

# Teaching digital humanities at high school level.

## A literature and special cases review.

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**Abstract.** The incorporation of digital technology in educational environments was usually thought of from a didactic and/or pedagogical perspective. However, the digital transformation driven by smartphones, platforms and generative artificial intelligence showed that curricular and/or epistemological aspects had to be considered, such as the incorporation of programming and computational thinking in basic education. Within this line of research, it is particularly productive to inquire about the incorporation of digital humanities at the high school level. The objective of this work is to know through a first literature review, the implementation of educational experiences in the field of digital humanities at the high school level of articles from academic sources. In addition to present global and local initiatives of innovative aspects in digital education. The analysis addresses the description of the fields in which relevant cases of teaching experiences were found, the digital methods used as well as the emergence of new emerging curricular areas such as Digital Citizenship. The conclusions point out the areas of opportunity for the development of knowledge areas, topics, applications and didactic materials to continue the development of the teaching of humanistic or digital humanistic computational knowledge at the high school level.

**Keywords:** Digital Humanities, Computational Thinking, Digital Citizenship, Curriculum, K-12, High School, Secondary School, Teaching, Learning, Training, Multiliteracies

## 1 Introduction

It is common, and even historical, to consider the incorporation of digital technology in educational environments from a didactic or pedagogical perspective. That is, to incorporate technology in education, the forms of teaching/learning must be rethought, the question of how to teach [1] [2].

Since 2013 the so-called "digital transformation", also known as the "revolution 4.0" driven by the smartphone, platforms and generative artificial intelligence, began

to consider curricular and/or epistemological aspects, the question of what should be taught. Hence, the advance of information technologies in this 21st century converged with curricular projects of computational thinking [3] [4], multi-literacy [5] and programming projects for the primary level (One hour of code<sup>1</sup>).

The "One Hour of Code" project of the Code.org<sup>2</sup> foundation, created in 2013, managed to arouse the interest of global audiences, constituting a collective action strategy that attracted technology corporations, governments and finally the educational community. In Latin America we found regional references that supported the initiative<sup>3</sup>. In other words, the paradigm shift from Educational Technology to Digital Education occurred almost simultaneously in the socio-technical imaginaries of global education. From thinking about changes in didactic strategies for the incorporation of technology to thinking about changes in contents and pedagogical-epistemic competences.

One of the lines of development of these educational changes is particularly significant in this work. The curricular project of teaching Digital Humanities (HD) at the high school level. This line of educational change is based on the opening to advanced computational skills that allowed the civil society movement as code.org to renew the contents of the teaching of humanities and social sciences at the high school level with content derived from the development of new fields of knowledge of digital humanities by higher level research teams [6].

The multidisciplinary field of Digital Humanities (DH) developed as a vanguard research practice incorporating new digital methods in the production of knowledge in the humanities and social sciences. To then apply them also in the teaching of these disciplines at the higher school level, and in some cases at the high school level.

At a first level, digital humanities education can be understood as the direct spillover of new knowledge from the field that was developed at the higher level and in research to the immediate lower level. We call this the narrow definition of digital humanities education at the high school level. At a second level it can be understood as the emergence of new knowledge, new types of thinking and capabilities comprised in new emerging social practices, such as digital citizenship [7], [8].

Given the change in the way of thinking and generating knowledge in the digital humanities by applying computational thinking, this paper establishes the need to analyze how this area of knowledge is taught at the high school level, in order to generate a bridge between the knowledge of this educational level and that required at the higher level and in professional life in general, considering the formation of the student as a digital citizen.

In this paper, the computational thinking approach is considered from the perspective of the discipline, as introduced in [9] and not from the purely computer science perspective. This is why we will explain below how computational thinking is related to digital humanities and the importance of both concepts as part of the curriculum in high school education.

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<sup>1</sup> <https://hourofcode.com/ar/es>

<sup>2</sup> <https://studio.code.org>

<sup>3</sup> What is missing in our schools. <https://youtu.be/EGgdCryC8Uo?si=efaQ8GfU34RBZ71w>

On the one hand, Silander considers that computational thinking was mainly studied and discussed by computer scientists, citing the cases of the proposals presented by Denning [10], Denning and Tedre [11] and Wing [12]. However, it marks the importance of researching, in education, computational thinking to consider it when designing curriculum and practices for the high school level. For the author, the focus should be on modeling and understanding real-world phenomena for the contextualization of computational thinking skills [13].

