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Theoretical article

The Development of Competences Specific to Primary Education Objects as a Prerequisite for the Development of Students' Digital Competence

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Abstract

The development of the digital competence is a lifelong learning goal, which will remain stable, taking into account the digitization of societies and global economies. In this context and unlike the other European states, in the Romanian curriculum, the digital competence can not be found among the acquisitions of learning at the primary education level. In the absence of some clearly formulated learning objectives, which could be integrated into the development of digital competence, the teaching staff has the option to adapt the learning activities or to propose some new ones, so that the projection of the lessons ensures a teaching approach adequate to the acquisition of digital knowledge and skills. This paper highlights the possibilities of developing the specific competences of the objects in the current education framework plan for primary education, in a prototype approach to support the premise of their integration in the development of digital competence.

Keywords:
digital competence; specific competences; primary education; integrated learning.

Zusammenfasung

Digitale Kompetenz ist ein lebenslanges Lernziel, und dieses Ziel wird auch angesichts der Digitalisierung von Gesellschaften und Weltwirtschaften stabil bleiben. In diesem Zusammenhang und im Gegensatz zu anderen europäischen Staaten ist digitale Kompetenz im rumänischen Lehrplan nicht unter den Lernerwerben im Primarbereich zu finden. In Ermangelung klar formulierter Lernziele, die in die Entwicklung digitaler Kompetenz integriert werden können, besteht für das Lehrpersonal die Möglichkeit, die Lernaktivitäten anzupassen oder neue vorzuschlagen, sodass die Projektion des Unterrichts einen angemessenen Unterrichtsansatz gewährleistet Erwerb von Wissen und Fähigkeiten digital. Dieser Beitrag beleuchtet die Möglichkeiten, die spezifischen Kompetenzen der Fächer im aktuellen Bildungsrahmenplan für die Grundschulbildung in einem prototypischen Ansatz zu entwickeln, um die Prämisse ihrer Integration in die Entwicklung digitaler Kompetenz zu unterstützen.

Schlüsselworte:
digitale Kompetenz; spezifische Fähigkeiten; Grundschulbildung; Integriertes Lernen.

1. Introduction

Digital competence is a learning objective which, although closely related to those aspects of life which are subject to the most frequent and profound changes, is nevertheless a long-standing and lifelong topic (Council of the European Union, 2006). To such a goal, some education systems have responded more quickly, others more slowly, as is the case in Romania, with reference to the primary education level (European Commission, 2019), although the importance of digital competence has been reconfirmed, 12 years later, through the update of the *Council of the European Union Recommendation on key competences for lifelong learning* (Council of the European Union, 2018). Thus, Member States are directed to contribute to raising the level of digital competence, paying special attention to it at all levels of the education and training process.

In order to shape a common vision for the implementation of digital education at Member State level, in response to the depth and high frequency of change brought about by the use and development of digital technologies, the European Commission (2018) has developed an *Action Plan for Digital Education*, whose principles and priorities have been partially updated after two years to cover the challenges brought about by the COVID-19 pandemic. Noting that there are substantial differences between the levels at which technology is used in everyday life and in education, a first priority set was to harness the untapped potential that technologies offer to improve learning (European Commission, 2018). The priority, in the time of the pandemic and the relocation of learning to the online space, has been updated to the demands of the moment by encouraging investment in a high-performance digital education ecosystem (European Commission, 2020). This refers to a combination of factors to ensure that education is properly adapted to the digital transformation, through actions that include both investment in and development of the digital logistics of formal

education systems, together with good connectivity to the internet, and the development of high quality educational content to meet educational objectives, including learning modes that involve the delivery of content mediated by the online environment.

A second priority has focused on developing skills relevant to digital transformation, emphasising the importance of acquiring digital skills with foundations laid from an early age and with continuity throughout life (European Commission, 2018). The emerging nature of everyday practices in the digital age, where in the labour market transformations are dictated by the use of robots and artificial intelligence (Iacob, 2020), and outside the field of work transformations are also dictated by digital technologies, the need to enhance digital skills and competences as a priority for digital transformation has been reiterated (European Commission, 2020). This recognises the value of the whole thematic spectrum from digital literacy to computer science education, with suggestions for the introduction of compulsory elements aimed at developing digital skills in early school age pupils, as these are essential for understanding the digital world and how contemporary society works.

