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ВЕСТНИК

РОО «НАЦИОНАЛЬНОЙ
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В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой

грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением, Благотворительный Фонд «Халык»!

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INTEGRAITING DIGITAL TECHNOLOGIES INTO EDUCATION: CURRENT TRENDS AND FUTURE CHALLENGES

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Abstract. Digital education in a globalizing world focuses on acquiring knowledge and skills related to digital technologies and their application in various contexts. This study examines the integration of technology into teaching and learning, emphasizing the importance of digital literacy for both educators and students. The relevance of this topic lies in the central role that technology plays in modern education systems and the continuous need for technological advancements. The methods used include a comprehensive analysis of scientific literature, periodicals, and electronic resources, alongside the examination of documents and methodological supports that promote the development of the information society and the digitalization of education. The hypothesis is that digital literacy skills are crucial not only within the classical education system but also for the general population to foster widespread «digital literacy». Key factors include training teachers in digital learning skills and utilizing digital technologies, as well as the concept of «computational thinking». The practical significance of this study is intended for researchers, educators, educational administrators, entrepreneurs, specialized journalists, and policymakers interested in the interplay between education and digital technologies.

Keywords: digitalization, education, teaching, information technology, «computational thinking»

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ЦИФРЛЫҚ ТТЕХНОЛОГИЯЛАРДЫ БІЛІМ ИНТЕГРАЦИЯЛАУ: ҚАЗІРГІ ҮРДІСТЕР МЕН БОЛАШАҚТАҒЫ ҚИЫНДЫҚТАР

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Аннотация. Жаһандану әлеміндегі цифрлық білім беру цифрлық технологияларға қатысты білім мен дағдыларды алуға және оларды әртүрлі контексттерде пайдалануға бағытталған. Бұл зерттеу технологияларды оқыту мен оқытуға интеграциялауды қарастырады, мұғалімдер мен студенттер үшін цифрлық сауаттылықтың маңыздылығын ерекше атап көрсетеді. Бұл тақырыптың өзектілігі қазіргі білім беру жүйелерінде технологияның орталық рөл атқаруында және технологиялық жетістіктердің үздіксіз қажеттілігінде жатыр. Зерттеуде қолданылған әдістерге ғылыми әдебиеттерді, мерзімді басылымдарды және электрондық ресурстарды жан-жақты талдау, сондай-ақ ақпараттық қоғамды дамытуға және білім беруді цифрландыруға жәрдемдесетін құжаттар мен әдістемелік қолдауды зерттеу кіреді. Зерттеу гипотезасы мынада: цифрлық сауаттылық дағдылары тек классикалық білім беру жүйесінде ғана емес, сонымен қатар халықтың қалың жігіндегі жаппай «цифрлық сауаттылықты» дамыту үшін де маңызды. Негізгі факторларға мұғалімдерді цифрлық оқыту дағдыларына үйрету және цифрлық технологияларды пайдалану, сондай-ақ «есептеу ойлау» тұжырымдамасы жатады. Зерттеудің практикалық маңыздылығы білім беру мен цифрлық технологиялар арасындағы байланысқа қызығушылық

Түйін сөздер: цифрландыру, білім беру, оқыту, ақпараттық технологиялар, «Есептеу ойлауы»

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ИНТЕГРАЦИЯ ЦИФРОВЫХ ТЕХНОЛОГИЙ В ОБРАЗОВАНИЕ: СОВРЕМЕННЫЕ ТЕНДЕНЦИИ В БУДУЩИЕ ВЫЗОВЫ

танытқан зерттеушілерге, педагогтарға, білім беру саласының әкімшілеріне, кәсіпкерлерге, мамандандырылған журналистерге және саясаткерлерге арналған.

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Аннотация. Цифровое образование в глобализирующемся мире направлено на получение знаний и навыков, связанных с цифровыми технологиями, и их применением в различных контекстах. Данное исследование рассматривает интеграцию технологий в процесс обучения, подчеркивая важность цифровой грамотности для учителей и учеников. Актуальность этой темы заключается в центральной роли технологий в современных системах образования и постоянной необходимости технологических усовершенствований. Методы исследования включают всесторонний анализ научной литературы, периодических изданий и электронных ресурсов, а также изучение документов и методической поддержки, способствующих развитию информационного общества и цифровизации образования. Гипотеза исследования заключается в том, что навыки цифровой грамотности важны не только в классической системе образования, но и для широкой общественности, чтобы способствовать повсеместной «цифровой грамотности». Ключевые факторы включают обучение учителей навыкам цифрового обучения и использованию цифровых технологий, а также концепцию «вычислительного мышления». Практическая значимость данного исследования предназначена для исследователей, педагогов, администраторов образовательных учреждений, предпринимателей, специализированных журналистов и политиков, заинтересованных во взаимодействии образования и цифровых технологий.

