews with 40 pupils in Zielona Góra and nearby towns (from 4 different stages of education: 10 from each type of institution) were conducted. The entire research group comprised **2,510 pupils**.

Within the main problem (what are the pupils' information competences in the use of ICT methods and tools in the context of new technological trends and the accompanying civilizational changes?), one of the detailed questions was related to the establishing of the scope of knowledge, understanding and the use of new trends in ICT and to the reflection on undertaken (or not undertaken) activities in the field of ICT implementation. Focusing on motivating factors, the problems directed the description, explanation and interpretation of pupils' reflections. Therefore, the results presented in this article relate to the establishing of the pupils' sources of knowledge and skills in the field of new technologies and factors differentiating their beliefs and experiences in this area.

## **Research results and discussion**

In an open question (in order not to limit the possible answers to a closed list of categories), the pupils were asked from where (from whom) they gain knowledge and skills in the use of ICT. 2,256 (89.9%) provided feedback. Numerous indica-

tions made it possible to isolate as many as 14 categories. When providing sources of information, the pupils often enumerated a selection, e.g.: “At first, I learnt on Computer Science lessons, then my mother and sister showed me more. I also learnt myself. I also looked at my sister, how she played and used ICT”. Hence, the results obtained relate to the frequency of pupil indications (Figure 1).



**Figure 1.** Sources of knowledge and skills acquisition by pupils in the field of using new technologies (incidence of occurrence distribution by percentage).

Analysis of open statements revealed a heterogeneous array of experiences, beliefs and even expectations as to the sources of knowledge and skills. The children and adolescents reveal that they learn about new technologies primarily from their teachers, especially teachers of Computer Science. These responses occupy the first two places in the frequency of occurrence – altogether constituting almost a third (31.9%) of all indications. This attests to the pupils’ being convinced about their role and professional didactic function – in line with the person-based approach, where the term “teacher” has always been associated with a person

who teaches and performs educational functions. “Great knowledge” is a positive, foremost sign in the identification of the teaching profession. The obtained results also attest to building trust and credibility and establishing a kind of “partnership” in order to learn. These pupils perceive the authority, dependence on someone “superior” (Day, 1999: 183, 184), i.e., in their eyes, the teacher, acting as an expert, is a reliable source of information supporting the building of knowledge. At the time of “authority loss”, this result (Pace, Hemmings, 2007: 4–27) is reassuring and gives hope that for many pupils, teachers are valued and significant people in their lives. In this way, pupils give a good testimony to their teachers, confirming their expertise in performing professional tasks. And it is not easy at all, as being a teacher immersed in the changes of the postmodern world is a real challenge. This is evidenced by the multiplicity of discussions about the sense and perspectives of educational work, at a time when the question of upbringing as such, seems to be more and more chaotic and appears to become increasingly difficult (Speck, 2005: 12).

It is also comforting that children and adolescents do not avoid independent learning. We can speak here about self-learners and self-study, and even about cases of spontaneous development and constant need for (self-) lifelong learning. The “myself” category reveals desirable curricular (in line with the objectives of the *Core Curriculum*) self-study attitude, classified here as third (14.8%). Independence in building ICT knowledge proves that the pupils manifest a sufficiently high level of competence. It proves their readiness to undertake tasks based on personal activity in the area of solving cognitive information and ICT tasks.

Every tenth respondent (i.e., approx. 10%) stated that they derived their knowledge and skills either from their parents (in this regard, natural trust and authority of the mother and/or father) or from online resources. Network resources, constantly developing cognitive methods and ICT tools are culturally valuable cognitive instruments for these pupils, building environments for learning ICT by means of ICT. Subsequently, as a source of ICT knowledge and skills (less than 7.5% of the indications), the pupils listed: siblings (sister and/or brother), school, friends, peers, family, home and library.

By grouping the results into broader categories, we can conclude that the sources are mainly found in informal education. If we include in this scope statements pointing to parents, siblings, acquaintances, close and distant relatives, peers, self-help and the Internet as well as books, library and “other” people, then they will account for more than half of the feedback (61.9%). Despite the fact that teachers occupy the first places, in total, the children and teenagers give less importance to formal education, diminishing the importance of organised educational processes

and the impact of educational institutions. This area, i.e., teachers, school, lessons, accounts for the total of 38.1% of the responses. The obtained result confirms the global tendency in the growing importance of non-formal education (interconnective learning) - in line with the idea of lifelong learning, which in turn results directly from ICT development, which gives more and more tools and opportunities to acquire and supplement knowledge on any topic of interest, anywhere, anytime (cf., Feng, Ha, 2016: 1653–1663). It is worth emphasising the important role of family home, as every fifth pupil, 761 (21.2% of the respondents), declares that they point to the closest family. A similar number, 710 (19.8%), point to peer groups (peer tutoring). However, it is difficult to clearly state to what extent the pupils learn from adults, including teachers, and how much they learn from each other in the digital environment (peer learning). The multiple statistics concerning the young generation, disclosed in various reports (reports, analyses), seem to provide mutually contradictory information.

