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VISION OF DIGITAL COMPETENCES OF PRIMARY SCHOOL STUDENTS AND TEACHERS IN BULGARIA IN EDUCATIONAL DOCUMENTATION OF THE SUBJECT "COMPUTER MODELLING"

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Abstract. This paper is the first part of a larger study on the vision of digital competences of primary school students and teachers in Bulgaria in the educational documentation. It attempts to explore the place and the approaches for developing digital competencies in the educational documentation concerning the Bulgarian primary school subject "Computer Modelling" (CM) and to define the necessary competencies for primary school teachers to develop the digital competencies of students within this subject. The primary research methods employed in the study are curriculum mapping, document analysis and comparative analysis of educational documentation as well as textbooks and methodological guides for primary school teachers. The results of the study demonstrate that the curricula predominantly focus on the development of programming skills, occasionally at the expense of other areas of digital competence. It raises the need to reconsider the CM curriculum to ensure a more balanced emphasis on different competence areas, which could also be achieved through their integration into other school subjects. The importance of the professional competence of the teachers for successful development of students' digital competencies is also highlighted in the paper. Some concerns regarding the efficacy of teaching the CM subject are raised accordingly. The emerging need for an in-depth empirical study of the factual state of the digital competences of teachers and students is indicated.

Keywords: digital competence; primary school; Computer Modelling; DigComp; DigCompEdu

Introduction

Digital competence is one of the key competences for lifelong learning, which is 'the confident, critical and responsible use of, and engagement with,

digital technologies for learning, at work and for participation in society'. Competency content includes 'information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking' (Vourikari et al. 2022). It is also the starting point for the knowledge, skills, and attitudes which European curricula for the development of digital competence should strive to achieve. In addition, the Digital Education Action Plan (2021 – 2027) of the European Commission (2020) emphasizes the need to promote, support and expand the targeted use of digital and innovative educational practices. The first priorities in the Action Plan are precisely related to the better use of digital technologies for teaching and learning. This emphasis aligns with the objectives of numerous educational reforms directed towards the digital transformation of education.

The "Digital Education at School in Europe" study, commissioned by the Eurydice network to the European Commission (2019), delineates approaches to fostering digital competences in students and teachers, examining curricula, teachers' digital proficiencies, and digital competence assessment across European countries, including Bulgaria. The report emphasizes the two distinct yet complementary priorities in the action plan: the enhancement of digital competences among learners and teachers, and the pedagogical utilization of digital technologies to support, enhance, and transform learning and teaching.

The development of learners' digital skills is part of all primary education curricula of European education systems in two ways – as a core and/or as a transversal key competence. As outlined in the report, the integration of digital competence in primary grade teaching documentation is achieved through three primary approaches: 1) as a ***cross-curricular theme:*** digital competences are understood to be transversal and are therefore taught across all subjects in the curriculum; 2) as a ***separate subject*****:** digital competences are taught as a separate subject area similar to other traditional subject-based competences; 3) ***integrated into other subjects:*** digital competences are incorporated into the curriculum of other subjects - EC, Eurydice, 2019. The report highlights that the second approach is applied in primary school education in Bulgaria – digital competences are primarily taught as a separate subject, known as 'Computer Modelling' (CM), which has been part of the 3rd and 4th-grade curriculum since 2019. However, the approach in Bulgaria is mixed and includes elements from the other approaches as well. As part of the educational reform initiated in 2015, a competence-based approach was adopted for developing new curricula across all subjects. Digital competence is one of the eight key competences integrated into these curricula. Consequently, digital competences are presented as key competences in all subjects with the corre-

sponding activities for their development. This outlines the two main aspects of the study regarding the vision for digital competencies in primary school students in Bulgaria within educational documentation – in the subject 'Computer Modelling' and within the education of all other subjects.

This paper is a part of a broader study that focuses on analysing the priorities in the Digital Education Action Plan of developing digital competences among both students and teachers, while exploring the integration of digital competences within the existing teaching documentation for primary education in Bulgaria. The paper specifically delves into the current state and vision of digital competencies, particularly within the subject CM, which plays a foundational role in fostering these competencies among primary school students in Bulgaria.

To examine educational documentation, the study utilizes the European Framework for Digital Competence for Citizens, DigComp 2.2 (Vuorikari et al. 2022), and the European Framework for Digital Competence for Educators, DigCompEdu (Punie 2017). These frameworks describe the digital knowledge, skills, and attitudes that all citizens/educators need in various fields in the rapidly evolving digital society. In the framework for citizens, digital competencies are categorized into the following five areas: 1) Information and data literacy; 2) Communication and collaboration; 3) Creating digital content; 4) Safety; 5) Problem-solving. Regarding the pedagogical use of digital technologies, the primary factor is the competence of teachers. For their specific roles in primary school education, the areas and levels of competence outlined in DigCompEdu are as follows: 1) Professional engagement; 2) Digital resources; 3) Teaching and learning; 4) Assessment; 5) Empowering learners; 6) Facilitating learners' digital competence. As noted in the "Eurydice" report, in addition to teachers' competence in using digital technologies, pedagogy plays a central role. It is even suggested that teachers do not necessarily need to be fully proficient in the technologies to use them in ways that enhance teaching and learning. Rather, teachers should be open to innovative pedagogical methods and understand the benefits that these technologies can bring to their practice. The competence framework for teachers includes competencies related to the pedagogical use of technologies, which is most broadly defined as the ability to use digital information and communication technologies, multimedia, tools, materials, and facilities in a functional, critical, and creative manner in teaching.

