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MARLENA PLEBAŃSKA

University of Warsaw

Digitisation of Polish Schools Based on the "Polish School in the Digitisation Era. The 2017 Diagnosis" Survey in the Context of the Necessity of Implementing the STEAM Model of Teaching

ABSTRACT: Marlena Plebańska, *Digitisation of Polish Schools Based on the "Polish School in the Digitisation Era. The 2017 Diagnosis" Survey in the Context of the Necessity of Implementing the STEAM Model of Teaching*, Interdisciplinary Contexts of Special Pedagogy, No. 23, Poznań 2018. Pp. 53–70. Adam Mickiewicz University Press. ISSN 2300-391X. DOI: https://doi.org/10.14746/ikps.2018.23.03

The author of the paper presents the concept of teaching in the STEAM model in relation to the necessity of building competence of tomorrow among pupils of primary schools and even preschools. The author sets forth the status of digitisation of Polish schools in the light of the most extensive Polish digitisation survey: the 2017 Digital Diagnosis. The author primarily discusses the conclusions from studies pertaining to the status of digitisation of the Polish schools in the context of implementation of the STEAM model as a concept for developing competence of tomorrow. Results of studies conducted in June 2017 among pupils, parents and teachers are presented. The study was prepared and conducted by a team of researchers/ academic employees of the Faculty of Education at the University of Warsaw in cooperation with PCG Edukacja under the supervision of the author of this paper. The study encompassed 100,129 respondents from primary schools, middle schools, high schools, technical schools and vocational schools from all provinces in Poland. The full report presenting the study results is available on website: https://www.

librus.pl/doradca-dyrektora/informacje-prawne/organizacja-pracy-szkoly/stan-cyfryzacji-polskich-szkol-ku-refleksji-raport-2017/

KEY WORDS: STEAM, competence of tomorrow, digital education technologies, digital school

Competence of Tomorrow

Wishing to determine the shape of the modern education, one often asks the following questions: in which direction should the modern education go? What kind of employees are needed at the labour market? Which competence should the future employees be provided with? At which stage of education should development of the competence of tomorrow be started? What is the impact of trends in the world economy on the teaching of children? These are just sample questions; their number could easily reach 100; nevertheless, they strongly pinpoint the vital interrelation between the economic development and education. Modern economy is characterised by constant changes, intense development of digitisation and progressing automation, the advent of artificial intelligence, as well as huge emphasis on the mastering of social competence, such as, for example, design work, work in virtual teams or work in a multi-cultural environment. There are a number of studies whose authors try to define the competence with which a modern pupil should be provided. One of such studies is the Future Work Skills 2020 report, prepared by the Institute for the Future (IFTF), which lists professional skills of tomorrow (2020). The study that underlies the report was performed in 2011 by the IFTF researchers and the University of Phoenix Research Institute. The report lists six major factors that influence the development of society in the next years, such as: extreme longevity, development of smart machines and systems, calculable world, new media eco-system, organisational super-structures, globally connected world. The report also presents ten types of future skills with which the pupils should be equipped: inter-cultural competence, work in noise, concluding, emotional

intelligence, cooperation in a virtual environment, data processing, adaptation skills, project-based thinking, interdisciplinarity, digital competence. On the other hand, the publication entitled "Miejsce pracy w 2020 r.: Jak innowacyjne firmy przyciągają dziś pracowników jutra, wspierają ich rozwój i zatrzymują" ("Work place in 2020: How Innovative Companies Attract Future Employees, Support Their Development and Retain Them"), devoted to creation and implementation of long- and mid-term strategies in the area of HR, presents a list of most important factors affecting changes. The authors describe ten of them:

1. *Demographic change:* at the end of this decade, i.e. around 2020, five generations of employees may work next to one another in a single work place for the first time in history. The authors describe these generations in the following manner: traditionalists (born before 1946), children of the post-war boom (the so-called *baby boomers* born between 1946 and 64), generation X (born between 1965 and 1976), generation of the last twenty years of the 20th century (born between 1977 and 1997) and generation 2020 (born after 1997).
2. Knowledge-based economy: the authors explain that in 2010, companies in the USA hired employees capable of creative thinking twice as frequently as employees who were only capable of copying typical activities. The term "knowledge-based economy" in the area of HR is understood by the authors primarily as flexibility of the employer and the employee in adjusting to the ongoing changes, the ability of acquiring new qualifications and simultaneous development of "hard" and interpersonal skills.
3. Globalisation: ease in outsourcing and remote employment result in changes in the local and global employment structure. The authors illustrate this factor by the examples of IBM and Procter & Gamble.
4. Digital work place: digital information about the professional and private life plays a growing role. New IT platforms and protocols appear, whereas issues of security of personal and corporate data are gaining significance.