Ключевые слова: цифровизация, преподавание, обучение, информационные технологии, «вычислительное мышление»

Introduction

The digitalization of the world is a total social fact, because it forces us to systematically rethink the functioning of our society. Many researchers emphasize the importance of technology in 21st century society, as the ubiquity of laptop computers and digital technologies in everyday life has changed our teaching methods. Digital technology has become a central element of society. Due to the digitalization of the world, it is becoming

increasingly important to acquire the appropriate skills to use these technologies.

The issue of the relationship between education and digital technologies is complex and has been discussed since the seventies of the 20th century. The transformation of the world as a result of the «digital revolution» has only intensified the contradictions.

In this scientific article, the authors are particularly interested in two aspects of interaction: on the one hand, the necessary training in digital sciences and, on the other hand, interest or lack thereof in the use of digital technologies in education.

Digital education aims to gain knowledge and skills related to the science of digital technologies and to use digital technologies in various contexts (for example, learning how to sort information using algorithms or protecting your privacy on social networks). As for the basics, this training can be conducted in the «no connection» mode, that is, without a digital device. Digital education uses digital devices (hardware and software, such as 3D representation capabilities) for disciplinary or interdisciplinary purposes, such as understanding electromagnetism through augmented reality or using clickers to assess students' understanding in an on-site classroom. These two aspects pose new research questions for both digital sciences and technologies, as well as for educational sciences (Betton et al., 2019).

Thus, the relevance of the chosen topic is due to the fact that one of the central tasks of the education system is the integration of technology into teaching and learning, as well as teaching new technologies.

The purpose of the study is to analyze the current state of digital education, while at the same time identifying the key elements of this analysis both in terms of technology and society transformations, as well as digital technology education.

The practical significance of the work is intended for everyone who is interested in the links between education and digital technologies: researchers, teachers, heads of educational institutions, entrepreneurs, specialized journalists and government decision makers. The theoretical significance will allow everyone to familiarize themselves with fundamental issues, as well as with the latest innovations that will stimulate reflection and debate on an important issue that concerns all of us as citizens.

Methods

This scientific study outlines the authors' vision on digital education and through digital technology. The breadth of research problems associated with these issues necessarily makes them interdisciplinary. Before proceeding with their solution, the authors presented the priorities that need to be addressed, and in particular, the issue of the contribution of digital technologies to academic achievement for all. This document also offers a broad perspective on the issues related to the interconnection of digital technologies and education. Finally, this triple analysis (what are the problems? What are the research topics? What are the questions?) allows to propose six recommendations presented on three topics:

- research activities,
- digital learning,
- community action.

The most important thing is the need to «understand» the scientific and technical foundations of this transformation; that is, to become familiar with computer thinking, which we precisely define, and to demonstrate the connection between studying computer science and awakening critical thinking. This then allows us to specify what training in the basics and use of digital technologies is, on the one hand, and training in methods and tools of digital technologies, on the other.

During the research, a set of methods was used that supported the implementation of tasks at all stages. To substantiate the theoretical results, the following methods were used: analysis of a wide range of scientific literature, periodicals and electronic resources;

study of documents and methodological support supporting the development of the information society and digitalization of education; generalization and modeling.

Results

The topic of «education and digital technologies» is far from exhausted, especially because the context is constantly changing. In particular, this evolution is a consequence of factors, internal and external:

- the development of new student-centered pedagogical approaches that look at digital technology work in education over the past decade in perspective to see that more attention has been paid to the student than to technology;
- psychological and emotional consequences of mediating learning through technology,
- The ethical and safety aspects should be taken into account when integrating digital technologies into education;
- changes in teaching practice caused or not caused by technological innovations and the issue of their introduction into society, going far beyond the scope of education;

On a more global level, it seems to us that it is necessary to solve the main problems faced by our education system, which is confirmed, in particular, by international assessments (OECD, 2019) in terms of inequality in education and access to digital and technological equipment, digital literacy, as well as critical thinking.

Thus, the prevalence of the use of information and communication technologies (ICT) in the classroom is low even in the richest countries of the world. According to a PISA survey conducted in 2018, only about 10% of 15-year-olds in more than 50 participating educational systems used digital devices for an average of more than an hour per week as part of math and science classes (Figure 1).