What competences are expected to be mastered by students at the primary stage in Bulgaria and what competences teachers need to acquire in order to develop digital competence in their students are important questions, the answer to which should be sought both in the educational documentation and in the classrooms. In this regard, the ***research questions (RQs)*** posed by this

current theoretical study are as follows: RQ1: What is the place of digital competencies in the educational documentation in Bulgaria concerning the subject "Computer Modelling"? RQ2: What are the approaches for building digital competencies in primary school students according to the educational documentation on "Computer Modelling"? RQ3: What competencies should primary school teachers possess to develop the digital competencies of students in the subject "Computer Modelling"? The answers to these questions will be sought in the following paragraphs.

Research Methodology

The primary ***research methods*** employed in this study are curriculum mapping, document and content analysis and comparative analysis. The study encompasses normative and educational documentation (national educational standards and curriculum), as well as textbooks and methodological guides intended for primary school teachers. For the purposes of this study within the context of digital competencies, the national educational standard for the primary education stage[1] has been analysed. Additionally, in-depth examinations were carried out on the two curricula on CM for 3rd and 4th grades (8 – 10-year-olds)[2]. The content of these documents was compared with the two competency frameworks – for citizens and for educators (DigComp 2.2 and DigCompEdu). To provide a clearer picture of the educational documentation for the development of digital competencies in students and their integration into teaching, learning, and assessment, all twelve currently active sets of instructional materials for the subject CM (six for 3rd grade and six for 4th grade)[3] were examined and analysed comparatively. This examination also included the methodological guides for teachers accompanying each set, totalling 34 textbooks and supplementary materials (12 textbooks, 10 workbooks, and 12 teacher's guides).

Digital competence in the content of the subject 'Computer Modelling'

As part of Bulgaria's curriculum reform for digital competencies in the 2018/2019 academic year, the subject CM was introduced at the primary education level. The training comprises 32 study hours for 3rd grade and 34 study hours for 4th grade (1 hour per week). According to the curriculum, it aims to impart foundational knowledge, skills, and attitudes related to the development of students' digital literacy through the creation of computer models of familiar objects, processes, and phenomena and experimenting with them. In the national educational standard (NES) for CM[1] at the end of the 4th grade, the four competency areas of the subject are presented, along with the corresponding expected outcomes: 1) Digital devices; 2) Digital identity; 3) Information; 4) Algorithms. The educational emphasis is on acquiring knowledge

and skills for working with digital devices, creating animated projects using algorithms with conditions and repetitions through a visual block-based programming environment. As programming that requires algorithmic thinking is an essential component of the digital competencies required by citizens in contemporary society (Koleva 2019), it is not surprising that approximately 65 – 70% of the educational content in CM is dedicated to topics related to programming. In CM classes, students utilize a programming environment to create their interactive stories and animations (3rd grade); tests, puzzles, games, and control of robotic devices (4th grade). According to the content of the CM textbooks, the primary environment used for visual block-based programming is Scratch.

Each of the competency areas from DigComp 2.2 and its integration in the CM curriculum is outlined below. CM textbooks were consulted for additional clarification when needed. Following the presentation of individual areas, the competencies that teachers need to develop to teach the corresponding topic, as per DigCompEdu, are also presented. For each competency area according to DigComp 2.2, which should be developed at the foundation level by students, teachers are expected to have at least an advanced level competence. Furthermore, they should possess the pedagogical competencies necessary for fostering digital competencies in students, as described in DigCompEdu.

Competency Area 1: Information and Data Literacy

The curriculum partially addresses the three distinct aspects of this digital competency, with all of them being grouped under the competency area 'Information' in the 4th-grade curriculum (there is no such area in the 3rd-grade curriculum). The topics and expected outcomes, as outlined in the curriculum, serve as the means through which this subdomain of DigComp is expected to be implemented and are presented in Table 1.

Table 1. Competency Area from DigComp 1. and their implementation through topics and expected outcomes in the CM curriculum

Subdomains of DigComp 2.2.	**Topics and expected outcomes from the CM curriculum (4th grade)**
1.1 Browsing, searching and filtering data, information and digital content (articulating information needs for searching data, information, and content in digital environments, accessing them, and navigating between them. Creating and updating personal search strategies)	Topic: 'Information/Types of Information': • Recognizes the ways of obtaining information (including perceptions - hearing, vision, receptors). Recognizes the forms of information presentation (textual, numerical, auditory, graphical).