5. Omnipresence of mobile technologies: emphasis on independent searching for useful information is growing, along with establishment and maintenance of contacts from any place in the world. Cases of Bank of America, Invitrogen and Wachowia are quoted as companies implementing platforms for remote training with the use of smartphones.
6. Communication culture: the authors use this term to determine the need of constant Internet access in order to fulfil the professional obligations, social needs, searching for information and expanding competence.
7. Participation society: this term in the book is used to determine the society where cooperation and knowledge sharing are flourishing.
8. Social learning: *this is* a process strongly integrated with the development of new technologies, such as *peer-to-peer chats,* social networking sites, video-blogs or dedicated e-learning platforms.
9. Corporate Social Responsibility (CSR): reflects a growing significance of non-financial impact of a company on the society.
10. New generations at work: these are employees who expect a completely different mode of integration at work than prior generations.[1]

On the other hand, the World Economic Forum built a ranking of competence which features the following skills prepared in Poland by MonsterPolska.pl.

Complex problem solving: unwaveringly occupying the top position on the list. This is the ability to analyse multiple data and information, make decisions and implement solutions. In the future, its significance may drop in more automated sectors such as infrastructure and power energy, yet it will grow in services and IT.

Critical thinking: the ability of logical reasoning and cool analysis is gaining significance. In the era of advanced technologies and

[1] http://www.pi.gov.pl/PARP/chapter_86199.asp?soid=C8A49387D2884B7B80AA8E3099BE0199

complex solutions, a person who is capable of approaching a situation critically and evaluating it will be very previous.

Creativity: went up from the 10th position in the ranking. This ability will be absolutely essential not only in industries with which it is associated today, i.e. the media or entertainment, but everywhere. Work will await people who think in a non-standard manner, as they will be able to come up with new services and products in rapidly changing times.

People management: this feature and the next one show that team work will gain significance at the labour market. Employers will need leaders: empathic, in control of body language and able to communicate with people.

Coordinating with others: the report defines it as the "ability to adjust own decisions and behaviour to the behaviour of others." Thus, it entails certain flexibility, not sticking to one's opinion and openness towards co-workers.

Emotional intelligence: a novelty in the ranking. Research confirms that higher emotional intelligence translates to better productivity. A person with such competence is capable of recognising and naming own emotions and emotions of others. Thus, such person can easily solve conflicts and reduce tension.

Judgement and decision-making: the employee of 2020 has to be independent. Waiting until somebody else handles the problem is not a good strategy. Work in the future will require the ability of making difficult decisions quickly.

Service orientation: in other words, this is the pro-customer attitude. An employee focused on helping others will be sought on the market. This is both about team work and work with clients.

Negotiations: conflict-free problem solving and ability of reconcile various views and stances dropped in the breakdown of the World Economic Forum, yet it still counts.

Cognitive flexibility: assumes the possibility of finding and combining various ideas and data. The capacity for seeing connections among ostensibly alien items guarantees development for

companies. Work in the future will greatly rely on choosing best among thousands of ideas.[2]

The above-listed examples of defining the factors impacting changes in trends on the labour market and the attempt of pinpointing the competence of tomorrow independently from the adopted classification strongly emphasise the fact that the two main groups of competence which will be indispensable for the present-day pupils in the future are the social competence and the digital competence.

STEAM: how to mould the competence of tomorrow?

STEAM is the mode of teaching known around the world for several years, focused on satisfying the actual needs of the 21st century economy by developing the competence of tomorrow. STEAM is an approach to learning which puts emphasis on project-based learning consolidating five key thematic blocks: science, technology, engineering, art and mathematics. STEAM is focused on teaching students who, in effect of implementing STEAM projects, are capable of thinking in an innovative and non-standard mode, who take prudent risks, are engaged in experimental learning, creative problem solving, undertake cooperation and actively participate in creative processes.