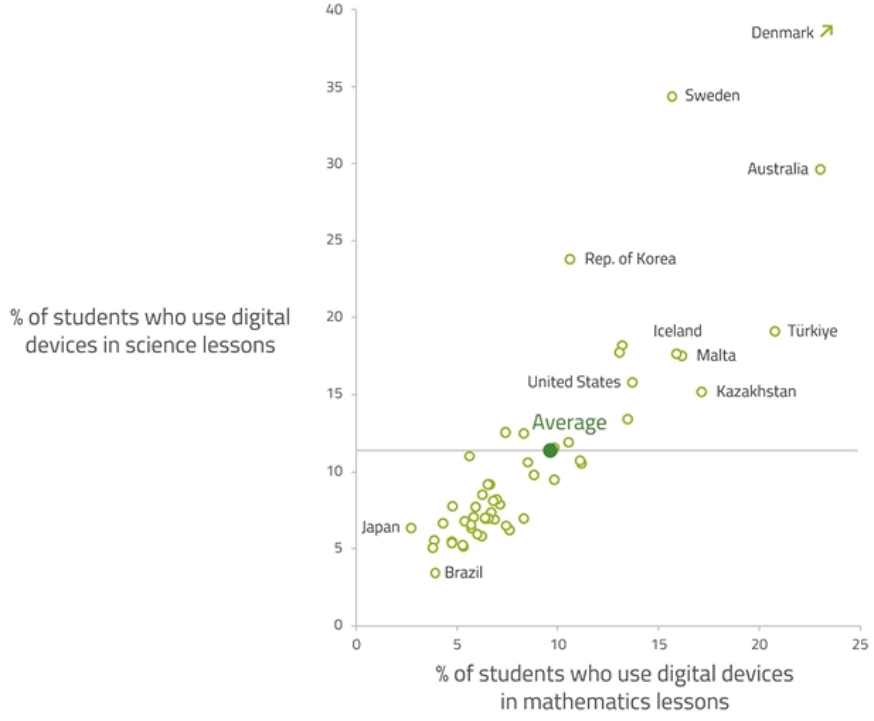

Figure 1 – Level of technology use in math and science lessons (OECD, 2019)

An international study on Computer Tool Mastery and Information Culture (The Ministry of National Education of France, 2018) conducted in 2018 found that in all 12 participating education systems, more than a third of students have access to modeling and simulation software, with national levels ranging from 8 % in Italy to 19 % in Italy. 91 % in Finland.

Of course, «digital technologies» by no means can solve all these problems alone, which are crucial for our societies and for some, this is even part of the problem, since it provides tools for the mass dissemination of information feeds and the development of fundamentalism. But nevertheless, we believe that the study of digital technologies in education can help provide elements of answers, on the one hand, through computer thinking training, and on the other hand, through research and new applications of digital technologies that can increase educational value.

Digital technologies can provide support in mediating pedagogical relationships, but also in popularizing educational content and learning activities. Mediatization with the help of digital technologies does not provide either an increase in educational value or educational innovations. Although digital technologies can provide a new environment, pedagogical attitudes and teaching methods are not always innovative.

Thus, the principles of an inverted classroom or learning through play, already present in analog forms, are not an innovation from the point of view of pedagogical relations, but acquire a new form with the help of the environment. Digital mediation is often reduced to a digital tool that allows you to return to them, which in the SAMR model (replacement, increase, modification, redefinition) Gronseth et al. (2010) considered as a level of substitution in which technology is used to perform the same task as before.

The expansion, modification and redefinition of practices through the use of digital technologies give an idea of the ability to accompany the instructor and the student through the personalization of learning. This point of view is an important driving force behind the dynamics that is manifested in the emergence of many companies in the field of EdTech, combined with a sharp increase in the number of startups in this field around the world.

To understand the changes caused by the use of digital technologies, it is necessary to take into account not only the task, but also the knowledge related to a specific disciplinary area involved in this task. From this, in fact, there are important limitations in the transfer of research results on various types of digital technology use in education.

Finally, since it is important to approach this topic from an interdisciplinary point of view, and not only from the point of view of hardware and/or software, as it has been and still happens too often, it seems fundamental to us to also take into account the opinions of scientists (Erstad et al., 2021). They are, regardless of whether they relate to educational sciences or digital technologies, as well as to cognitive sciences and neuroscience, which allow us to shed light on the use of digital technologies, while taking into account the diversity of contexts, tasks and interpersonal differences in digital-mediated learning activities.