On the other hand, Berry and Fagerjord, from a more disciplinary perspective, mention that the digital humanities contribute to the traditional humanities by requiring a critical approach to thinking, which can be taken forward with computational thinking. For them, this kind of thinking must be connected to practice, technical and know-how, that is to consider computational thinking in a more general way, no longer from a computer science perspective, but from a philosophical and material practices perspective. It constitutes a way of approaching solutions to problems using computers as well as a way of thinking that can transform argumentation and the way knowledge is thought about. In the digital humanities, new methods such as data visualization are introduced. The digital humanities enable the creation of new jobs, skills and knowledge of their own, what the authors call, "the new economy" [14].

This new way of doing humanities requires new teaching strategies, and although there are several studies that address the teaching of digital humanities at the higher level, very few do so at the primary or high school level [15] and to advance the debate on the pedagogy of digital humanities it is necessary that more studies focus on this level [7].

The unit of analysis of this literature review work consists of sources that report on curricular change, including academic articles that describe experiences on teaching practices, or curricular models or directly theories on the problem, as well as documents on curricular designs. In addition, in a more general way, mention will be made of some methodological frameworks, recommendations and initiatives that make it possible to report on the feasibility of adding innovative proposals in the development of digital citizenship from the educational environment.

## **2 Methodology**

The main objective of this research is to find out about the need to include aspects of computational thinking through data visualization in the teaching of digital humanities at high school level to promote the empowerment of digital citizens. Specific questions were defined to be answered when analyzing each of the papers.

### **2.1 Research questions**

Given that the objective is to work from the perspective of computational thinking, the first question (RQ1) proposes to analyze, from the aspects of abstraction, decomposition, patterns and algorithms, which of these are evident in each of the proposals

analyzed. On the other hand, it is of interest to know the specific subjects or areas for which evidence is found, which is why the second question (RQ2) is presented.

Then, it is of interest to know whether the results found are proposals with students or whether they are addressed to teachers as guides or suggestions (RQ3), whether they are described for a specific country (RQ4), whether they respect a specific school curriculum (RQ5) and in which year they were published to analyze their distribution over time (RQ6). Finally, the general methods of digital humanities were identified considering, among others, those mentioned by Mills [16] (RQ7). Table 1 below describes each of the research questions.

**Table 1.** Research Questions (RQ)

#	Research Question
RQ1	What aspect of computational thinking is revealed?
RQ2	In which areas of the humanities is there evidence for the teaching and learning process of digital humanities at high school level?
RQ3	How many and which of the proposals are addressed to actors in the education system? Which are these actors?
RQ4	How many and which of the proposals are contextualized in a specific country or area?
RQ5	How many and which of the proposals are framed within a specific curricular theme?
RQ6	What is the distribution of the proposal according to the year of publication?
RQ7	Which digital humanities methods emerge from the survey applied to the specific domain?

In addition, we hope to gather experiences in participatory spaces such as workshops and panels, where debates are opened with teachers about the incorporation of digital humanities proposals at high school level. For these spaces, the research questions are presented in Table 2.

**Table 2.** Research questions for participatory space (RQW)

#	Research Question
RQW1	What proposals were carried out within the space to promote the incorporation of digital humanities in the classroom?
RQW2	Which actors in the education system are considered when working on digital humanities proposals in the high school classroom?
RQW3	What possibilities are highlighted as possible for incorporating digital humanities in the classroom?
RQW4	What problems stand out in relation to the possibility of incorporating digital humanities in the classroom?
RQW5	Is this a generally applicable proposal or is it for a particular place or audience?

Finally, as part of the analysis, some special cases about methodological guidelines, recommendations and initiatives are included which, in some way, show the viability

of innovative proposals in the development of digital citizenship from the educational environment.

The aim of this first review was to find papers in English or Spanish that used the terms Digital Humanities or Digital Citizenship, High School Education, Computational Thinking and/or terms related to learning or teaching.