The STEAM philosophy reflects the concept:
STEAM = Science & Technology interpreted by Engineering & the Arts, relying on Mathematics

STEAM is an educational initiative created by the Rhode Island School of Design, which added arts to the original STEM structure. According to the Rhode Island School of Design, the purpose is "support of true innovation, which combines the scientist's or technologist's mind with the concept of an artist or a designer." Adding arts to the original STEM concept is important due to the fact that it

[2] https://sukcespisanyszminka.pl/kompetencje-przyszlosci/

sets a natural direction for the processes of cognition and creation and engages all of the pupils' potential and entire brain in the process of learning. As can be seen on the diagram presented below, the original STEM model used only the left hemisphere responsible for thinking and reasoning, logical thinking, analytical processes, mathematical calculations, recognition of items with the use of touch, writing, i.e. four areas from our model (STEM); only after supplementing it with the letter A – meaning the area of arts, introduced the use of the right hemisphere responsible for abstract thinking, being guided by intuition, being creative, coming up with atypical ideas, spatial imagination and being an artist.

Diagram 1. Brain: activation during work in the STEAM model

Source: https://www.bricks4kidz.com.au/sydney-miranda/steam/

Thus, it is only the full STEAM model that allows the pupils to use their full potential and for shaping the competence of tomorrow.[3] STEAM is adequate for every level of teaching and may be successfully introduced both at the stage of preschool education, in primary schools, middle schools and at university level education. STEAM projects around the world are most often applied in primary schools and in middle schools. Many British schools use the STEAM model implementing interesting projects, such as, e.g., a system for designing bird feeding in school gardens or a system of plant watering. Polish schools are also implementing STEAM projects and the very first examples may already be noticed, e.g. in Primary School No. 6 in Września or in complex of schools No. 6 in Jastrzębie Zdrój. The possibility of implementing STEAM projects predominantly depends on the technological infrastructure of the Polish schools and the level of preparation of teachers for their implementation. The status of preparation of Polish schools to implement innovative education with the use of digital technology is presented in the analysis of results of the largest Polish study on the digitisation of Polish schools "Polish School in the Digitisation Era. The 2017 Diagnosis."

Are the Polish schools ready to implement the innovative teaching of the competence of tomorrow? Results of study "Polish School in the Digitisation Era. The 2017 Diagnosis"

Selected issues from the "Polish School in the Digitisation Era. The 2017 Diagnosis" study are presented below. They show the condition of digitisation of Polish schools and their level of preparation to introduce innovative methods of teaching by building competence of tomorrow, such as STEAM.

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[3] M. Plebanska, "Meritum" 4/2018.

Digitisation Level of Polish Schools

50% of pupils participating in the study declare that their schools apply no digital technologies. 50% claim that multimedia aids are used in the didactic process in which they participate (Diagram No. 2). Teachers evaluate the efficiency of classes with the use of digital technologies on a good (approx. 48%) and very good (approx. 23%) level and they claim that digital technologies most often are an attraction for pupils, a diversifying element, enriching the classes. Teachers also say that pupils do not treat the use of digital technologies fully seriously, and consider them more as supporting material. Thus, as far as increasing the attraction of classes is concerned, this material performs well, but when attraction is taken into account, the correlation is no longer so obvious. (oryg.: Zatem jeśli chodzi o zwiększenia atrakcyjności zajęć dydaktycznych ten materiał sprawdza się, zaś jeśli mówimy już o atrakcyjności korelacja nie jest już taka oczywista.)

According to teachers, use of modern technologies during classes is definitely more common. 90% of teachers claim that they use modern technologies in the didactic process.

