Computers in Education

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***Abstract* - Computers, or in wider scope, information and communication technology (ICT), have had revolutionary impact on education. ICT is both merged to the education process and is supporting it. Computers and information technology are typical enabling technologies – not in the focus itself, but when available, these are adopted in use. Performance of computers has grown exponentially: According to Moore's law processing power and RAM capacity is doubled in 1.5 years. The similar growth rate relates to mass memories and data transmission speed. During the era of computing (from the middle 1940s) information technology has gradually transferred to new areas of use. In the beginning, the computers themselves were in focus. In the 1970s microelectronics has been the key to changes: first personal computers, then networking and cloud technologies, further embedded intelligence of devices, distributed computing, complex software, wide access to heterogeneous data sources etc. have brought the computer to the growing number of applications, also in the education sector. The purpose of this paper is to have a look at the concept "computers in education". It has been the title of the conference track in Mipro over decades. It is widely handled in literature, journals, and other publications. These provide forum for experience transfer in the area, as well as encourage researchers to study the topic from the scientific direction. The paper is partially based on the experiences of the authors and aimed to clarify the term from a variety point of view.**

Keywords - computers; education; computing trends; teacher training.

I. INTRODUCTION

The role of *computers in education* has been in focus in last decades. The progress relates both to computers and the spread of information and communication technology (ICT) in the education sector. Computers and related technologies are seen as enablers of changes in this progress. The spread of ICT in education has not been an isolated phenomenon but followed the general changes in the role of ICT in society. In this progress, the education sector has not been the frontier field, more in the role of follower which uses the opportunities than the developer of new innovative uses. Why to be a follower? The main reason might be the lack of resources, especially funding (at all levels), which is mainly coming from limited sources, mainly public but in some amount also private. The education sector is neither in focus of funding for research and development if compared with other sectors of society and economy. Investments in the use of new technologies are targeted to such sectors whose productivity *is seen* as higher. There seems to be also some force of inertia in the education sector, which makes the progress slower than it could be in optimal situation – conservatism in attitudes, lack of required skills to adopt ICT based solutions and resistance to changes.

The matter can also be looked at from the opposite direction: to what extent are computers and ICT needed in education. In some cases, it looks that real needs have not been the driving force, but ICT itself has become such. In recently published studies [1; 2] Mertala et al. analysed the characteristics of 200 highly cited research articles in the field of educational technology. They found the phenomenon called "*positive bias*": the studies emphasized the benefits and positive findings of using ICT in education but ignored the negative aspects. The studies showed that the results of otherwise well-achieving students improved when using the researched technology but ignored the fact that the results of low-achieving students simultaneously deteriorated. These findings indicate a strong desire to find positive effects, even in the case that the results are not so promising. Professor Mertala is distinguished in the field of critical educational technology (Ed-Tech) research. He has provided empirical evidence for the qualities of the phenomenon known as *Ed-Tech speak*, having focus especially in research articles reporting experiences in the use of IPad in education.

In long run, outside the research environment, the adoption of new technologies in practice are based on rationale decision-making and long-term experiences in real environment of use. The desire and the opportunities meet, and the use of ICT finds appropriate solutions. A lot of studies also confirm this finding. Research and tests of new kinds of solutions are needed to get the best ones to find their way to the practice. However, the focus of this paper is not on the discussion about good and bad solutions in the use of ICT in education, but to have look at the *concept "computers in education"* from different perspectives.

The title of the paper comes from the title of the track CE in Mipro conference. The authors have participated in it already since the 1990s and seen presentations having a variety of approaches to the topic area and temporal changes in trends. Quite many of the papers in the conferences report the results of tests and trials, based on statistical analysis, in real teaching / learning situations, some propose new kinds of solutions and the use of new technologies, some represent the wider approach to the topic and show the flexibility of the conference scope interpretation.

The "*research problem*" of the paper is to find (at least a partial) answer to the question *what means the concept "computers in education*". We approach the solution by looking at the temporal changes in the role of computers and the use of ICT in general (Section II); we see steps in this progress as *enablers*, which provide opportunities for the education sector. How the opportunities were taken in the beneficial use, what means "*computers in education*" in different periods, is discussed in Section III. To get the more objective view, we have a *light-weight look* at the literature in Section IV. The discussion is concluded in Section V.