2. Problem statement

Whether in industry, politics or education, digital technologies are now found in every area of modern society (Secundo et al., 2020), and the digitisation of societies continues to be an unstoppable process (Catalano, 2021). In this context, digital competence is needed in all perspectives of life and needs to be developed from early school age onwards, including and especially through formal education that should accelerate the process of adaptation to digital education. Key competences and implicitly digital competences have been assumed for public education and are found in the Romanian National Education Act (No 1/2011), which in Art. 68, para. 1, states that the profile of the pupil's education, according to the national curriculum for primary and secondary education, focuses on the 8 areas of key competences (Romanian Parliament, 2011). However, a Eurydice report on *Digital Education at School in Europe* (European Commission, 2019) indicates that, at primary school level in Romania, digital competence is not addressed in the teaching-learning process. Even a more detailed analysis between general and specific competences in all school curricula for primary education, in force in 2021, through a search by keywords describing digital competence, the results are minimal (Bănuț & Albulescu, 2021), with only the term *digital* being found in two cases, but also here as an alternative or secondary option to content in traditional format. These are *C.S. 4.2. Writing short functional texts on paper or digital media* (MEN [Ministry of National Education], 2014b), a competence specific (C.S.) to the discipline of *Romanian Language and Literature* for grade 4, and *C.S. 3.2. Identifying important elements of an event on a poster (including digital poster)* (MEN, 2014c) or on another medium, a competence specific to the discipline of *Modern Language* for grade 4. Thus, the lack of integration of digital skills into teaching at primary curriculum level is a reality unfavourable to the acquisition of digital skills from an early age.

Taking into account the above finding, it can be deduced that educational policy has no counterpart in curriculum design and especially in teaching design at primary school level. More specifically, the possibilities for developing digital competence are diluted along the educational policy - curriculum design - teaching process pathway. This is a shortcoming in the educational process, to which this paper aims to make a contribution in the actions plan for digital education. The field of information technology remains unexplored at primary school level, where the start is made in the development of digital skills at an elementary level, but the possibilities exist and are more accessible than one might think, starting from the specific competences of primary school subjects, whose development is possible in an interdisciplinary approach.

3. Ways of digitalising primary education

In the current romanian curriculum, digital competence is directly targeted at secondary school level through the subject of *Informatics and ICT* (MEN, 2017), but indirectly it can be developed based on primary school curricula, as developed in 2013 in the current framework plan for primary education (MEN, 2013a) and the school programmes for this level of education. Such a pathway is a digital competence development pathway that ensures compatibility between the content of the various subjects studied by pupils, with the integrated approach making the connection between different areas of study and resonating with STEAM (Science, Technology, Engineering, Arts, Mathematics) learning.

A first and best example of a pre-middle school experience, useful in the process of developing digital competence, is the subject of *Mathematics*, studied in grades 3 and 4. A selection of specific competences

(S.C.) pursued by the school curriculum and which can also be developed simultaneously through an interdisciplinary approach and the integration of information technology content, useful in the formation of digital competence, is (MEN, 2014a):

- "Explaining patterns/regularity to create own reasoning" (C.S. 1.1.);
- "Generation of repetitive patterns/regularity" (C.S. 1.2.);
- "Ordering of natural numbers in the range 0 - 1 000 000 and fractions having the same numerator or denominator less than or equal to 10 or denominator equal to 100" (C.S. 2.3.);
- "Use of standardised instruments and units of measurement in concrete situations, including for the validation of transformations" (C.S. 4.1.);
- "Operating with standardised units of measurement using transformations" (C.S. 4.2.);
- "Organising data in tables and their graphical representation" (C.S. 5.2.).

The computer is, for these examples, both a resource and a suitable means for achieving educational goals and can answer two essential questions: what will I do with and how will I do it? The specific competences listed are useful when starting to study *Informatics and ICT*, as they make it easier to understand how a computer processes data. It is capable of sorting and ordering various lists (by name, by price) and does so on the basis of a mathematical algorithm implemented behind the application that meets the sorting need. The mathematics helps to explain these algorithms and to *generate repeatable models* that support the recursion of performing operations in a data sorting problem. Also, learning to *organize data into tables and represent them graphically* is facilitated when the iconic ledger and applications that have this attribute of representing by drawing/diagrams the variation of data magnitudes centralized and organized by the learner are used.

In identifying relationships with the surrounding reality and presenting this reality on electronic devices, the *Romanian language and literature* discipline makes a notable contribution. Socialization and communication take place to a large extent online and then this is a familiar context for students to receive, write, express messages and develop skills such as (MEN, 2014b):

- "Recognizing and correcting spelling and punctuation errors in writing" (C.S. 4.1.);
- "Writing short functional texts on paper or digitally" (C.S. 4.2.);
- "Show an interest in creative writing and in writing informative and functional texts" (C.S. 4.5.).

Electronic communication situations also require the ability to understand such messages and to communicate in writing. In this context, however, it is instructive to differentiate the drafting of messages according to the communication situation and the tools used. As spelling and punctuation mistakes in digitally written texts are more frequent and sometimes inherent in the specificity of writing from the console, they can be relevant examples for recognising and correcting them, error-free writing and practice in writing on digital media can be exploited by integrating digital education in primary education.