On the other hand, as with any other instrument, the use of digital equipment can present risks and negative consequences that need to be taken into account. For example, increasing the number of tools can lead to mental overload, or, again, personalization can lead to non-standard behavior. Full awareness of this is necessary, on the one hand, to combat deviation from using the tool, and on the other hand, to ask basic research questions in order to find solutions and implement them.

Discussion

In connection with the above, it is necessary to involve and stimulate new areas of research in order to have a significant impact on:

- improving well-synthesized educational processes using the pedagogical triangle proposed by J. Houssaye (1988) and expanded by Joseph Rézeau (2002) (Figure

2),

- providing opportunities to study various subjects of education (students, teachers, heads of educational institutions, families, decision makers) understand the challenges of digital technology.

The pedagogical triangle is a representation of the key components and actors of the learning situation in learning, which examines the relationship between the teacher and his way of organizing educational activities for the student (pedagogy), between the learners and the teacher (didactic relations) and between the student and knowledge (learning process). The development of solutions that combine the contribution of educational sciences and digital technologies can become a lever for solving modern educational problems and, thus, contribute to the fight against academic failure, promote success and improve lifelong learning.

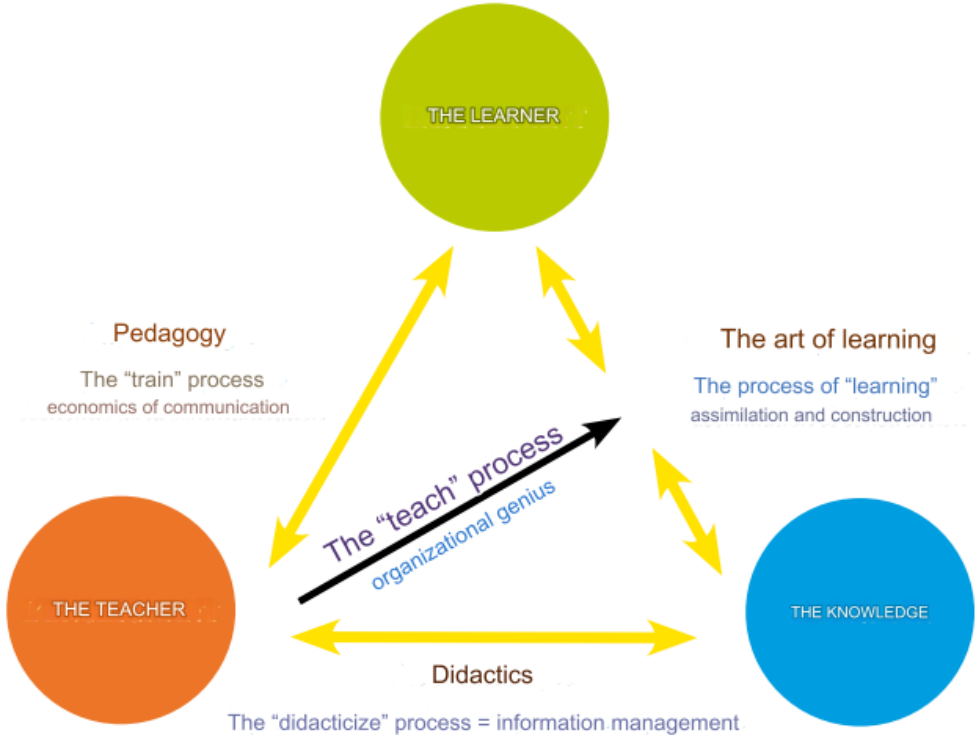

Figure 2 – Teaching-learning situation Rezeau from the pedagogical triangle Houssaye

Of course, it can be assumed that regardless of the transformations caused by inventions and the use of technology, there are invariants in how a person learns. Homo sapiens is extremely good at learning. This competence is collective, not just individual. His mimetic abilities provide him with continuous learning, even without "effort", interacting in a daily environment. However, as noted by Peciuliauskiene et al. (2022), in addition to this primary knowledge, other secondary-type knowledge must be the subject of a focused learning approach so that it can be acquired by the student.

The role of the school is precisely to provide this unnatural, self-evident education. According to Nonaka & Takeuchi (1995), one should distinguish between implicit knowledge (which is not recorded, such as customs, habits and intentions) and explicit knowledge, which is the subject of institutionalized knowledge. According to Nonaka & Takeuchi, the relationship between implicit and explicit knowledge is continuous and takes different forms depending on the transformation of one type of knowledge into another.

Nonaka & Takeuchi call model SEUI (Socialization- Exteriorization-Unification-Internalization).