It was then decided to carry out an exploratory study of the bibliography that consisted of three stages: i) search by string, ii) search considering the "Snowball" method [17] and iii) specific search by projects or tools from the universities of Stanford, Harvard, Oxford and MIT. This last stage, due to knowledge of the use of certain projects or tools at other educational levels.

For the first stage, the search string was assembled using the AND operator to join first level terms and the OR operator for synonyms of terms considered second level [18]. The data sources consulted were Google Scholar and Jstor (due to availability of access), while the types of papers included were conference papers, journals, workshops, guides with didactic sequences associated with a framework project and book chapters.

The search string for queries in English is shown below:

((("digital humanities" OR "computational humanities") OR "digital citizenship") AND ("secondary education" OR k12 OR "Middle School" OR "High School") AND (teach\* OR learn\* OR "computational thinking"))

The second stage for "Snowball" was done by exploration.

The third stage involved an adaptation of the search string as the aim was to explore specific projects and tools. First, a search was made for each of the 79 projects listed on the Stanford University website<sup>4</sup>, the *Cultures of Knowledge* project from Oxford University<sup>5</sup>, *Annotation Studio* project from MIT<sup>6</sup>.

The inclusion and exclusion criteria are listed below.

The following were considered as inclusion criteria:

- it should apply at least to the high school level (i.e. it can be applied additionally to other levels)
- it should relate to a proposal addressed to an actor in the education system
- that the proposal contained some aspect of computational thinking and was not just a digital proposal.

Exclusion criteria consider are:

- the paper considers the use of computer technology in the proposal but not from the perspective of digital humanities or computational thinking
- the paper corresponds to the ones presented by the authors of this work.

Once the search was methodologically defined, we proceeded to carry it out and analyze the results.

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<sup>4</sup> <https://digitalhumanities.stanford.edu/projects/>

<sup>5</sup> <https://www.history.ox.ac.uk/cultures-knowledge>

<sup>6</sup> <https://www.annotationstudio.org/>

### 3 Analysis

After searching for papers in the three stages described above and applying the inclusion/exclusion criteria, 14 papers remained. Thirteen different projects emerged from the papers. The papers [19] and [20] refer to the same project. The first shows the project scope and the second shows the specific activities.

The analysis of the papers is carried out considering the specific research questions presented in Table 1, Besides, two participatory spaces were found: a workshop and a panel. Both spaces are analyzed with the questions in Table 2. Finally, we introduce de general analysis about special cases with methodological frameworks, recommendations and initiatives.

#### 3.1 Proposal analysis

We will begin by analyzing the 13 proposals found in the 14 articles. The research questions presented in Table 1 are used for this purpose.

For *RQ1*, what aspect of computational thinking is revealed? The answer is that all the papers analyzed consider both the Abstraction and Decomposition aspects [15], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30] and [31]. Twelve (12) of them consider Pattern analysis [15], [19], [20], [21], [22], [23], [24], [25], [26], [27], [29], [30] and [31], and only two (2) in addition to the three previous aspects consider Algorithmics either by means of an exploratory coding [21] or by means of writing prompts [22].

To answer the *RQ2*, when analyzing the papers, we considered the area or subject for which the proposal was generated, without considering other possible areas of application potentially mentioned. Based on this, two (2) of the papers focus on geography, one on ancient geography, more precisely the Roman period [31] and the other on aspects of geographical movements of individuals [30]. Five (5) refer to topics from history, from Greece [24], art [26] and [28], physics [27] and history of classical antiquity [22] On the other hand, one (1) proposal is addressed to English teachers in rural schools [19] and [20] Finally, five (5) works refer to literature studies, dealing with the Silver Age of Spanish literature [23], Ancient Greek [25], taking as a basis literary texts for computational analysis [21], analysis of the text "La casa de Bernarda Alba" [29] and to improve competences linked to literary education [15].

In *RQ3*, students and teachers are mentioned as actors of the education system in the papers. According to the analysis conducted, five (5) proposals were carried out with students [21], [23], [24], [27] and [31], while the remaining seven (7) constitute guides for teachers [15], [19] and [20], [22], [25], [26], [28], [29] and [30].