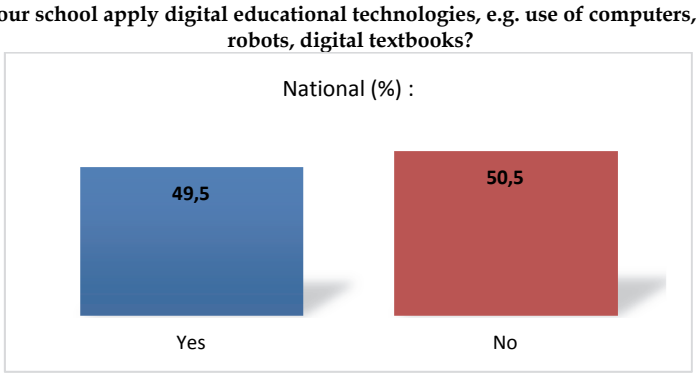

Diagram 2. Use of digital technologies in schools

Source: Report Polish School in the Digitisation Era. The 2017 Diagnosis.

A small group (10% of all respondents) which does not use digital resources at work with pupils most probably experience equipment difficulties or technical problems with Internet access. However, the discrepancy between the teachers' responses and the pupils' claims, reaching approx. 40%, is quite worrying. This result is probably influenced by teachers' knowledge: they are aware of how classes with the use of digital technologies should look and how they look in reality. The teachers are aware of which factors affect the efficiency of classes and if their potential at school is limited, they may conduct classes in a limited scope.

In your opinion, do digital educational technologies support the education of children and youth?

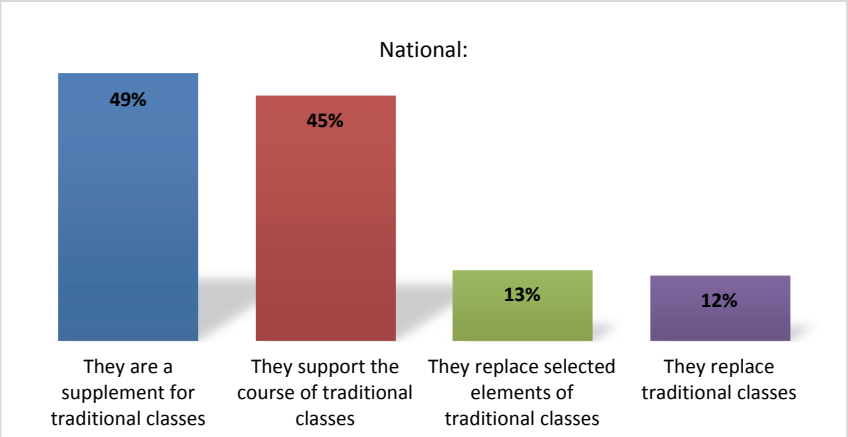

Diagram 3. Use of digital technologies at schools in parents' opinions

Source: Report Polish School in the Digitisation Era. The 2017 Diagnosis.

On the other hand, parents believe that digital technologies support the education of children and youth (48%), supplement traditional classes (45%) and support their course. Parents are in favour of using digital technologies in education and are not afraid of the fact that their children, apart from using traditional (well known to parents) didactic aids and tools, also use digital tools.

However, parents treat education with the use of digital technologies not as the main leading trend in education, but as a supplement for the traditional classes. A very small group of parents believe that digital technologies/ digital teaching are replacing or could replace the traditional forms and methods of education. Parents see the possibility of using digital educational technologies as a support in the education of their children, both at school and at home. Parents' general approach to the use of digital technologies in education of their children does not feature differences as far as educational level is concerned (the situation is evaluated similarly by parents of primary school pupils, middle school pupils, students of vocational schools, general high schools and technical schools). Parents believe that digital technologies increase both the efficiency and attraction of classes, whereas they evaluate their impact on the attractiveness of classes much higher. Parents highly assess the impact of using

How can digital technologies support a child's education?