Socialization links implicit knowledge into relationships between subjects and allows the transfer of this type of knowledge without recourse to codification or formal language to describe this knowledge. Thus, formalization or exteriorization makes it possible to transform unspoken knowledge into explicit knowledge, while internalization transforms the explicit into the unspoken. According to Nonaki, combining explicit knowledge with a common language or code can allow the generation of new explicit knowledge. Computer science allows you to codify explicit knowledge, and also allows you to combine explicit knowledge.

If the processing of explicit knowledge with the help of computing technology has led to numerous works in the field of knowledge engineering, the question remains how to treat implicit knowledge that combines innate or acquired skills related to knowledge and experience (in the sense of "having experience"). They are more difficult to formalize, but socialization can allow them to be shared. Some knowledge related to the use of digital technologies should be considered as unspoken (for example, network etiquette or other custom of using social networks). In addition, the four stages identified by Nonaka & Takeuchi in the transformations between implicit knowledge and explicit knowledge (outsourcing, pooling, internalization, socialization) are probably easier to integrate using each other's digital tools.

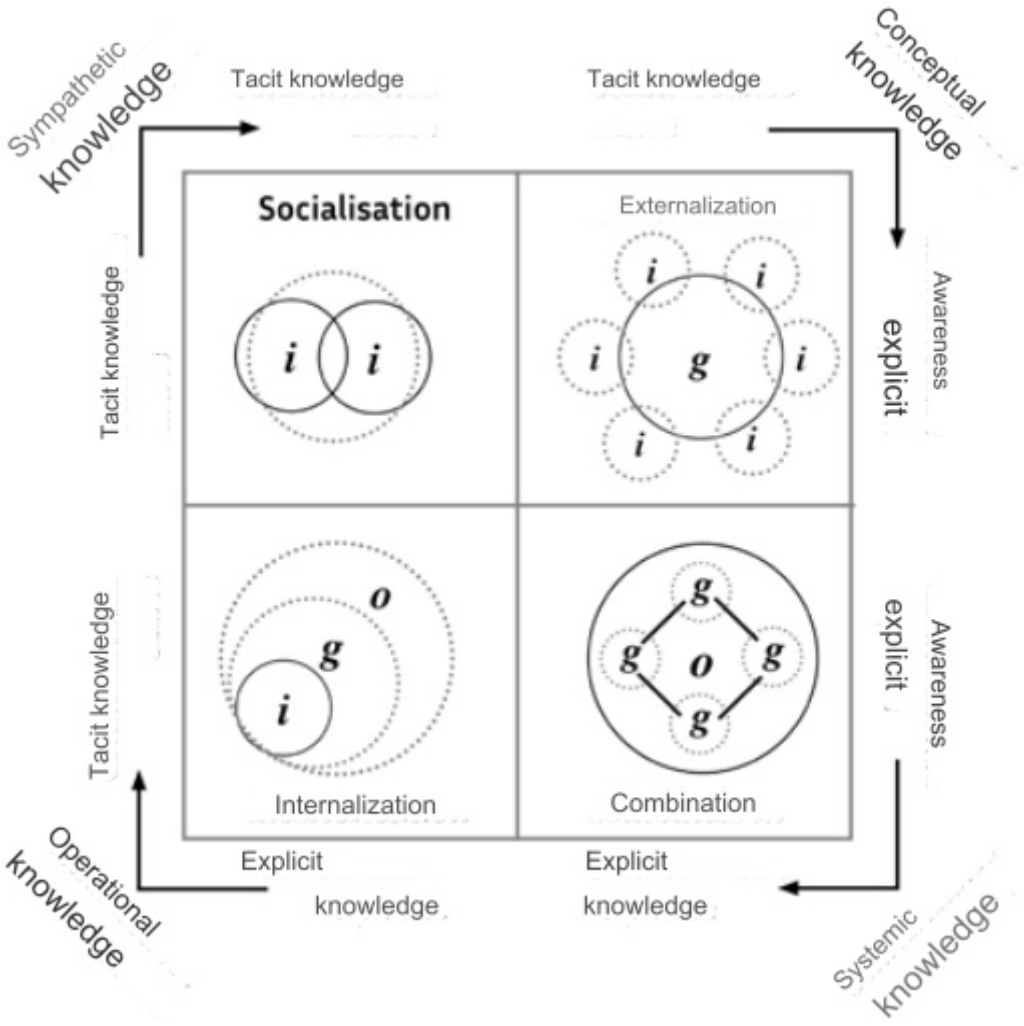

Figure 3 – Model of the spiral creation of knowledge Nonaka & Takeuchi (i: individual; g: group; o: organization)

Many factors, both individual and collective, organizational and socio-cultural, must be taken into account in the pedagogical engineering work performed by various subjects of education when developing teaching and learning situations (Figure 3). Human behavior can be analyzed from different points of view, both biological, mental, and social. We need to take them into account in order to develop educational situations that can help build self-confidence and motivation by allowing commitment. Teachers must take these various aspects into account in order to be able to develop their activities.