Answering *RQ4*, the countries for which proposals were developed are Brazil (1) [27]; Spain (2) [23] and [29]; United States (3) [19] and [20], [21], [30]; Greece (2) [24] and [25]; Italy (1) [28]; United Kingdom (1) [30]; unspecified (3) [15], [22], [26].

When analyzing *RQ5*, it is found that although all of them are defined in a particular subject, five (5) are included in a curricular proposal [24], [25], [27], [30], [31],

while the remaining eight (8) are not [15], [19] and [20], [21], [23], [26], [20], [28], and [29].

The proposals analyzed to answer *RQ6*, show that for 2014 there is one proposal [19] and [20]. One (1) for 2015 [28], one (1) for 2019 [21], one (1) for 2020 [27], two (2) for 2021 [15], [31], three (3) for 2022 [23], [26], [29], three (3) for 2023 [22] [24], [25] and one (1) for 2024 [30].

To answer *RQ7*, we will first introduce some concepts. Mills [16] indicates that general digital humanities methods include, but are not limited to digital storytelling, distant reading [32], analysis networks, data visualization, mapping, gamification, modeling, and exploratory games. Based on this and the emerging, the methods of the analyzed articles were classified according to the authors' interpretation. Due to the characteristics of the proposals, the same article may refer to one or more methods.

The following is a brief detail of each of the methods surveyed from the analyzed papers: sentiment analysis from a prototypical platform that allows loading text (1) [19], [20]; annotations through which it is possible to augment artifacts (1) [28]; search for information in different digital formats (4) [22], [24], [25], [27]; coding in a programming language and writing prompts for artificial intelligence (2) [21], [22]; the use or generation of immersive exhibits (1) [28]; the realization or analysis of graphs, social networks or historical networks (2) [23], [27]. On the other hand, close reading (traditional reading of texts) (2) [27], [29], distant reading (analyzing texts qualitatively) [32] (3) [15], [25], [29], mapping (relating concepts) (2) [25], [32], storymap (storytelling using digital maps) (2) [19], [20], [30], storytelling (storytelling using digital resources) (2) [24], [26], use or reading from texts in TEI format (specific markup language for books, which stands for Text Encoding Initiative) (1) [23], Visualization beyond the type of technique by which data is viewed (e.g. by word clouds, maps and storytelling) (12) [15], [19], [20], [21], [22], [23], [24], [25], [27], [28], [29], [30], [31].

### 3.2 Panel Analysis

The following briefly introduces the Panel's background and answers the pointed research questions presented in Table 2.

In 2018, an edition of the annual Digital Humanities Congress (DH2018) was held for the first and only time to date in Latin America. During it, there was a panel to address issues of digital humanities education at the high school level, called "Digital Humanities in Middle and High School: Case Studies and Pedagogical Approaches" [32]. While it is possible to access the panel summary only results presented were reached through what was described by Canes and Smith [7]. The panelists highlighted digital humanities pedagogy for its value in cultivating 21st century literacies linked to knowledge production and the ability to interpret digital media, particularly for high school students.

Based on the works cited above, we proceed to answer the specific questions for this section of the paper.

To answer *RQW1*, it is possible to mention that the panel highlighted the importance of project-based learning to promote collaborative work among students which in turn allows them to learn how knowledge is produced. The objective of the

panel was to present methods and discuss with the community, but unfortunately there are no minutes of what happened during the panel.

Among the actors of the educational system that *RQW2* asks to identify, only students are mentioned in the brief information.

Answering *RQW3*, the panelists highlighted the potential for the development of literacies through digital humanities and the importance of joint work between high school and university teachers.

In *RQW4*, it is detected that the panelists highlighted the need to contemplate the curricula and the specific needs of students in the curricula as well as the socio-economic dimension of their lives. The importance of acceptance by all stakeholders is also highlighted.

In this case, and in response to *QRW5*, the proposal itself is the panel, and only the summary motivating participants to join has been accessible.

### 3.3 Workshop Analysis

The following briefly introduces the workshop background and answers the pointed research questions presented in Table 2.