Our approach is based on the findings in literature and on our (decades long) experience based views, which in this article we organize as *a kind of framework*. Emphasis is given more to the *changes and trends* than in listing the applications. The topic is handled also in some of our earlier papers: papers [3; 9] handle the machine and human learning and intelligence, papers [4; 5] the role of artificial intelligence in education and papers [6; 7; 8] technological changes (the trends in enabling technologies). The topic is handled mainly from the technical point of view, not pedagogical.

II. ABOUT THE ENABLING TECHNOLOGIES

A. *The Embryonic Era and the Centralized Use of Computers*

The era of computers, based on the current concept, started in 1946 when ENIAC was released. It was developed to provide a platform for "complex" scientific calculations. The spread of computer uses to other sectors of society was happening little by little in the 1950s although only the 1960s can be called the decade of the expansion. Even then, computers were rare and mainly used by large companies and organizations. These decades could be called the "*embryonic era of computers*". The use of computers was *centralized,* and users were the computing experts. They provided their services to allow the development and use of the applications. This was called "*closed shop*" use of computers.

B. *Towards Distributed Use f Computers*

The widespread use of computers in society dates to the 1970s. There were two *key enablers*: improvements in computer technology (transistors, mass memories) and new type of operating systems (*time-sharing*). The transition to mass production lowered the prices of and made it possible for smaller (mid-size) organizations to acquire a computer. The time-sharing operating system, in turn, made *direct computer use* via terminals available to the users from different application areas. In a way it was question on a *radical change,* because the first time the *end-users* were able to operate computers themselves. The computer architectures became simpler and did not expect any more special environments of location. The scale of computers became wider – all from large to mini and micro computers were available in the market. Transfer from *the closed shop to the open shop* use had started.

Simultaneously, development in programming languages was active: high-level programming languages FORTRAN, COBOL, Algol and C were published and application development was active. Software supporting the use of computers in different application sectors appeared and the use of computers became more and more common in wide sectors of society and application areas. Even the software development skills became possible for application area experts, because of the easier-to-use programming languages and environments. Even at that time, IT skills were not widespread, but rather belonged to IT professionals and a group of advanced pioneer users from a variety application areas.

C. *Unmanaged Distribution – Introduction of PC*

If the change from closed to open use was called by the term *radical*, then the introduction of PC to the market represents a *revolution*. The first PCs (in wider use) appeared in the *early 1980s*. The key enabler was a new technology – *microprocessor* and in more common *VLSI* technology. Fast growing performance [1] , lowering computer prices brought computers in the new sectors of society, including schools, and eventually in homes as well. This progress, in turn, created the conditions for a *promising market for applications*

The fast (unmanaged) spread of PCs resulted in the dramatical change in the use of computing resources. Before *PC era*, computers were centrally managed by the experts. Now, every PC was an independent device managed by the user(s), which mostly had no deep education in computing. The *era of centralized computing* changed to *the era of unmanaged distributed computing*. The term "unmanaged" points out the fact that in organization level computing resources (computers, data) were not manageable and wild out-of-strategy use became possible. This was the beginning to a variety of *security risks*, too.

D. *Centralized Distributed Computing* **-** *Networking*

The Networking of computers partially solved the problem of management of computing resources. It provided means for *collaborative and distributed computing*, in which computers were able to share and distribute data between computing units, also the parallel use of separate units became possible. The technical invention of the computer network (Ethernet; competing solutions existed) has roots in the 1970s, but its adoption in practice has started one, almost two decades later *in the 1990s*. Along with networks, layered architecture (two-tier, n-tier, client-server) also became common. These made possible to provide *centrally managed services* to the distributed clients in the network.

Further, progress in networking was seen when wireless (Wi-Fi) networks were introduced in the early 2000s. As in Ethernet, the invention itself has its roots in the 1970s, but transfer to practice took a couple of

[1] First published in "Gordon E. Moore: Cramming more components onto integrated circuits. Electronics, Volume 38, Number 8, April 19, 1965". Simplified interpretation of the law: processing power and memory capacity (in fixed price) of computers doubles every 1.5 years because of the progress in VLSI technology.

decades: Wi-Fi networks started to become *common in the 2000-2010s.*

E. Cloud

Cloud technologies can be seen as an innovative integration of several components of ICT. More than technology, it is a *computing paradigm*, which connects users to their needs in computing ecosystem. Largely, it is question on the access to the services and data resources. Cloud technology (at the conceptual level) has its roots in early network solutions (ARPANET) and in the aim of implementing the concept of *virtualization* (a virtual machine that acts like a real machine from the user point of view). Despite having first references to cloud computing very early in the 1960s, the practical solutions are scheduled in the first decade of 2000 and spread in wide use in the 2010s.