Thus, given the key importance of the role of teachers in the development and organization of educational activities, the training of these specialists in the field of teaching and learning should be formed in connection with digital learning and the use of digital technologies to support teaching and learning processes.

Another key factor in learning is the concepts of computer science, called "computational thinking" by Janet Wing (2006), which are increasingly recognized as a way of structuring thinking. That is why the OECD (2018) Report on Education for 2018 emphasizes that they should be part of the learning framework for every student.

Computer thinking is a set of concepts and methods explicitly used in computer science to represent and solve problems, in particular, the concept of an algorithm occupies a central place in it, as well as data processing, problem solving methods, etc. This set of concepts and methods can be used in other fields, because it includes, for example, the ability

- to assign appropriate names to objects with explicit indication of their type or category for proper handling;
- work with the complexity of a large problem or system by prioritizing or dividing it into several simpler subtasks;
- specify the process in great detail so that it can be unambiguously performed mechanically, etc.

Thus, among these concepts and methods we find:

- algorithmics (thinking through the tasks to be performed in a series of steps),
- abstraction-modeling (understanding the problem at different levels),
- decomposition (splitting a complex problem into several simple tasks),
- reformulation (reformulating the problem for a better understanding). solve it),
- generalization (linking a new problem to a solution strategy),
- optimization (choosing the most effective way to solve a problem whose algorithmic complexity is inherently reasonable or exponential),
- control (defining error control and uncertainty management tools).

We are talking about computer thinking to show that we want not only to start programming (in the sense of writing a computer program), but also to allow students to take a step back from digital (to understand in a technological and critical way) and position computer science education as a cross-cutting competence that helps to form educated citizens.

It is about acquiring knowledge and know-how that, in addition to simple computer development, will be used in other scientific disciplines, including the humanities and social sciences, as well as in other areas of our daily activities.

Along with this, the study of computer science should be accompanied by the education of mass media, through which critical thinking develops both about the information disseminated by the media and about the processes of creating and distributing this information.

The flood of information (fake news) accompanying this huge progress in ensuring universal access to public speaking reminds us that it must necessarily be accompanied by parallel progress in critical thinking: since everyone can now speak publicly, it becomes vital that everyone knows how to ask themselves questions (Metsäpelto et al., 2022).

Thanks to this thinking, being an actor and putting forward our own assumptions and refuting them ourselves, we acquire the ability to change our minds. This is where computer education should play a role, because just as we cannot learn to play a musical instrument without playing it ourselves, we cannot study computer science without doing it, especially without writing our own programs ourselves.

It goes without saying that learning computer thinking helps to understand and reasonably build your own use of digital technologies. But this is not enough: technology training is also needed. The introduction of teaching its basics in elementary and secondary schools has shown that an introduction to computer thinking can be integrated into school. As an illustration, the basics of programming are based on four concepts:

- command sequence,
- variable assignment,
- test,
- a cycle of commands that are easy to explain and understand.

As part of learning this mindset, it is necessary to focus on how to learn, because this allows you to develop true know-how and know-how in comparison with digital technologies: students gain confidence that they are making their own choice of use, which also teaches them to redirect tools to other purposes. Due to its very high flexibility and wide possibilities, and although it is not the only one, the digital tool is an excellent platform for the development of creativity.

As for usage, it is not so much individual learning as collective learning in human ecosystems: digital technologies are also a culture because they are collective. Mastering the methods of use necessarily implies the development of good practices that go beyond the isolated use of tools.

Finally, since digital technologies occupy an important place in the global economy, it is important to understand the mechanisms that govern them, in particular the mechanisms of apparent free access, ways of accessing information, using data and, consequently, the bias and manipulation that result from this.

Although technology provides access to a lot of knowledge, the assimilation of school knowledge requires efforts that are difficult to regulate on their own. The teacher remains the key person in achieving mediation between learning goals and student needs. Digital technologies provide additional resources (tools and content) to the teacher, but do not replace his important role in both pedagogical engineering and classroom organization.