Also, modern language and especially English frequently intersects with computer science, online space and programming languages. When surfing this huge, global network that is the internet, one often accesses web pages with information displayed in English. Extracting details from online texts or correctly retrieving the information someone is looking for is an activity that integrated into the teaching-learning process leads to an interdisciplinary lesson. Moreover, when studying how those web pages, or apps or digital games were made, one explores computer programming languages, whose syntax uses English keywords and then, this discipline, becomes a precondition for the development of digital competence, which includes computer programming (Vuorikari et al., 2022). This type of learning acquisition that is achieved by analyzing code proposes an experience similar to those cases where reading is learned before writing, the advantage of such an approach being that the learning situation is adapted to the characteristics of novice programmers, not requiring a particular programming language, along with the adaptation of the learning situation to the logistics of primary schools, not requiring a computer to program (Selby, 2011). In this sense, a short list of educational aims that can be successfully integrated into the development of digital competence is complemented by subject-specific competences in *English language* at primary school level as well (MEN, 2014c):

- "Identify details in simple texts containing common information" (C.S. 3.1.);

- "Writing simple messages about self/others" (C.S. 4.2.).

Virtual reality reproduces the surrounding reality and for a more faithful correlation between the two dimensions or a correct perception of both realities, the discipline of *Natural Sciences* is the link between the two worlds. The problem of identifying ways of protecting the environment can be raised in relation to technological development, whereby end users access a variety of electrical and electronic equipment which generally has an extremely limited and short lifespan compared to the life of a human being, leading to the periodic replacement of working equipment, and the abandonment of old equipment weighs heavily on the planet's ecosystem which must be protected. This is even a learning objective promoted by UNESCO through the new Education Agenda for the SDGs (Sustainable Development Goals) *Education 2030* where, one of the goals, SDG 12 is "Responsible consumption and production" (UNESCO, 2017, p. 34). This goal includes and takes into account the considerable amount of waste produced globally, and the waste generated by the use of technology, called WEEE (waste electrical and electronic equipment) and its legal disposal is an integrated learned responsibility by addressing the contents of the computer domain, with every computer system, accessory or digital peripheral equipment being subject to such accountability. Thus, between the use of digital technologies and environmental protection, which is also a digital competence (Vuorikari et al., 2022), there is a strong relationship based on the knowledge of "eco" behaviours to follow when disposing of unused devices, but also when purchasing new ones, valuing those products with lower energy consumption, less polluting (including in terms of noise pollution), as well as those products with packaging made from recycled materials. In such a context, the aims in the study of the *Natural Sciences* discipline, which pursue a desirable profile for the society of the future and which take into account the relationship between digital technology and the environment, are (MEN, 2014d):

- "Identify relationships between bodies within phenomena and processes" (C.S. 1.1.);
- "Identify ways to protect the environment" (S.C. 3.2.).

The computer reproduces situations from the surrounding reality and these situations serve to develop computational thinking. There are subjects that involve less computer use such as *Physical Education*, although the trend in physical activities is to use digital technology to measure parameters such as heart rate, blood pressure, calories burned, distance travelled, but can also provide situations for classroom activities that can be translated into the development of logical, computational thinking and foster the development of digital competence. One such example is the ordering of students by height before the start of sports class, and as the computer is extremely fast at ordering various lists, text or numbers, alphabetically or ascending/descending, in *Informatics and ICT* class this aesthetic component of sports class can be harnessed by challenging students with questions such as *If the sports teacher were a computer or a robot, how do you think he/she would order you so that you are aligned by height*? In the list of competences specific to the discipline of *Physical Education*, on the basis of which sports skills can be used in the process of developing computational thinking, necessary in the design of ordering or sorting algorithms, is (MEN, 2014e):

- "Exploiting sports skills with an aesthetic component in class/unit representation activities" (C.S. 2.7.).

There are many interconnections and causal links between the discipline of *Personal Development* and the field of Informatics. As digital technologies are present in all sectors of activity and their use is constantly increasing, they have major implications for personal development and are one of the causes of success or failure in the modern world, if not certainly in the current economy where successful companies are those that have managed to harness digital tools in their economic activity, such as SpaceX, Epic Games, Open AI, Grammarly, Monzo, etc. (CB Information Services, 2023). Digital technologies accompany the individual in both work and leisure time, becoming assistants in human actions, but just as they are useful in the various professions practised, these professions in turn provide both contexts for the implementation of digital technologies and learning contexts for the development of digital competence, establishing a reciprocal relationship. An example is the job of a chef who works with ingredients and then engages in actions that transform selected ingredients into a dish. This is an example which, by analogy, can be used to make understanding of IT processes accessible to the characteristics of primary school pupils. The program is the expression of an algorithm in a programming language, and in the above case, by analogy, the ingredients are the data with which the program operates and the steps the chef goes through to

complete the preparation are the sequences of instructions executed by running the program. Thus the primary school pupil can learn that, in computer science, a particular sequence of instructions is called a program. The subject-specific competence *Personal Development*, which captures this aspect, is (MEN, 2013b):

- "Presentation of the usefulness of known trades/occupations" (C.S. 3.3.).