F. VLSI Technology, Embedded Systems, Digital Convergence

Thanks to the rapid changes in ICT infrastructure belongs to *VLSI technology*. First, it has provided the new implementation base for computers. Secondly it has provided an opportunity to *embed* "computer kind of intelligence" in different devices (*Robotics*, *Internet of Things*, *IoT*). *Digital convergence* is a phenomenon, which has a huge impact on today's society: (tele)communication, computing and media are integrated and available for use as multi-purpose devices: mobile phone and television are good examples of this progress. The background of this development is also haunted by VLSI technology and the "convergence-based devices" are typical examples of "computer inside" devices.

G. The Role of the Enabling Technologies Summarized

The discussion above has focus in the progress of computing from *technical perspective*. The aim of this paper, to have a look at the concept "*computers in education"*, represents one of the application areas of ICT. In this context it is good to bring up a saying of Edsger Dijkstra[2], one of the pioneers in computing: "*Computer science is no more about computers than astronomy is about telescopes*". This describes the situation: the aim of computer science is to support the progress towards the easy and beneficial use of computers, which has been tightly bounded to the progress steps in related technologies as *enabler.*

ICT has been adopted by the education sector within its resources, needs and the expected skills of users, following the technical progress providing opportunities for the adoption. Because of that the concept "Computers in education" has *different interpretations in different periods.* These aspects are handled in Section III.

[2] Quoted from https://www.brainyquote.com/quotes/edsger_dijkstra_201168

III. HISTORICAL PERSPECTIVE TO COMPUTERS IN EDUCATION

A. Step 0: Training of Professionals

On the early 1950s computers were rare, mainly used for research purposes. Later (the late 1950s, the 1960s) user base extended to government organizations and bigger companies. Education related to computers was (professional) *training oriented* and mainly on the responsibility of manufacturers' organizations. On this period "*computers in education*" was professional training (not education) to use computers. Some research-oriented workshops were also organized by universities and research institutes, mostly in collaboration with manufacturers. A similar cooperative relationship also concerned the development of computers and their software.

B. Step 1: Computer Science Education

Early initiatives to teach "*computer science*" date back to the 1940s and 1950s. The study [10] reports about the first academic credit courses in computing in 1946 in Columbia University, based on the collaboration between the University and IBM. In 1947 Harvard University (Howard Aiken) established a computing laboratory and a degree program in computing there. This was bound to the development of Harvard MARK I computer. In 1953 Computer Laboratory at Cambridge University UK (Maurice Wilkes) also established a computer degree program in 1953. However, these activities are either related to teaching the use of data processing equipment at the time (Columbia) or are part of the history of computer development (Harvard, Cambridge). They therefore do not represent the actual teaching of computer science, the creation of which they have had a great influence, however.

In the 1960s, interest (and need) in the general education of computing began to arise. As a result, university level education started. In the USA both Purdue University and University of North Carolina at Chapel Hill established *computer science department* and related curricula. Very same time the first computer science curriculum started *in Finland by the University of Tampere* in 1965. This was the first initiative in Europe, too. The concept "*computers in education"* would be interpreted as being equal to *computer science education* and could be called the *first step on "computers in education".* Focus was set to provide skills in the professional use and development of computers and their environments. Manufacturers' training courses to use computers played still an important role, too.

C. Step 2: Spread of Computer Use to Application Areas – Closed Shop Based Services

To enable computer science studies, universities acquired computers, the use of which gradually *spread in other disciplines* as well: science, statistics and solving a variety of research problems. Typical of this era was that all operations needed the support of computer specialists in "*closed shop*" manner and the tasks were executed in the *batch processing* mode without interaction with the end-user. This was the *second (historical) step.*

"Computers in education" was to transfer of computing skills to a variety of application areas. In practice this means *education to consider the opportunities computers (of that time) provide* in these disciplines, mainly in the form of complex mathematical analysis and calculations.