In addition to tools, methods and concepts developed for digital technologies can offer interesting insights in several disciplines. In mathematics, computer thinking is an important contribution to problem solving. For example, at the exercise level, the student will be able to distinguish what relates to the mechanical application of an algorithm that he performs to obtain a result (for example, a calculation based on algebraic rules) from what relates to another form of thinking (for example, geometric reasoning about a problem). In French, the correct differentiation of the concept of language (human) and language (formal) allows you to rise above the problems of grammar or phrases. In other subjects, it helps to distinguish knowledge that relates to memorizing data (for example, dates) or simple knowledge (in the sense of what can be found on Wikipedia) from knowledge that requires real study (for example, critical analysis) and helps to learn how to learn.

Again, digital technology is not the only approach to such a step, but its existence facilitates this differentiation. The introduction of digital technologies into education takes place at different levels of interaction:

- the versatility of digital tools,
- access to distance learning content at any time,
- individualization of learning paths,
- online tutoring,
- pooling of resources and a community of practitioners.

There are also preliminary options for using digital technologies for the development of educational/educational devices (including those that do not use digital technologies), for example, for optimization at the initial stage of training or for evaluating the ergonomics of an educational device (not necessarily digital).

The versatility of digital tools allows, once they are mastered, to be able to use them in various fields and thus simplify their mobilization.

The ability to access educational content anywhere and at any time is an important contribution to the democratization and diversification of knowledge and learning. However, it is necessary to be aware of their limitations, to be critical of the problems of assessing their relevance and manipulating opinions. Thus, labeling, verification, and comparison of points of view are necessary so that this content can be a reasoned source of knowledge and represent reliable sources.

Within the framework of distance learning devices, among other things, we can

mention online trainings that are open to everyone, capable of accommodating a large number of participants, and hybrid distance/face-to-face (mixed learning). These are ways to offer structured content, most often verified by recognized experts. However, providing the opportunity to take training courses on their own does not guarantee that users will complete the entire training path.

The more the integration of digital technologies into educational practice develops and diversifies, the more important it becomes to assess this contribution in order to inform public policy and direct the activities of economic entities in the search for useful and reliable solutions.

Indeed, investments made in digital technologies as a result of political decisions are not always reasonable, and some information technology companies make arguments in favor of their decision that are not supported by scientific assessments.

The assessment of the impact of digital technologies on learning and vocational training processes should take into account and have several aspects that could be schematically summarized using numerical training, but also define evaluation criteria (improve the average grade? allow the most successful students to learn faster? or, on the contrary, to struggle with academic failure?) and this is when discussing the support provided to teachers in mastering digital practices. These several elements demonstrate the complexity of identifying phenomena to be evaluated, the strict definition of research issues and conditions (Roztocki et al., 2019).

If it is currently impossible to recommend a single type of assessment for all practices involving digital technologies, and therefore each study must be conducted with a specific need in mind, nevertheless it is necessary to rely on proven methodologies in other areas (implement place and track cohorts, reliable statistics, etc.), nevertheless, it is possible There are several structural initiatives, the first of which relate to the assessment of digital skills. Within this framework and in order to support European countries in developing policies, measures, programs and other mechanisms that promote the development of digital skills, the joint Research Center of the European Commission (2022) has developed the DIGCOMP 2.2 project, which provides a framework for research in the field of digital technologies.

Digital skills that are intended for all Europeans and are defined as “the safe and critical use of Information Society (TSI) technologies”. The DIGCOMP platform defines 21 competencies grouped into five areas:

1) Information literacy;
2) Communication and cooperation;
3) Creating digital content;
4) Safety;
5) Problem solving.

Based on the DIGCOMP platform, each user is given the opportunity to evaluate their digital technology skills through the platform, which also aims to certify their skill level.

In the report “for the learning society: proposals for a national higher education strategy” (Baran, 2016), the authors advocate “opening a cross-cutting platform for lifelong learning: replacing the present continuum with the current gap between primary and continuing education, which no longer meets the needs of youth, workers and enterprises, to reconsider the allocation of funds for vocational training by reducing the percentage of expenses from the tuition tax in higher education institutions, in order to, so that every fifth student is accepted for permanent or professional training.”

And this report highlights the challenges of lifelong learning: “the latter include the excessive weight of primary education, while rapid technological and social changes, as well as the diverse pace of human development, require the creation of a genuine device for lifelong learning.” These recommendations are complemented in the report by

an action plan that highlights the importance of shared or cross-cutting skills that allow adaptation: "while the most in-demand jobs today did not exist a few years ago, and while the most in-demand workers are expected to make important changes in work, therefore it seems urgent for everyone to think about conditions and cross-cutting competencies which will allow organizations and individuals to prepare for these changes, whether at the initial stage of training or during their professional training."In this case, the main task is to give each student general and cross-cutting skills that allow them to learn how to learn. Since digital learning is part of the common and end-to-end skills in a world that has become digital, as digital learning is an important task for the development of citizenship and lifelong employment opportunities.