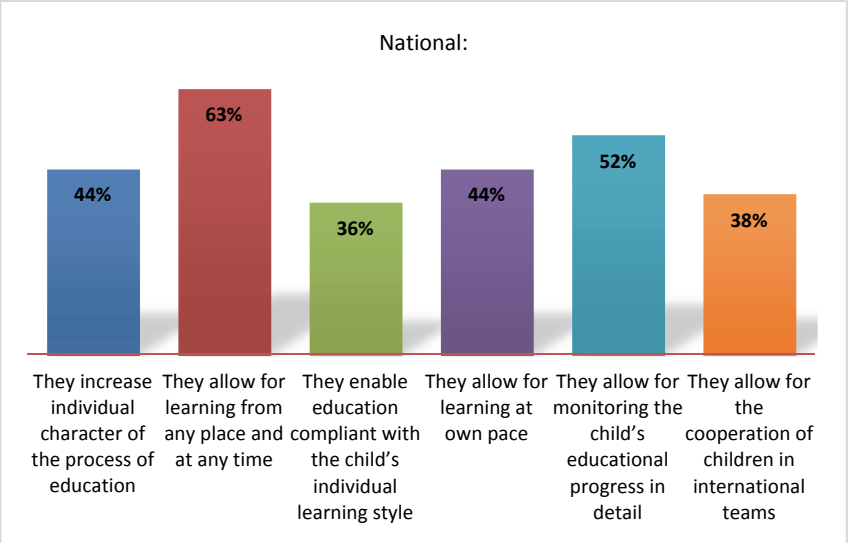

Diagram 4. Role of digital technologies in the process of teaching

Source: Report Polish School in the Digitisation Era. The 2017 Diagnosis.

digital technologies on the possibility of learning from any place and at any rate and individualisation of the process of education of children and youth.

Equipment of Computer Labs

Teachers declare that almost all computer labs are equipped with computers (96%). 75% of labs are equipped with projectors, 45% with interactive boards and only 5% with tablets. Labs are provided with specialist equipment extremely rarely, i.e. robots, blocks for programming, sensors, interactive maps, visualisers, glasses for augmented reality, etc. The equipment of labs, in the opinion of teachers, is on a good (41%) and very good level (14%). 30% of teachers describe it on the average level.

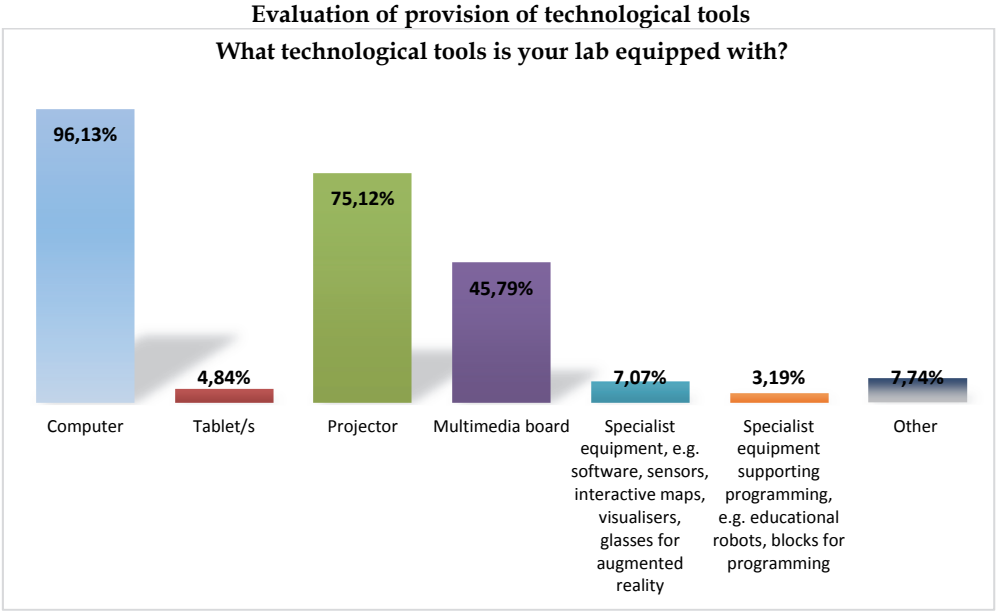

Diagram 5. Technological tools at school

Source: Report Polish School in the Digitisation Era. The 2017 Diagnosis.

On the other hand, parents – when listing technological tools adequate in their opinion to be used in education – indicate solutions/ tools that they are familiar with, and which they often use at work. Parents consider computers and multimedia boards most popular tools; the use of tablets, smartphones and programming tools is evaluated much worse. This result shows that parents do not understand the principles of using individual tools in education and benefits resulting from the use of individual tools. Very interesting indices are related to the use of electronic textbooks and digital educational resources. It seems very optimistic that the respondents of the study see greater potential in the use of digital resources rather than typical e-books. Parents also believe that the application of digital technologies in education increases the pupils' engagement in the educational process. Only few parents evaluated the potential of digital technology as low in improving pupils' engagement in the educational process and broadly understood development.