D. Step 3: Open Shop - Distributed Use of (Centralized) Computers

In the 1970s, the interactive use of computers opened the use of computers for the wider group of users. The use of computers spread widely in universities and computers were also acquired to lower-level institutes, however, not yet in schools. Terminals (dummy input / output devices) connected to the central computer allowed the direct *interactive use* (open shop) of computers even for end-users from the application areas. This led to an increased need to include *skills in the use a computer* as part of curricula in different disciplines. It included not only teaching the *use of applications* in one's own research field, but also *teaching programming* in some cases. "*Computers in education"* in that time was related to the ability to *independently utilize the opportunities* offered by the computer in one's own field of research and the ability to *independently develop his / her own computer applications* based on programming skills.

E. Step 4: The PC Revolution

The appearance of *personal computers* (PC) in the early 1980s changed the computer ecosystem dramatically. In the past, computers were special instruments, the use of which was possible only for a few and in limited environments. Now the computer was in principle available for everybody, and computers spread widely everywhere in the society, even *to the schools*. Simultaneously, the development of applications accelerated, and these were available in wide scope of application areas for low price. In the beginning the role of PC in education focused, as traditionally, to provide skills to use it, but with the growing range of applications, they became an integral part of education in *a variety of ways*, and it was also seen as a *pedagogical object*.

The first steps in using computers (PC) in schools were taken in the second half of the 1980s. However, computers in schools were still rare, and we had to wait until the 1990s to see the more *systematic and organized progress* in this area. Nationwide strategies were developed in several countries: Finland [11], Estonia [12]. These "strategies" provided the basement for systematic development to use computers as a part of education. The BSc thesis [13] describes the transfer of ICT to Finnish elementary schools. First steps were based on the volunteer work of teachers in mathematics and sciences by organizing "outside working hours" activities as a study circle. Resistance was noticeable among teachers and their continuing education was not well organized, almost not available. The national syllabus for elementary schools from 1985 had some references to include ICT skills in education as a goal to increase interest in technology, embedded in some topic areas, but not as a study subject itself.

The early era of PCs (the 1980s) blew up the use of computers in education, but only in reasonable limited scope. Partially it was question on lack of (computer) resources and partially on missing skills among teachers. "*Computers in education"* in this era can be described as *seeking opportunities and adapting to a new culture* where the computer plays a growing role.

The improvement of PC technology increased the possibilities of using it in new ways and contexts. Growth of processing power and memory technology (Moore's law) including new mass memories (capacity to store data), transfer from desktop to laptop (portability), graphical user interfaces (usefulness, easy-to-use) diversified the possibilities of using computers in education and *diversified* the interpretation of the concept "*computers in education*".

F. Step 5: Transfer to the Networked World

First steps towards the expansion of computers in education were taken by using computers for a variety and growing number of purposes as an independent unit. Networks (wired from the 1990s, Wi-Fi from the 2000s onwards) provided an enormous number of new opportunities, which were further complemented by the transition to the large-scale use of mobile devices (smart phone, tablet). Additional dimension was provided by the fast-spreading use of cloud-based technologies and services. A large amount of data (knowledge) and services became easily accessible and easy to use in education as well. Today we live in an information society, which is strongly based on the use of information technology. Computers and mobile devices are widely used in homes, workplaces, and schools. Ownership of the computer (or a kind of device) is no more important because students are using their own devices at school (BYOD phenomenon), computers are used to make remote studies possible, as well as virtual classes have become a part of education culture. The use of ICT has become a *part of everyday life*, and so has the use of computers in education. "*Computers in education" has gradually become a part of information society technology and services*, *more or less equal to ICT in other sectors of society*. This has happened step by step in parallel with other information society developments. In the initial phase, the development focused on the utilization of network solutions, gradually on the utilization of new applications and spread in new application areas, and currently the focus is effective *knowledge creation* using the network capabilities and available data sources (cloud, big data, open data, data pipelines, structured and non-structured sources). Further, the number of applicable technologies and solutions are growing continuously.

G. Historical Perspective Summarized

The aim of this section is to have a look into the role of computers in education in somewhat longer time perspective than just today. The steps are triggered by *technological changes as enablers*.

In addition to the direct use of computers (and computer kind devices) ICT provides wide variety of opportunities for education. ICT based systems in the form of embedded VLSI technology (Lego Education), cheap microcomputer based (Arduino, Rasberry) construction kits, IoT devices, and robotics provide new opportunities for the use of computers in education; in principle the wide spectrum of current technology is valid this purpose. With the development, the interpretation of the concept "*computers in education*" also changed over time and finally ended up covering the use of information technology in its various forms, adapted to the needs of education.