In 2012, a network was created between university and high school teachers with the goal of making St Louis a leading city in teaching digital humanities at both the high school and university levels. For this, work was done on how to increase and improve the teaching of DH in schools and how university and high school teachers could support each other in this. The network planned a workshop that was held in April 2022 (the normal course was affected by the COVID pandemic) in which out of 17 high school teachers who were registered to participate, only 5 were able to do so. Despite the low number, the attendees were highly informed and committed to the workshop and represented both public and private schools [34] [7].

During the workshop, and responding to *RQW1*, we worked in different sessions in which: a) current practices of digital humanities in the classroom were shared, b) some tools to work with data in the classroom were shown, and c) some tools to work with data in the classroom were shown.

To answer *RQW2* in relation to the actors of the educational system, teachers and students appear as necessary actors, and adds the importance of having internet administrators and devices in the classroom as well as the support of the directors of educational institutions.

To *RQW3*, the workshop focuses on a specific geographic area, highlighting that the curriculum there is broad enough to add digital humanities, for example in both history and English in specific years of the high school level.

It is also mentioned that in the digital humanities it is possible to help students see how the use of data is a form of storytelling.

As a result of the workshop, to respond to *RQW4*, it is known that there are a series of challenges to work on in the medium and long term.

There are different points to consider, on the one hand, the speed of change of the tools and the large amount of time it takes a teacher to learn a particular technology, time being a very valuable and limited resource for him/her. From this, it was noted

that teachers were more inclined to use simple or commercial tools with broad support, since they understood that they would last longer in time; however, these tools are usually paid and even so, they can be discontinued. On the other hand, the possibility that the project, once applied in the classroom, does not generate the expected result, and should be considered in a different way, mainly by students concerned about their note, thus suggesting considering a stage of reflection on the process and the result, including the aspects that eventually the project did not turn out as expected.

Something important is the need for support from the schools' Internet and computer equipment administrators to have sufficient permissions to install the necessary software, as well as the importance of the participation of the management teams in promoting and sustaining this type of activities over time.

On the other hand, it is important to highlight the need for formation of teacher training students so that they can, upon graduation, apply digital humanities in the classroom.

The network focuses on the area of St Louis, Illinois, USA. It focuses on establishing relationships between university and high school level teachers in the area, in response to *RQW5*.

### 3.4 Special cases Analysis

We will begin by describing the ISTE<sup>7</sup> (International Society for Technology in Education), which proposes a series of standards for the adoption by students, teachers, managers and coaches, on digital citizenship (among other topics). Adding videos and recommendations and making courses and manuals available for sale. UNESCO<sup>8</sup> (The United Nations Educational Scientific and Cultural Organization) presents guidelines for the planning of educational policies to capitalize on the contribution of digital technologies [35] and considers digital citizenship as a vital element in the 21st century [36], highlighting the importance of its approach from the different forms of education [37]. The OECD<sup>9</sup> (Organization for Economic Co-operation and Development) collects data through various initiatives to understand how students learn and how teachers teach, as well as the skills of the population, which helps to make decisions on educational policies. It also examines education systems in member countries and its partners, helping to develop and implement policies to improve systems. Among its best-known programs are the PISA<sup>10</sup>, PIAAC<sup>11</sup> and TALIS<sup>12</sup>. Their activities include systematic innovation and digital resources (CERI<sup>13</sup>), which allows reviewing and evaluating innovation processes of public and private initiatives by col-

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<sup>7</sup> <https://iste.org/>

<sup>8</sup> <https://www.unesco.org/es>

<sup>9</sup> <https://www.oecd.org/>

<sup>10</sup> <https://www.oecd.org/pisa/>

<sup>11</sup> <https://www.oecd.org/skills/piaac/>

<sup>12</sup> <https://www.oecd.org/education/talis/>

<sup>13</sup> <https://www.oecd.org/education/cei/cei-digitallearningresourcesassystemicinnovation.htm>

lecting innovations promoted by students and teachers and studying how the educational system responds to them.