1.2 Evaluating data, information and digital content (Analyzing, comparing, and critically evaluating the credibility and reliability of data, information, and digital content sources. Analyzing, interpreting, and critically evaluating data, information, and digital content. Determining the credibility and reliability of shared sources of data, information, and their digital content)	Topic: 'Information in Contemporary Society' • Understands that digital resources may not be free for use, copying, and distribution. Understands that not all information in the virtual space is trustworthy.
1.3 Managing data, information, and digital content (Organizing, storing, and retrieving data, information, and content in digital environments. Organizing and processing them in a structured environment. Selecting data, information, and content to organize, store, and retrieve routinely in digital environments. Organizing them routinely in a structured environment)	Topic: 'Information and Digital Devices' • Understands the primary purpose of digital devices. • Knows how information is stored in digital devices. • Knows how information is processed in digital devices. • Recognizes and compares units of measurement for file sizes used.

In fact, the expected outcomes related to 1.1. (Browsing, searching and filtering data, information and digital content) are not fully implemented according to the idea presented in DigComp 2.2. Students are only superficially introduced to concepts such as searching for information and the relevant specifics of this process in the surrounding and digital environment. There is a lack of targeted work for articulating information needs, and navigation in different digital environments is limited given the students' age. Search strategies are not explicitly introduced.

Although the work on 1.2. (Evaluating data, information and digital content) is designed for only 2 study hours, this topic is presented in much greater depth compared to the previous one and includes most of the competencies outlined in the framework, albeit at a basic level. Across all textbooks, there is a consistent recognition of the need for more lessons on the topic since the instructional content is quite condensed, delivering a substantial amount of information in a single lesson.

Subdomain 1.3. (Managing data, information, and digital content) is relatively well-implemented in the textbooks, as far as it is feasible with students of this age group. The Scratch application is primarily used for this purpose (in both online and offline formats).

The competencies of teachers for teaching CM in the field

In order to teach effectively and develop students' knowledge, skills, and attitudes, teachers must develop competence at the B1 level for ***Facilitating Learners,*** in the ***Information and Media Literacy*** domain. At the ***Integrator level*** (B1), teachers are expected to engage in activities that promote the information

and media literacy of their students. They should be able to implement learning activities in which learners use digital technologies to retrieve information and teach them how to find information, assess its reliability, and compare and combine information from different sources.

Competency Area 2. Communication & Collaboration

In the CM curriculum, there are topics related to only two out of the six sub-areas of this competency, namely 2.2 Sharing through digital technologies and 2.6 Managing digital identity. There are no planned activities related to the remaining topics: 2.1 Interacting through digital technologies, 2.3 Engaging citizenship through digital technologies, 2.4 Collaborating through digital technologies, and 2.5 Netiquette, although Netiquette is mentioned in some textbooks.

The topics and learning outcomes at the curriculum level through which sub-area 2 of the DigComp is envisaged to be implemented are presented in Table 2.

Table 2. Competency Area from DigComp 2 and their implementation through topics and expected outcomes in the CM curriculum

Subdomains of DigComp 2.2.	Topics and expected outcomes from the CM curriculum – 3rd and 4th grade
2.2 Sharing through digital technologies (To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices. To recognize basic suitable digital technologies for sharing data, information, and digital content.)	Topic: 'Present their own project in both real and virtual environments' • Share the completed project in designated places on the internet (3rd grade) • Create the project and present it in both real and virtual environments (3rd grade)

2.6 Managing digital identity (To create and manage one or multiple digital identities, to be able to protect one's own reputation, to deal with the data that one produces through several digital tools, environments and services. To identify digital identity, describe simple ways to protect one's online reputation, and recognize basic data generated through digital tools, environments, or services.)	**3rd grade** – topic: 'Creating a user profile' • Creates a personal avatar in a learning management system • Operates in a virtual environment and topic: 'Digital and physical identity': • Distinguishes between digital and physical identity • Recognizes basic threats in the digital environment • Applies rules for responding to threats in the digital environment • Knows not to provide personal information during communication or work in a virtual environment	**4th grade** – topic 'Conditions for safety in a digital environment': • Does not provide personal information in a digital environment • Recognizes well-known threats when working in a digital environment • Knows how to seek help when needed • Understands ethical norms when working in an online environment • Knows the benefits and drawbacks of using digital devices for the environment

Topic 2.2 (sharing through digital technologies) appears to be underrepresented. This could be attributed to the necessity of obtaining parental consent for students under 14 years old when sharing information in a virtual environment. All data and information sharing occurs within secure learning platforms like Scratch and Code, following registration with parental approval. Despite the collaborative nature of project-based learning, it is evident that the assigned projects, as per the guidelines in textbooks and instructional materials, predominantly emphasize individual efforts.

The term "digital identity" is introduced as early as the 3rd grade, where students learn to distinguish it from physical identity. The topic of managing digital identity is well-represented, to some extent overlapping with the realm of safety.