There seems to be no rational reason to specify exactly the coverage of the concept "computers in education" by listing topics related to it. Nowadays pretty much everything is up to the imagination, both from student and teacher side. From technology and service point of view almost everything is possible.

However, it is worth distinguishing *innovative ad hoc use* from *serious strategic use*. It is always worth making trials to get new experiences, but the skeleton of the use of computers in education must come from the *pre-planned strategic approach*. Both approaches are reported by various publications. Section IV looks at the topic from this point of view.

IV. PUBLICATIONS BASED APPROACH

A. Computers in Education – About the Publications

To find a common view to the topic we conducted a light review of the publications in the area. Not systematic, all coverage, but just to get an overview about the texts available. *Google Scholar* was used because we see it as the source of books and articles having the widest coverage, even outside scientific importance. The search term "*computers in education*" was used. The result covered close to *six Million publications*; even in the limited search covering the 2020s over 0.5 Million publications were listed. last year (2022) over 16,500. We did a rough analysis of over one hundred top-ranked findings. The following topic areas were handled:

- *education technologies and organizing the studies*: teaching and learning platforms, the role of technology, technology-based education methodology, e-learning, mobile learning, game based learning, social media, the use of tablets, online examinations, virtual classroom, automatic feedback, MOOC;
- *learning and teaching*: motivation, investigating the impacts, comparing traditional and computer-based learning, automatic assessment, impact on learning and satisfaction, blended learning, flipped learning;
- *abilities*: the readiness of teachers and students in the use of new technologies;
- *cognition:* cognitive view in the use of computers, modern knowledge, computational thinking;
- *social aspects*: COVID-19, equality;
- *technology*: augmented reality, virtual reality, AI, cloud, chatbots, virtual assistants, IoT, robots, the use of open resources.

The spectrum is wide and covers *both soft and hard topics*. From the point of view of this paper, we found a couple of interesting articles handling the history (long term changes, development) in the area. The papers [14; 15; 16; 17] complement and were also used as a source of ideas in, our history perspective in Section III. An interesting article [18] was found in Scientific American from 1966: it reports about the computer supported instruction trial and learning results in the very early era of computers. Mainframe computer was used with a simple terminal as an interaction tool. Promising learning results results in mathematics teaching were reported. One important topic does not seem to be widely handled: *preparing teachers using ICT in education*. Organized studies are not widely available, much is based on the volunteer work of teachers. Especially preparing *support for the older generation of teachers* is missing although some studies are already now provided as a part of teacher studies.

The shortcomings of continuing education were also noted in the recently published research report [19] handling the impact of digitization on learning in middle schools in Finland. According to it, digital technology is used in the limited scale and the use is rather one-sided. Digital technology use and learning outcomes seem to have negative correlation (as indicated in [1; 2]), but in general it seems not to weaken the learning results. Digitization enables the differentiation of learning and assessment, which increases the motivation and the engagement in learning situations.

B. Computers in Education – The ACM Approach

Association for Computing Machinery (ACM) has published the classification of computing related topics. Along the progress of computing the classification has gone through seven revisions. The first version was published in 1964 and revised versions appeared in 1982, 1983, 1987, 1991, 1998 and the current version is from 2012 [20]. It is implemented as an interactive WWW artefact which represents the classification of different areas of computing as a tree structure.

In the classification the concept "*computers in education*" locates in the branch CCS -> Applied computing -> Education. The topics listed cover:

- Digital libraries and archives,
- Computer-assisted instruction,
- Interactive learning environments,
- Collaborative learning,
- Learning management systems,
- Distance learning,
- E-learning,
- Computer-managed instruction.

The subclass that complements this locates in another branch of the structure: CCS -> Social and Professional topics -> Professional topics -> *Computing education*. This covers the topics of professional education in the area.

The earlier version of the classification from 1998 [21] lists the following topics in the branch Computing Milieux -> Computers and Education -> Computer Uses in Education: Collaborative learning, Computer-assisted instruction (CAI), Computer-managed instruction (CMI) and Distance learning. Difference between two versions is remarkable and points out the *dynamics in the area*. However, comparing these categories with the findings of the literature review above, topic listing is reasonable inadequate and generalized.

C. Computers in Education – The AI Approach

One of the topics under discussion today is the use of artificial intelligence (AI) in problem solving. A lot of publicity is given to the company OpenAI. The company reports having a mission "*to ensure that artificial general intelligence benefits all of the humanity*". To fill the mission it has brought a variety of tools to a public use; one of these is ChatGPT, the question-answer system based on deep learning having capability to multilingual interactive discussion with the user.