The established data (Table 1) and the calculations performed by means of Chi-square independence test allow for concluding that among **the differentiating factors** analysed, such features as: gender, stage of education, and pupils' place of study revealed significant statistical differences. Before the statistic calculations, the number of categories was reduced from 14 to 11. The least abundant categories were added to others (with higher frequency of indications) as follows: 1) "library" with "books, textbooks, magazines"; 2) "I do not know, from 'everybody'/other people (others)" with "acquaintances, friends, distant relatives"; 3) "home" with "family". The detailed distribution of numbers reveals the following:

### (1) Gender

[Result TEST.CHI:  $\chi^2 = 114,55 > \chi^2_{(\alpha=0,01; df=10)} = 23,21$ ;  $p = 6,41825E-20 \Rightarrow H_0$  rejected]

When asked where (from whom) they obtain ICT knowledge and skills, the girls more often (in comparison with the boys) indicated IT teachers, as well as home, parents, siblings and acquaintances. On the other hand, the boys (more often than the girls) stated that they were coping themselves, and that they learned about the modern technology from the Internet, from school, printed sources and from their peers. Generally speaking, we can conclude that girls acquire their ICT knowledge and skills primarily from formal education (mainly learning from their IT teachers) and building knowledge in the home environment. In turn, boys identify their competence development in the use of ICT with self-help and the use of network resources (cf., Volman, 2005: 35–55).



**Table 1. cont.**

Differ- entiating factors	Sources of knowledge and skills in the field of ICT																							
	Teachers		IT/ Tech- nology teachers		School		I'm coping myself		Siblings		Parents		Home		Ac- quaint- ances		Peers		Books/ Maga- zines		Total			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%		
<i>Total</i>	579	16.2	563	15.7	225	6.3	529	14.8	269	7.5	381	10.6	111	3.1	244	6.8	378	10.5	197	5.5	109	3.0	3585	100.0
Village (<2 thou- sand)	220	18.7	202	17.1	66	5.6	188	16.0	86	7.3	96	8.1	26	2.2	65	5.5	103	8.7	86	7.3	40	3.4	1178	100.0
Country town (2-10 thousand)	116	15.7	104	14.1	37	5.0	95	12.9	79	10.7	90	12.2	32	4.3	51	6.9	67	9.1	42	5.7	25	3.4	738	100.0
Small town (10-25 thousand)	79	14.7	59	11.0	44	8.2	99	18.4	38	7.1	45	8.4	17	3.2	37	6.9	79	14.7	24	4.5	16	3.0	537	100.0
Medi- um-size city (25-100 thousand)	69	10.8	134	21.0	35	5.5	91	14.3	41	6.4	74	11.6	24	3.8	59	9.3	68	10.7	30	4.7	12	1.9	637	100.0
Big city (>100 thousand)	95	19.2	64	12.9	43	8.7	56	11.3	25	5.1	76	15.4	12	2.4	32	6.5	61	12.3	15	3.0	16	3.2	495	100.0
<i>Total</i>	579	16.2	563	15.7	225	6.3	529	14.8	269	7.5	381	10.6	111	3.1	244	6.8	378	10.5	197	5.5	109	3.0	3585	100.0



## **(2) Type of educational institution (education stage)**

[Result TEST.CHI:  $\chi^2 = 750,49 > \chi^2_{(\alpha=0,01; df=30)} = 50,90$ ;  $p = 1,4134E-138 \Rightarrow H_0$  rejected]