The competencies of teachers for teaching CM in the field

In order to teach effectively and enhance students' knowledge, skills, and attitudes, teachers should develop the following competencies at the Integrator level (B1): 1) ***Creating Digital Content*** – Integrator (B1) – Implementing activities fostering digital content creation by learners. The teacher should be able to implement learning activities in which learners use digital technologies to produce digital content, e.g., in the form of text, photos, other images, videos, etc. The teacher should also encourage learners to publish and share their digital productions. 2) ***Responsible Use*** - Integrator (B1) - Implementing measures to ensure learners' wellbeing. The teacher should be able to give practical and experience-based advice on how to protect privacy and data, e.g., using passwords, adjusting the settings of social media. Additionally, they should assist learners in protecting their digital identity and

managing their digital footprint. The teacher should also offer advice to learners on effective measures to confine or counter the impact of inappropriate behaviour (of their own or their peers). 3) ***Digital Communication and Collaboration*** - Integrator (B1) - Implementing activities fostering learners' digital communication and collaboration. Teachers should be able to implement learning activities in which learners use digital technologies for communication. They should guide learners in respecting behavioural norms, appropriately selecting communication strategies and channels, and being aware of cultural and social diversity in digital environments.

Competency Area 3. Digital Content Creation

This DigComp area is most effectively developed in the curricula. It places a primary focus on programming, a substantial component of the subject's instructional content. Expected outcomes related to the creation of digital content are embedded to varying degrees throughout the curriculum, as evident in Table 3 below.

Table 3. Competency Area from DigComp 3 and their implementation through topics and expected outcomes in the CM curriculum

Subdomains of DigComp 2.2.	**Topics and expected outcomes from the CM curriculum**	
3.1 Developing Digital Content (Creating and editing digital content in various formats, expressing oneself through digital means. Identifying ways to create and edit simple content in simple formats, choosing how to express ideas through through the creation of simple digital means..)	3rd grade - Topic: What is Animation? • Introduction to the world of animation • Creating a short animation on paper • Creating a short animation in a visual environment • Creating a dialogue between multiple characters • Crafting stories based on given plots • Ensuring logical progression and recreating it using the necessary blocks. Project Work • Planning and preparing resources for implementing an artistic idea • Creating a personal animated card	4th grade - Topic: What is Animation? • Creating a game using the features of a specific visual environment • Knowing how to choose characters based on the given plot • Able to set basic characteristics - costumes and select a scene • Establishing rules for the game. Project Work • Determining the necessary resources for a given project • Choosing the type of project to be created: a test, comic, puzzle, game, calculator, etc.

3.2. Integrating and Re-elaborating Digital Content (Modifying, refining, and integrating new information and content into an existing body of knowledge and resources to create new, original, and relevant content and knowledge. Selecting ways to modify, refine, refine, improve and integrate simple items of new content and information to create new and original ones.)	The expected outcomes in the curriculum related to the implementation of this competency combine those presented in points 3.1 and 3.4.
3.3. Copyright and Licenses (Understanding how copyright and licenses apply to digital information and content. Identifying basic rules of copyright and licenses that apply to data, digital information, and content.)	4th grade – Topic: "Information in Contemporary Society" • Understanding that digital resources may not be free for use, copying, and distribution • Understanding that not all information in virtual space is reliable
3.4. Programming (Planning and developing a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.)	The expected learning outcomes for this topic in 4th grade are over 20, while for the 3th grade, they exceed 40 and therefore are detailed in Appendix 1

It is evident that the development of digital content (3.1) in the curriculum is implemented with a focus on block programming and project development in a virtual environment, rather than emphasizing "creating and editing content in simple formats" as outlined in the framework. The integration and re-elaboration of digital content (3.2) is built upon the work in 3.1 and 3.4 and are primarily associated with project work in the block programming environment. Copyright and licenses, essential to the 4th-grade topic "Information in Contemporary Society", receive limited attention, treated as separate elements. Programming is the most widely covered competence in the curricula. It is linked to various activities in the field of block programming and constitutes approximately 65 – 70% of the subject's lessons.

Upon reviewing textbooks and teacher guides, it becomes apparent that there is considerable freedom of interpretation and a divergence in the emphasis placed on teaching the competence 3.3. Copyright and Licenses. In addition to the lack of uniformity, the coverage of the topic is notably insufficient (within only a single lesson), providing scant opportunity for exercises. The topic is extensive and important, and it could be presented in a more accessible way to students by including appropriate exercises. However, a substantial portion of the educational content is dedicated to programming-related topics, potentially limiting the opportunities to more appropriate distribution of the 3.3. content.

Obviously, the focus in the CM education, as suggested by its name, is on program-

ming and work in the third area of digital competence. The motivation behind this decision probably is to provide students with programming skills from an early age, aiming to educate a generation prepared for the professions of the future and the increasing demand for programmers.

However, it raises the question of whether this emphasis might overshadow other digital competencies, prompting consideration for a more balanced approach. Notably, the curriculum covered by Bulgarian students in one year of 3rd grade is distributed across three years in other countries like UK (Koleva 2019).