We made a trial with the ChatGPT tool for seeing, how the concept "*computers in education*" is seen by it. The discussion below was made in [22] in late January 2023.

What means computers in education: "*Computers in education" refers to the use of computer technology in the classroom or for educational purposes. This can include using computers for teaching and learning, for research and data analysis, for administrative tasks, and for communication and collaboration among students and teachers*".

Would it be someway more wide interpretation of the concept: "*A more comprehensive interpretation of "computers in education" would include not only the use of computer hardware and software in the classroom, but also the integration of technology into the educational curriculum and pedagogy. This could include the use of online resources, educational apps, and digital learning tools to enhance the learning experience and support student engagement and progress. Additionally, "computers in education" can also encompass the use of technology for professional development, such as online teacher training and the use of technology to improve administrative tasks such as attendance tracking and student data management*".

The discussion was continued by asking the **current trends in the area**. The following topics were listed: "*blended learning, personalized learning, gamification, online assessments, virtual and augmented reality, artificial intelligence-powered education, remote/distance learning".*

The topics listed above are worth comparing with the findings in earlier sections of this paper and the list of the topics of Mipro CE[3]; the match is quite good.

We also asked about **relevant publication forums** in the area. We got the list of *seven journals*. In the question about conferences, also *seven conferences* were listed. To assess the *quality of the reply* the forums were compared with the ranks (scientific level) given by the Federation of Finnish Learned Societies[4]. This classification is used in ranking publication forums for Finnish universities to guide them towards high-impact publishing. The ranking classes cover "not-known", 0 (no value), 1 (basic), 2 (leading), 3 (top). In listed journals *none reached level 3, two were in level 2, 4 in level 1* and *one was not listed*. In the listed conferences, *none was ranked*. The quality of the answer in journals was acceptable but in the conference category the reply was inferior. **About MIPRO conference** ChatGPT says: "*it is a well-established and respected conference in the field of information and communication technology*". As a reference, Mipro belongs to ranking class 1, as most conferences ranked by the system.

V. CONCLUSIONS

The aim of this paper is to clarify the concept "*computers in education*". We selected the approach to look for its interpretation in *history perspective*. *Enabling technologies* were selected to explain the changes. The key technical changes were discussed (Section II) and the improvement steps in the use of computers in education (Section III) were mirrored against the technical changes.

TABLE I. STEPS IN THE USE OF COMPUTERS IN EDUCATION

Step	Enabler	Period
0: Training oriented	Early computers	1950s -
1: Computer science education	Computers to Universities	1960s -
2: Computers to application areas, closed shop	Application availability, in Universities.	Late 1960s -
3: Independent utilization in applications, open shop	Operating systems (time-sharing), programming skills. Spread of computers.	1970s -
4: Seeking for new opportunities, widening use	PC	1980s -
5: Merging gradually to Information Society: 5a. Network based and mobile use. 5b. Knowledge based use.	Networking. Cloud. Diversification of devices. Access to wide knowledge resources.	1990s-

Table I summarizes the analysis and the discussion in Sections II-III: Six steps triggered by enabling technologies adjusted to the timeline. Section IV indicates the topics under discussion, based on publications. Mipro CE conference seems to be on the frontier.

The use of *computers in education* follows the general trend in the use of ICT. The focus has shifted from *technical topics* to the ability to find and *utilize accessible knowledge*. The concept "*computer*" is diversified and the use of it is changed in time. The computer has become an extension of thinking, also partially the replacement of it.

In the future (already today) artificial intelligence (AI) based applications will play an important role. The authors have handled this topic in their pearlier apers [3; 4]. In this paper, we provided an example about using one of the AI applications, ChatGPT, in finding answer to our research problem. One of the hot topics in Finnish universities is the acceptability of the use of such tools in studies. The Intranet of Tampere University informs: "*Tampere University welcomes the use of AI-based applications and language models (eg ChatGPT) in research and teaching".* In the same text challenges are listed, *ethical issues* are handled, and problems related to "*plagiation-kind*" text production are pointed out. In the thesis and reports the use of ChatGPT is approved within the defined rules. Is this the beginning of one *new era* in *computers in education*? In addition to learning, ability to use intelligent tools in beneficial way, having ability to critical review will be in focus.

[3] http://www.mipro.hr/MIPRO2023.CE/ELink.aspx
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