Last but not least, *Music and Movement* object provides the framework for developing and practising digital competence. A brief selection of specific competences from the school curriculum that interrelate with digital competence are (MEN, 2014f):

- "Reception of songs from children's folklore, carols, accessible works from the cultural heritage, with the perception of differences of a musical nature and body/stage movement" (C.S. 1.1.);
- "The manifestation of reactions, emotions, feelings suggested by musical fragments accompanied by dance" (C.S. 3.1.);
- "Improvisation of songs, associated with body movements" (C.S. 3.3.).

The reception of songs and the manifestation of emotions suggested by these musical fragments can be obtained and amplified through the use of digital technologies, by listening to or watching on digital terminals, musical fragments accompanied by dance. The improvisation of songs is also most easily achieved with the help of digital technologies, taking into account the possibilities unlocked by the digital transformation. A computer can include and reproduce the sounds of all musical instruments, instrumental in facilitating musical experiments that the formal logistical infrastructure does not have or would require more storage space. Further, learning experiences of music theory and practice in primary schools depend more on the teaching setting than the curriculum (Laato et al., 2019). Digital technologies today offer a wide range of applications that make it possible to generate sounds electronically, making melodic-rhythmic fragments, in digital space, extremely accessible. Moreover, digital technologies have the capacity to give music lessons a legendary character and to reposition the discipline responsible for the realisation of music education on an important place in the curriculum by integrating contents with those specific to computer programming. Discipline-specific learning objectives can be achieved by generating sounds with the help of programming languages through specificities of transdisciplinarity aimed at unifying contents and merging knowledge (Popovici Borzea, 2017) relevant for connecting the teaching-learning process to issues in the surrounding reality. The great advantage is that computer programming skills, increasingly in demand in the job market, are trained without minimizing the learning acquisitions specific to music education, the romanian text book *Mici muzicieni, mari programatori* [Little musicians, big programmers] (Bănuț, 2022) being a digital learning and co-facilitation resource that addresses music and programming in an integrated way through 25 worksheets and that does not require experience or pre-requisites from the programming sphere, as computers provide immediate and as suggestive as possible sound feedback for the comprehension of written codes.

4. Conclusions

Thinking ahead, it is stated that the future content of the instructional-educational process will have a broader scope which, not surprisingly, will not be limited to technologies, especially digital ones, but will include, in relation to them, elements of ethics, civic/social education, foreign languages and other inherent elements deriving from the use of digital tools (Prensky, 2001). In this context, adapting and synchronizing the educational process to the pace of technological evolution is a challenge in instructional design as well as in lesson design. Against the backdrop of the characteristics of the global economy and societies, which require training in relation to digital transformation, preparation to be digitally competitive can be initiated by integrating knowledge already accessed through the subjects covered at primary school level, as these are educational opportunities available at any time.

Digital competence, as a key competence and transversal competence, has the advantage of being developed through a specific subject, integrated into another compulsory subject or through a cross-curricular learning pathway, which also crosses over to other school subjects. In the latter case, the common core subjects in primary education are genuine tools for building digital competence. This paper provides a series of answers that a primary school teacher would seek to the question: What are the possibilities to contribute to the development of digital competence through the teaching-learning process of subjects from different curricular areas? The examples listed open up the possibility of adhering to digitalisation approaches in education from the very beginning of a transition

process from curriculum to e-curriculum for primary education.

With regard to the problematic framework that reveals the absence of directly addressing digital competence at the romanian primary education level, it can be noted, however, that the learning experience at this level can be valorised into a transferable resource for the next level of studies, in terms of prerequisites for the knowledge and skills required by the discipline of *Informatics and ICT*. Thus, digital competence is also achieved by linking the teaching approach to other school subjects. Therefore, the suggestions of this paper, located at the intersection of the theoretical and practical-applicative levels, are options aimed at achieving interdisciplinary connections and supporting the improvement of the teaching-learning process through the integration of digital competence. Thus, the development of subject-specific competences in primary education is a prerequisite for the development of pupils' digital competence, and achieving such a relationship in the teaching-learning process carried out is the subject of concern for current and forward-looking teaching approaches.

Authors note:

Marius Bănuț, engineer in technology information and a PhD. in Educational Sciences, is interested in research aimed at the role and advantages of using digital technologies for specific purposes, such as: making teaching more efficient, producing better and faster learning, as well as developing students' digital competence.

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