The competencies of teachers for teaching CM in the field

In order to teach effectively and enhance students' knowledge, skills, and attitudes, teachers should develop the following competencies at the Integrator level (B1) to support the learners:

1) ***Information and Media Literacy*** – Integrator (B1) – Implementation of learning activities to promote the information and media literacy of students. Teachers should be able to implement learning activities where learners use digital technologies for information retrieval; teach learners how to find information, assess its reliability, and compare and combine information from different sources. 2) ***Creating Digital Content*** – Integrator (B1) – Implementing activities fostering digital content creation by learners. The teacher should be able to implement learning activities in which learners use digital technologies to produce digital content, e.g., in the form of text, photos, other images, videos, etc. The teacher should also encourage learners to publish and share their digital productions. 3) ***Digital Problem Solving*** – Integrator (B1) – Implementation of activities fostering learners' digital problem solving. Teachers should be able to implement learning activities in which learners use digital technologies creatively, expanding their technical repertoire, and encourage learners to help each other in developing their digital competence.

Competency Area 4. Safety

The entire competency area related to safety from the framework is strongly covered in the CM curriculum, particularly in the 3rd grade. According to the National Educational Standard for the "Digital Devices" competency area, at the end of the primary stage, the students are expected to "be familiar with the basic health, environmental, and ethical norms when working with digital devices." The topics and learning outcomes at the curriculum level, through which the implementation of Sub-area 4 of DigComp is anticipated, are presented in Table 4.

Table 4. Competency Area from DigComp 4 and their implementation through topics and expected outcomes in the CM curriculum

Subdomains of DigComp 2.2.	Topics and expected outcomes from the CM curriculum	
4.1 Protecting Devices (To protect devices and digital content, and to understand the risks and threats in digital environments. To know about safety and security measures, and to have a due regard to reliability and privacy. Identify simple ways to protect devices and digital content; differentiate simple risks and threats in digital environments; choose simple safety and security measures, and identify simple ways to have due regard to reliability and privacy.)	3rd Grade - Topic: Basic Components of Digital Devices • Recognises the basic components of digital devices – stationary and mobile. • Knows how to input information into the respective digital device. • Knows where to look for output information on the respective digital device, as well as on connected output devices. • Can start and finish work with a specific device. Management of Digital Device • Knows that the device can perform various tasks after receiving precise and clear commands. • Knows that certain activities can be performed through the device only if the corresponding program is installed. Safety and security measures related to digital content and digital environments are addressed in the next sub-area.	
4.2 Protecting Personal Data and Privacy (To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable information while being able to protect oneself and others from damages. To understand that digital services use a "Privacy policy" to inform how personal data is used. Select simple ways to protect personal data and privacy in digital environments, identify simple ways to use and share personally identifiable information while protecting oneself and others from damages. Identify simple privacy policy statements of how personal data is used in digital services.)	3rd Grade: Creating a User Profile • Creates a personal avatar in a learning management system. • Works in a virtual environment. Digital and Physical Identity • Differentiates between digital and physical identity. • Recognises basic threats in the digital environment. • Applies rules for responding to threats in the digital environment. • Knows not to provide personal information when communicating or working in a virtual environment.	4th Grade: Conditions for Safety in the Digital Environment • Does not provide personal information in the digital environment. • Recognizes well-known threats when working in the digital environment. • Knows how to seek help when needed. • Understands ethical norms when working in an online environment.

4.3. Protecting Health and well-being (avoid health-risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying). To be aware of digital technologies for social well-being and social inclusion. To differentiate simple ways to avoid health risks and threats to physical and psychological well-being while using digital technologies. To select simple ways to protect oneself from possible dangers in the digital environment. To identify simple digital technologies for social well-being and social inclusion.)	3rd Grade: Rules for Healthy and Safe Use of Digital Devices • Recognises the basic health issues related to a person using digital devices. • Applies rules to prevent physical fatigue and injuries after prolonged work in a digital environment. • Properly organizes computer equipment (good screen lighting, well-placed input and output devices, a well-positioned chair and desk, safe sound levels).
4.4 Protecting the Environment (To be aware of the environmental impact of digital technologies and their use. To recognise simple environmental impacts of digital technologies and their use.)	4th Grade: Recognises the benefits and drawbacks of using digital devices for the environment.

The above information clearly indicates the comprehensive integration of safety-related work into the curriculum, underscoring its paramount importance for students in the early grades. The four safety-related sub-domains are interlinked, with active engagement expected. Textbooks and learning materials incorporate relevant activities to assist students in mastering basic rules and approaches. Various sets of materials also offer diverse guidelines for safely working with digital devices and in digital environments.

The competencies of teachers for teaching CM in the field

In order to teach effectively and enhance students' knowledge, skills, and attitudes, teachers should develop the following competencies at the Integrator level (B1): 1) ***Responsible Use*** – Integrator (B1) – Implementing measures to ensure learners' wellbeing. The teacher should be able to give practical and experience-based advice on how to protect privacy and data, e.g., using passwords, adjusting the settings of social media. Additionally, they should assist learners in protecting their digital identity and managing their digital footprint. The teacher should also offer advise learners on effective measures to confine or counter the impact of inappropriate behaviour (of their own or their peers). 2) ***Digital Communication and Collaboration*** – Integrator (B1) – Implementing activities fostering learners' digital communication and collaboration. Teachers should be able to implement learning activities in which learners use digital technologies for communication. They should guide learners in respecting behavioural norms, appropriately selecting communication strategies and channels, and being aware of cultural and social diversity in digital environments.