Access to Internet

A satisfactory aspect of changes in the Polish schools is access to the Internet: in the majority of cases, it is evaluated on a good (42%) and very good (27%) level. Majority of pupils use own Internet access in school premises (52% of respondents). 27% of respondents do not have Internet access at school. 23% use the school wireless network. Wireless Internet functions best in technical schools (33%) and worst in middle schools (20%). In middle schools, the percentage of respondents declaring complete lack of access to wireless Internet (oryg: W gimnazjum odsetek ankietowanych deklarujących całkowity brak dostępu do bezprzewodowego Internetu). The majority of students evaluate access to the Internet at schools as average (32%). 30% claim that is very good or good. 38% assess it as weak and very weak. Students in vocational schools (22%) evaluate Internet access as the worst; the best is in technical schools (35%).

Access to wireless Internet is evaluated by majority as average or weak (58%). 8% assess it as very good, 12% as very weak. Students of vocational schools and middle schools evaluate access to wireless Internet as weakest (15% of students from these facilities claim that it is very weak).

Teacher refer to the provision of schools with Internet access in a much more favourable manner than the students. The majority of teachers evaluate access to the Internet on a good (42%) and very good (27%) level. Every third respondent (33% of indications) may also use wireless Internet available for students and teachers.

How do you evaluate Internet access for the students in your school?

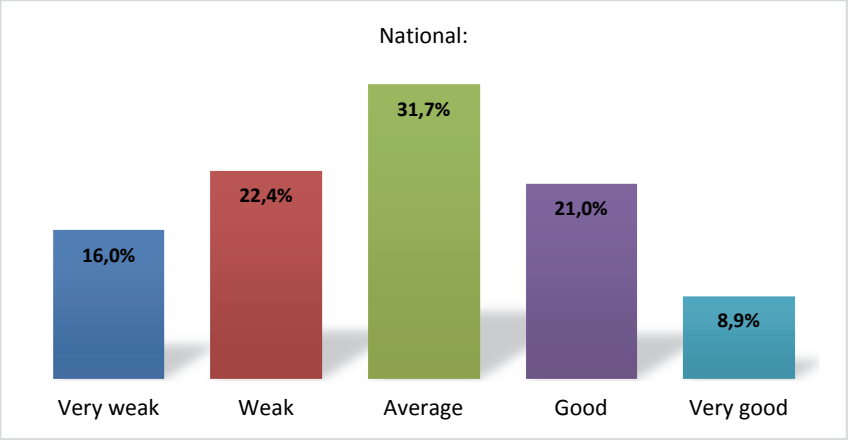

Diagram No. 6. Internet access in schools

Source: Report Polish School in the Digitisation Era. The 2017 Diagnosis.

The OSE project has had great significance for the full use of the potential of digital education. As shown the studies of the Ministry of Digitisation, nowadays only 10% of schools and educational facilities in Poland have Internet access with parameters that allow for its use for didactic purposes. Providing all schools with quick and safe Internet levels the educational opportunities and is an investment in the future.

Implementation of the governmental OSE project will constitute a civilisation change for the Polish schools. Safe Internet in every school is an opportunity for levelling access to knowledge, development of new forms of teaching and acquisition of competence, both by students and by teachers. The OSE project was created by the Ministry of Digitisation and its operator is NASK the State Research Institute.[4] Definitely, subsequent diagnoses of digitisation after the OSE project will show significant changes in this area of digitisation.

Multimedia Tools in Didactics

The most frequently used multimedia tool is the computer (34% of respondents provided such answer). The second place is occupied by the multimedia board (26%) and the third one by smartphone (18%). Only 2% of pupils declare the use of tablets at school. Measuring interface, programming blocks and robots are used in educational facilities by approx. 1% of respondents.