Comparing the determined figures in individual categories with reference to educational stage, we may conclude that: the youngest children (early-school education) assign the most important role to their teachers, parents and siblings. Elementary school pupils point to home learning environment. Lower-secondary school pupils prefer to independently acquire and supplement ICT knowledge and skills as well as point to IT teachers and peers. At the upper secondary level, digital environment (Internet) and school, friends and printed sources (books, magazines) are valued as highest. The general tendencies in relation to education stage, allow us to conclude that: 1) downward trends: with age (ascending education), parental and home educational participation and support are reduced, and so is the authority and trust in this regard; 2) upward trends: the older the children (the higher educational level), the more they appreciate the digital learning environment (Internet sources) and the assistance of school (educational institution); with time, also awareness of the need for independent planning and organising the process of learning about ICT (self-education) develops; also the importance of cooperation with peers increases significantly; 3) specific directions: at the beginning of the educational path, the teacher's authority, from the perspective of a reliable source of information about ICT, is high. Then, at the primary and lower-secondary levels, it gradually decreases, and at the highest educational level grows again – here the mandate for trust somehow returns and adopts the same scope as at the primary level; the highest confidence in learning about new media with the support of formal education (planned and organised activities of educational institutions and cooperation with teachers) is revealed by the youngest (children of early-school education) and the oldest (upper-secondary level).

## **3) Place (environment) of learning**

[Result TEST.CHI:  $\chi^2 = 154,36 > \chi^2_{(\alpha=0,01; df=40)} = 63,69$ ;  $p = 2,39366E-15 \Rightarrow H_0$  rejected]

When comparing the determined figures in particular categories with reference to the place of study, we may conclude that: pupils attending rural schools ascribe the greatest role to gaining knowledge and skills about new technologies from their teachers, peers and paper materials. The children and young people from small towns (2–10,000) most often declared that they learned about practical application of ICT tools at home and in cooperation with siblings. Also, printed sources (books, textbooks, magazines) are very important in obtaining infor-

mation about ICT. The respondents from small towns (10–25 thousand) prefer learning network environment (Internet) and self-help (independent acquisition of information about technological novelties). The people studying in midium-size cities (25–100 thousand) most often pointed to IT teachers as well as friends and acquaintances. In large cities (over 100,000), the pupils pointed mainly to the supporting role of teachers and the school as well as parents. In general terms, we can distinguish: 1) a downward trend: the bigger the place where the school is located, the less frequent is the benefitting from peer support; 2) specific directions: learners in the smallest locations (in villages, up to 2 thousand inhabitants) and in the largest (large cities, over 100,000 inhabitants) demonstrate the highest level of trust in teachers and their supporting role in constructing knowledge about new media. The same result was obtained in the sphere of formal education (with the respondents pointing to “pupils”, “teachers”, “IT teachers” and “school”); the respondents attending schools in small towns (up to 10,000 inhabitants) most often use professional materials issued on paper; the pupils from the largest cities (over 100,000 inhabitants) most often (in comparison with other people learning in smaller cities) obtain knowledge and skills in using ICT from their parents (thus revealing their adequately high level of IT and information competences); the group of pupils from small town educational institutions (2–10 thousand inhabitants) mostly prefer support from home environment (i.e., ‘siblings’, ‘parents’ and ‘home’); for the pupils from of medium-size cities (with a population of 25–100 thousand) the rank of cooperation with friends in the field of obtaining information about ICT and the practical implementation of digital tools is the highest.

## **Conclusions**

The presented results of the analysis of open statements of 3,585 respondents revealed a broad spectrum (creating 14 categories) and significant diversity (gender-conditioned, educational stage and learning environment) of the pupils’ experiences, beliefs and expectations about the sources of ICT knowledge and skills acquisition, they revealed where and from whom they can obtain support, who they want in everyday learning situations at school and during out-of-school training (cf., research findings: Wrońska, Lange, 2017: 23, 24).

The presented research revealed children’s and adolescents’ positive attitudes to technological changes. They divulge attitudes full of optimism and openness to all technical innovations. When learning about ICT, they use many and various (depending on the level of development) sources of help and support. Knowledge

and skills in the use of new media find their way to pupils primarily through informal education. Although the indications for the supporting and caring role of teachers occupy the first places, in total, the pupils assign much less importance to formal education, significantly reducing the importance of organised educational process and the impact of educational institutions. The family home (the closest family) and peer groups (peer tutoring, peer learning) play an important role in building ICT knowledge. Through such generalisations as “I learn by myself”, the children and adolescents often betray their inclination to self-education (cf., Aesaert, Braak, 2014: 327–341). The fact that they tend to prefer their own initiative and various forms of individual self-education (mainly obtaining ICT information from online resources) over organised and targeted forms of education, shows that they see a wide range of independent knowledge and practical skills in discovering ICT through ICT, thus noticing, unlike teachers (cf., Baron-Polańczyk, 2014: 184–185), the foundations of modern learning within the constructivist and cognitivist theory, as well as taking into account the formation of knowledge about ICT methods and tools by means of this very technology.

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