Competency Area 5. Problem Solving

This competency area is partially covered in educational documentation, primarily through block programming activities. Broadly speaking, the emphasis is on identifying needs and technological solutions, especially within the visual programming environ-

ment, with a focus on creatively using digital technologies. Both sub-domains are presented jointly below.

Table 5. Competency Area from DigComp 5 and their implementation through topics and expected outcomes in the CM curriculum

Subdomains of DigComp 2.2.	Topics and expected outcomes from the CM curriculum
5.2 Identifying Needs and Technological Responses (To assess needs and to identify, evaluate, select and use digital tools and possible technological responses and to solve them. To adjust and customise digital environments to personal needs (e.g. accessibility). To identify needs and recognise simple digital tools and possible technological responses to solve those needs. To choose simple ways to adjust and customize digital environments to personal needs.) 5.3 Creatively Using Digital Technologies (To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments. To identify simple digital tools and technologies that can be used to create knowledge and to innovate processes and products. To show interest individually and collectively in simple cognitive processing to understand and resolve simple conceptual problems and problem situations in a digital environment.)	3rd grade Complexifying Movements – Rotation, Flipping • Recognises ways to complexify movements • Works with buttons and blocks provided by the environment to solve a given task • Moves the character along a simple trajectory Changing the Environment of Characters – Changing the Scene • Sets new scenes for stories from those available in the environment • Creates own scenes according to the goal Changing the Appearance of Characters and Creating New Characters • Recognises costume collections embedded in the environment • Creates costumes for the character • Creates new characters Using a Repeat Block • Defines the sequence to be repeated to model an action in a visual environment • Determines how many times a given sequence should be repeated Building a Cyclical Algorithm for a Given Task • Creates a short animation in the visual environment Project Work • Plans and prepares resources for realizing an artistic idea • Creates a personal animated card 4th grade Characters Move and Speak • Synchronizes the movements and dialogues of multiple characters sequentially, ensuring appropriate timing and coordination; Creating a Game Using the Features of a Specific Visual Environment • Knows how to select characters according to the given plot • Knows how to set basic characteristics – costumes and choose a scene • Sets rules for the game • Uses variables to record the result • Knows how to assemble code using blocks to control the characters in the game Project Work • Determines the necessary resources for a given project

It is obvious that a sufficient number of topics and learning outcomes are planned in the problem-solving domain. However, the extent to which activities encourage genuine problem-solving and creative approaches, as opposed to following memorized algorithms, is debatable. The teacher's role is crucial in applying problem-based learning and fostering student creativity.

The integration of problem-solving competency lacks sub-domains 5.1 Solving technical problems and 5.4 Identifying digital competence gaps in the curricula. The omission of technical problem-solving may be attributed to age-specific characteristics, but consideration could be given to incorporating topics related to simple technical problems and solutions. Identifying one's own digital competence gaps is challenging at the curriculum level but can be implemented through methods like reflection and self-reflection. Certainly, for this purpose, teachers should possess the relevant competencies and guidelines.

The competencies of teachers for teaching CM in the area

In order to teach effectively and enhance students' knowledge, skills, and attitudes, teachers should develop the following competencies at the Integrator level (B1) to support the learners: 1) ***Creating Digital Content*** – Integrator (B1) – Implementing activities fostering digital content creation by learners. The teacher should be able to implement learning activities in which learners use digital technologies to produce digital content, e.g., in the form of text, photos, other images, videos, etc. The teacher should also encourage learners to publish and share their digital productions. 2) ***Digital Problem Solving*** – Integrator (B1) – Implementation of activities fostering learners' digital problem solving. Teachers should be able to implement learning activities in which learners use digital technologies creatively, expanding their technical repertoire, and encourage learners to help each other in developing their digital competence.

Overview of digital competences developed in the subject CM

The analysis of educational curricula in relation to the DigComp 2.2 framework for digital competencies reveals that the subject CM encompasses all components of the European framework to varying extents. The basic level of these competencies, whether supported or independent, is embedded in CM programs. Activities designed to foster the development of competencies in the areas of "1. Information and Data Literacy," "4. Safety," and "3. Creating Digital Content" are integrated. The table below illustrates the specific competencies expected to evolve through CM education and the corresponding grade levels. It is crucial to emphasize that the development of all competency areas is envisioned at a basic level (Foundation), indicating a basic proficiency level with guidance, or autonomously where appropriate.

Table 6. Comparison between the content in the CM curriculum and the digital competencies that should be developed according to DigComp 2.2.

On a basic level with support		Information and Data Literacy			Communication and Collaboration						Digital Content Creation				Safety				Problem Solving			
School subject	Grade	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	2.6	3.1	3.1	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4
Computer Modelling	3					X				X	X	X		X	X		X	X		X	X	
	4	X	X	X		X					X	X	X	X		X				X	X	

The focus of CM education is on programming and creating digital artifacts, aiming to stimulate creativity. Emphasis is placed on the creation of digital content as an area of digital competence in DigComp 2.2., and to some extent, on problem-solving (activities include only identifying needs and technological responses, as well as the creative use of digital technologies). The goal is likely to develop algorithmic thinking and prepare students for future programming-related professions, though an official justification is lacking.