Teachers declare that during the didactic process, they most often use the computers (99% of indications) and interactive boards (56%). They use smartphones (30%) and tablets (12%) less frequently. Least indications referred to measuring interface, robots, programming blocks (2-3%). A positive conclusion from the conducted study is the fact that the teachers use all the above-listed digital educational technologies. However, during school classes teachers most often use multimedia presentations (87.7%) and engage pupils (56.7%) in creating them or preparing digital materials at home. They also frequently use the interactive board (48%), multimedia materials and interactive exercises. Thus, it may be assumed that classes have a traditional structure, organisation and course where the teacher is the most active, sharing knowledge or assessing the knowledge of his/ her students (use of interactive quizzes on the level of 41%). Even educational games were indicated only on the level of 20%.

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[4] https://ose.gov.pl

According to students, primarily multimedia presentations are used during classes (17%), films and animations (15%), tables, illustrations (14%), articles and information from the Internet (13%), digital textbooks (10%) audio materials (7%), games and quizzes (7%). Only 3% of students use mobile apps and e-books.

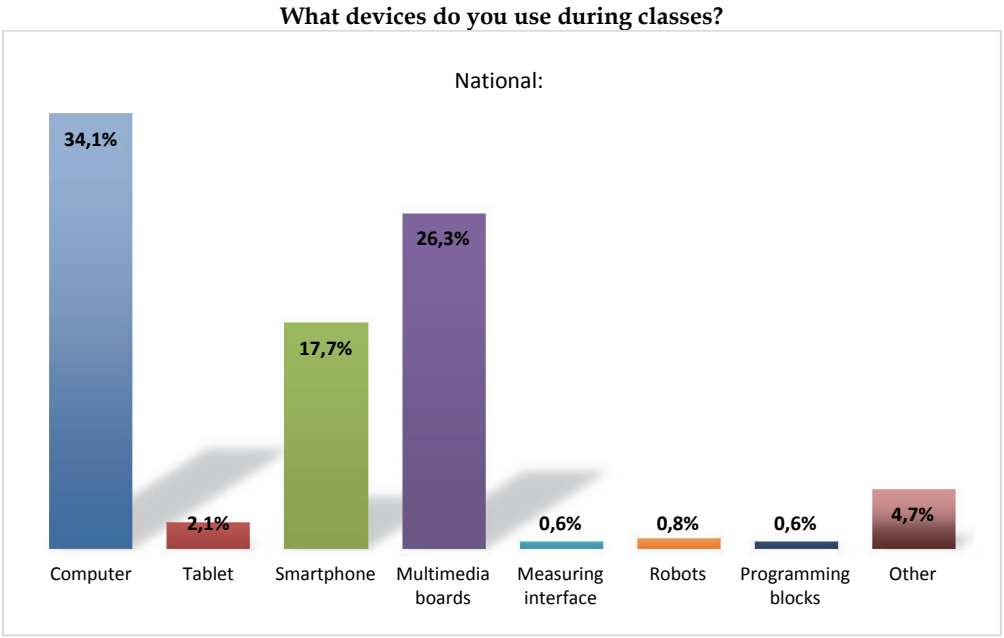

Diagram No. 7. Use of devices during classes

Source: Report Polish School in the Digitisation Era. The 2017 Diagnosis.

The level of use and purposefulness of use of multimedia materials by the teachers leaves a number of doubts. A class conducted with the use of a computer, a projector and a multi-media presentation is slightly efficient and copies the traditional instruction-based methods. The issue of efficient model of classes with the use of digital educational resources leaves a lot to wish for.

Recapitulation

According to the presented data, the level of preparation of Polish schools to implement innovative education is low. Both hard parameters, such as the level of use of the network infrastructure or hardware, as well as soft indices, namely the level of digital competence testify that the Polish schools are at the very beginning of the road towards implementation of education relying on digital tools. A very important element of the process of digitisation of Polish schools is the teachers' competence. Unfortunately, there is no necessity of developing digital competence, and the didactic offer for teachers with respect to improving their digital competence and purposeful introduction of innovative, well-considered classes is insufficiently prepared. A long path to digitisation lies ahead of the Polish school; this path leads not only to passive implementation of devices in schools, but is meant to build the capacity of creative construction of didactic classes in strong correlation with competence of tomorrow. The path is not hard in the technological context, but very difficult in the mental context; it is tough to break the existing schemes, search for new solutions and look at the development of pupils as the employees of tomorrow.

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