Along with this, the Pedagogical Development Unit (2018) report "Competences for Lifelong Learning in the European Schools" is interesting, which emphasizes the importance of digital skills in developing people's abilities to learn throughout their lives. Within the framework of projects aimed at representatives of different generations, younger participants collaborate with older users in the development of technologies. In the study, users work together in a generational interaction mode to make tablets and smartphones a tool, creating intergenerational connections that, in addition to digital skills, allow them to develop social connections.

The goal is not to make everyone an expert in computer science, but to lay the foundations for mass "digital literacy", since every citizen, every employee, every artisan, every farmer, etc. must have a minimum mastery of digital skills for the ability to use, freedom of choice, in order to avoid alienation from the sides of the "machine" (computer). Therefore, it is necessary to resort to universal mobilization, because, ultimately, the most important issue is the digital divide (which often goes hand in hand with the social divide) and the building of citizens in a society that has become "digital".

Conclusion

Faced with current educational challenges, digital science research, along with other sciences, can contribute to the understanding and development of work on the research topics presented in the following recommendations.

Recommendation No. 1: Develop research projects in the field of digital sciences to achieve academic success. There are many topics related to academic performance for which digital science research can benefit, in particular by involving students in teaching activities through approaches using computer science.

Recommendation No. 2: Develop rigorous methodologies for evaluating digital education. In the past, some digital integrations were performed without evaluating their impact on learning or as part of experiments that were too limited in scope. Consequently, it is necessary to develop interdisciplinary research that will lead to thorough research that provides convincing evidence of the impact of digital technologies on education.

Another limitation of some studies on the impact of digital technologies in education is their retrospective assessment, an attempt to compare situations with and without the use of technology. The development of digital technologies in education has been based on technological advances, which have sometimes been achieved as a result of collaboration between digital technology specialists and education specialists.

Recommendation No. 3: Scaling up teacher training. Teacher training should allow for the development of their digital culture and the development of their digital skills, including the development of computer thinking (also called computational). The development of these skills should allow each teacher

- to develop a digital approach that allows him to master skills that go beyond gaining confidence in his position as a coach in the field of information technology;
- to develop skills that allow him to critically and consciously position himself in the face of digital technologies in society, as well as when integrating him in the classroom;

- to be able to effectively integrate the use of digital technologies into educational activities in their discipline.

Recommendation No. 4: Towards a "civic and popular digital university" capable of providing digital technology education for everyone. Digital education is the concern of citizens, which should lead to actions aimed at developing digital culture and digital skills among representatives of different age categories and professions. This training is particularly critical for decision makers at the local and national levels when choosing investments related to digital education, at the municipal level and more generally at the level of their departmental or regional responsibilities.

Recommendation No. 5: Create conditions for the development and updating of digital educational resources as a common domain. It is necessary to create common benefits in education that are scalable and based on the free and editable resources of the subjects of education. These resources should be able to be indexed in a way that makes them easier for teachers to use.

Currently, despite the availability of a very large number of resources, their localization and the ability to easily find the resources needed for various disciplines and levels of education remain a problem. In addition, some resources are limited in distribution because they were developed using proprietary technologies or are available only by subscription. The accessibility of all digital educational resources is an important educational challenge aimed at ensuring that educational inequalities do not worsen due to resource availability constraints.

It should be emphasized that disability situations exacerbate this problem of access to resources. In this context, we are talking about the lack of digital accessibility, which de facto deprives people of the basic right of all citizens to education. This remark can be expanded to access information, entertainment, and employment using digital technology tools that have become mandatory today.

Finally, we can remind you that this exception is all the more painful to experience and realize that digital technologies offer potentially useful solutions for people with disabilities.

Recommendation No. 6: Ensure the portability of personal data for educational purposes and improve the compatibility of software solutions. It is necessary to create such a regulation based on the principles of "confidentiality by design" and individual consent, which guarantees the portability of data for everyone, which, therefore, is a mandatory right. To date, no system, including within the framework of national education or higher education, guarantees such portability. It is necessary to create conditions that would allow individuals to manage their personal data in local or online secure storage systems and share them at any time and with any person of their choice. We recommend creating an individual learning file that allows any student and a female student to reuse their educational data in the already mentioned context of the learning society and which is fully consistent with the reform of the personal learning account.

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