The topic of safety is highly prioritized, which is a good approach acknowledging the students' age and the importance of a secure digital environment. However, the "Communication and Collaboration" topic is limited to sharing via digital technologies and managing digital identity, probably due to age restrictions for communication without parental consent, including the use of various communication tools. There is a need for more active integration of the "Collaboration through Digital Technologies" sub-domain into the curriculum in a manner suitable for the students.

The competency areas that are missing (or are not explicitly presented) in the curriculum are from Competence Area 2: Communication & Collaboration (2.1 Interacting through Digital Technologies; 2.3 Engaging Citizenship through Digital Technologies; 2.4 Collaborating through Digital Technologies; 2.5 Netiquette) and from Competence Area 5: Problem Solving (5.1 Solving Technical Problems; 5.4 Identifying Digital Competence Gaps). It is unclear if these competencies are intended as transversal skills across other subjects, a topic to be explored in the next publication.

For effective teaching, teachers need advanced competencies in all DigComp 2.2 areas, particularly those targeted for foundational development (Foundation) in students. Additionally, teachers must hold pedagogical competencies at a minimum level of B1 (Integrator), crucial for shaping students' digital competencies as described in DigCompEdu's Supporting the Digital Competence of Learners section (Table 7).

Table 7. Competencies of teachers for fostering digital competence in CM education

Teacher competencies for shaping digital competence in CM education		Supporting learners' digital competence				
Level		6.1 Information and media literacy	6.2 Digital communication and collaboration	6.3 Digital content creation	6.4 Responsible use	6.5 Digital problem solving
Integrator	B1	X	X	X	X	X

To teach CM, teachers must excel in block programming and various visual programming environments. Therefore, according to Ordinance No. 15 on the Status and Professional Development of Teachers, Principals and Other Pedagogical Specialists[4], a primary school CM teacher should hold a degree in the professional field of "Computer Science and Information Technology" or "Pedagogy of Teaching in... all subjects, including computer science, with the qualification of "teacher of computer science and information technologies." Currently, those teaching CM in practice are primary school teachers who have obtained specialized training or another form of professional qualification for teaching CM. This potentially raises questions about the outcomes of teaching the subject since its launch in 2019.

Methodological support for teachers in the development of students' digital competencies in teaching CM

In CM teaching, the following ***specifics*** should be considered for clarifying the methodological support:

– Students use a programming environment to create interactive stories and animations (3rd Grade); tests, puzzles, games, and control robotic devices (4th Grade). The main environment chosen in five out of the six textbooks approved by the Ministry of Education is Scratch. It is a platform that not only fosters creativity but also places a strong emphasis on sharing. Projects can be uploaded to the Scratch website, allowing users to download the source code for any project and utilize it for their own projects.

– CM education is practical and involves active engagement with the teacher and includes various tasks for independent study and homework related to topics from other subjects.

– Supervision is required for creating profiles in the digital environment.

– Students gain an understanding of the environmental impacts of using digital devices, both positive and negative. This fosters a sense of responsibility among users of digital technology and promotes ethically sound behaviour in the online environment (4th grade).

– The instruction is project-based – unlike instruction in other subjects in the early grades, the project method in CM is fundamental.

A key factor for successful work in CM is the professional competence of the teacher. In addition to their pedagogical skills, a CM teachers must have well-developed digital competencies. This includes proficiency in block programming and working with various visual programming environments.

The available educational sets for CM for 3rd and 4th grades, approved by the Ministry of Education and Science, consist of six sets for each grade, typically including a textbook and workbook The recommended percentage distribution of mandatory study hours for CM per year, according to the curriculum (a total of 32 hours in 3rd grade and 34 hours in 4th grade), is as follows: 50% for new knowledge and skills, 30% for exercises and project work, 14% for reinforcement and summarization, and 6% for diagnostic assessments. Notably, lessons for acquiring new knowledge dominate in both grades, a less suitable approach for a practically oriented subject. The curriculum is extensive, requiring coverage of digital competence fundamentals in a short period, with a reliance on independent project-based homework.

In 3rd grade CM, diagnostics are mostly at an intermediate and final level in textbooks, given the subject is introduced for the first time. Most sets have two diagnostic lessons per class, involving a test and/or project presentation. However, considering potential prior student experience, diagnosing it at an initial level could support differential teaching.

Teacher's Books

Each of the six approved educational sets includes a teacher's book or guide with instructions for individual lessons. However, there is a lack of comprehensive guidance for shaping digital competencies, and instructions are somewhat fragmented for each specific lesson. Some sets include supplementary materials, such as videos for teachers, primarily focusing on developing technological skills for the chosen block programming environment. In general, the provided information in the teacher's books is as follows:

– Comprehensive methodological guidelines for lessons, yet lacking specific instructions for fostering students' digital competencies[5, 6, 7], including "Initial Instructions for Students" outlining rights and obligations for safe work[7];

– Description of digital competencies that students will acquire with a focus on programming. Key recommendations include implementing education through heuristic and exploratory methods, combining them with playful approaches and project activities; presenting the studied material in an engaging and accessible manner; requiring students to explain in detail what they are doing and what they have learned; increased attention from the teacher regarding safety and hygiene; teamwork on digital projects with the teacher taking on a mentoring role[8];

– Assessment guidelines at the end of the class, employing self-assessment and reflection in the form of ratings and an exemplary criteria matrix for project evaluation[8];

– Instructions for the teacher's preparation and the working environment (installation of e-resources and programs, guidelines for file organization, safety rules; creating student profiles)[8];

– Requirements for the "technical preparation" of the teacher, which includes the following digital skills: "working with a computer mouse, keyboard, information carriers, file system, e-platform on the internet, basic knowledge of copyright, digital identity, internet safety"; familiarity with Scratch; knowledge of algorithm theory[9];

– Schematic lesson plans outlining both teacher and student activities, along with necessary resources; utilization of the visual programming environment Kodu Game Lab[10].

The Eurydice network report "Digital Education at School in Europe" highlights the central role of pedagogy in effective learning, emphasizing that teachers do not need full technological proficiency to enhance teaching. However, teacher guides mainly concentrate on technological skills, offering minimal discussion on specific teaching methods. An exception is noted in one set, which attempts to emphasize pedagogy[8]. The project method is identified as a specific teaching approach but is not thoroughly explored in the context of digital learning.

At the same time, teachers have informal opportunities to enhance their competencies, challenging to trace. Recommended platforms like Code.org and Scratch provide lesson plans, activities, videos, and tutorials. YouTube offers supportive materials for visual block programming, and online webinars by textbook author teams are accessible. Additionally, online instructional guidelines in the form of webinars from most textbook author teams are accessible (a practice adopted by most publishers within textbook selection campaigns). However, most of these resources tend to prioritize technological aspects over pedagogical ones.

The curriculum and thus the textbooks appear to be quite condensed and there seems to be an intense teaching and learning load, which certainly raises questions about CM education quality.

Conclusions

In the educational documentation for primary grades in Bulgaria, the integration of digital competencies stands out as a distinct subject "Computer Modelling" taught in the 3rd and 4th grades. The focus of this subject, as implied by its name, is on block programming. The curriculum, textbooks, and teacher guides cover all areas of competence from DigComp 2.2 at a basic level (with support or independently), but the topics related to programming dominate, constituting approximately 70% of the lessons. The instruction on the remaining topics lacks depth, and

there are insufficient practice lessons. Overall, the educational content is extensive, and its absorption is intensive.

The emphasis is placed on the competency areas associated with creating digital content and, to some extent, problem-solving. A significant portion of the educational content revolves around programming, with an attempt to cultivate algorithmic thinking in students. Presumably, the aim of this approach is to equip students with programming skills from an early age, preparing the future generation for the growing demand for programmers. The topic of safety is appropriately addressed, reflecting a good approach given the students' age and the numerous risks online. However, the weakest aspect in the CM curriculum and textbooks is the presentation of the "Communication and Collaboration" topic which could be explained to the age limits related to communication in the online environment. Across all CM textbooks, the educational content is condensed, with a predominant emphasis on lessons for acquiring new knowledge. This approach might not be the most effective for a practical, hands-on subject.

A crucial factor for successful development of students' digital competencies is the professional competence of the teacher. This involves advanced digital competencies in accordance with DigComp 2.2, as well as pedagogical competencies needed to develop these skills in students, as outlined in DigCompEdu, particularly in the areas of "Teaching and Learning" and "Supporting Learners' Digital Competence." CM instruction also requires skills in block programming and working with various visual programming environments. Therefore, a primary school teacher in CM should have completed a degree in the professional field of "Informatics and Computer Science" and/or have obtained the qualification of "teacher in informatics and information technologies". Presently, it is common practice for CM teachers to be primary school educators who have obtained supplementary qualifications or completed other forms of professional training in the CM instruction. This raises concerns regarding the efficacy of teaching the subject.

Teacher guides and methodological manuals lack a cohesive framework for developing specific areas of digital competence. Instead, there are fragmented guidelines provided for specific lessons. Predominantly, the methodological directions focus on the technological skills of the teacher, with rare insights into the pedagogical aspects of technology application. In instances where such guidance is present, there is a lack of consistency and conceptual clarity.

The question regarding the effectiveness of the approach that predominantly focuses on the development of programming skills at the expense of other areas of digital competence remains open. It raises the need to reconsider the CM curriculum to ensure a more balanced emphasis on different competency areas. An alternative approach could involve the more effective development of other digital competence domains through integration into other school subjects.

From this point, a set of research questions for future investigation arises, including: What is the level of development of students' digital competencies at the end of the 4th grade, and to what extent is it acquired at school? How can a balanced development of digital competencies from the five areas of DigComp 2.2 be ensured in primary school education? Answering these questions will require additional analytical studies and empirical research involving primary school teachers and students. One of the steps in this direction will be a subject of a forthcoming publication, focusing on the vision for digital competencies in the curricula across all subjects.

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