From a more focused point of view, in Uruguay there is a center for educational innovation with digital technologies of the State, called Ceibal<sup>14</sup>. Since 2007, this center has been promoting the integration of digital technologies in education, with the aim of improving learning and promoting processes of innovation, inclusion and personal growth. It has six management areas, including digital citizenship, educational programs to develop computational thinking and professional development for teachers to develop digital skills, work on innovative approaches and train them as trainers in digital citizenship. It also has different programs, among which stand out those of digital citizenship<sup>15</sup> and computational thinking<sup>16</sup>. For each program, educational resources, training and experience stories are available. On the other hand, in Argentina, there is the Sadosky Foundation<sup>17</sup>, which "works in the articulation between the scientific-technological system and the productive structure in the field of information technology and telecommunications, as a mechanism for the country's development. It seeks to strengthen the informatics capabilities of the scientific, educational and public sectors, as well as to strengthen the productive structure". Through its Program.ar<sup>18</sup> initiative, it promotes the teaching of computer science in Argentine schools. Among its lines of action are teacher training and didactic materials, where it is possible to find teaching proposals, a digital repository with open digital educational resources, recreational resources, multimedia materials and videos, as well as textbooks for teaching computer science to primary and high school teachers about computational thinking and digital citizenship from a computer science perspective. Argentina also has, since 2018 (a process that began in 2004), "Nucleos de Aprendizajes Prioritarios" (NAPs<sup>19</sup>) for Digital Education, Programming and Robotics, which are in force throughout the country for the different levels of education (initial, primary and high school) and in the different areas of knowledge, with the aim of achieving cohesion in teaching practice and enriching educational experiences arising from institutional projects and provincial policies. The NAPs encompass interconnected and articulated knowledge, aimed at promoting digital literacy so that students can be integrated into the digital culture. According to the NAPs, programming and computational thinking are fundamental areas of knowledge to develop digital competencies. Integrating this field of knowledge allows students to develop skills to solve various problems, including social ones, as well as to create opportunities and prepare for the working world and to deepen the exercise of democratic citizenship. For the high school level, a series of educational situations to be promoted in educational institutions are listed. It includes: "The recognition of how information, in its various formats, is collected, represented, visualized and analyzed, through computerized devices, and the understanding of the use of large volumes of data, related to quantification,

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<sup>14</sup> <https://ceibal.edu.uy/institucional/que-es-ceibal/>

<sup>15</sup> <https://ceibal.edu.uy/institucional/ciudadania-digital/>

<sup>16</sup> <https://pensamientocomputacional.ceibal.edu.uy/>

<sup>17</sup> <https://fundacionsadosky.org.ar/>

<sup>18</sup> <https://program.ar/>

<sup>19</sup> <https://www.educ.ar/recursos/150199/coleccion-nucleos-de-aprendizajes-prioritarios-nap>

prediction and optimization of processes, reflecting on its social utility and on ethical aspects related to access to user information".

Finally, and as a special case, mention should be made of Finland's education system, which is considered by many to be the best in the world [38], since it was among the first places in the OECD's Pisa tests in 2001. Finland acts as a reference society in which other countries feel inspired to imagine a different educational system [38]. And according to EDMO<sup>20</sup> (European Digital Media Observatory) "the country's population has high levels of digital skills compared to other European countries". Since 2014, phenomenon-based learning was introduced in basic education, Silander describes it as a multidisciplinary learning in which teaching and learning are based on holistic contextualized topics, where it is important to perform creative activities that lead to adopt genuine disciplinary practices that allow students to participate in projects of the expert culture of the disciplinary field. Where for example, depending on the nature of the project, authentic design challenges could be solved by applying collaborative design, computational thinking and coding [13].

## 4 Discussion

As part of the debate based on the analyzed bibliography and special cases, the importance of putting on the agenda, at the high school level, the introduction of the teaching of digital humanities contents and methods stands out worldwide to promote the empowerment of digital citizens.

From the aspects of abstraction, decomposition, patterns and algorithm appears evidence of the possibility of its analysis in the reviewed proposals. Particularly, for abstraction is important to note that have specific application contexts depending on the humanistic discipline in question. In this the cases seem to align with the definitions of Denning and Tedre [11].

There is a sustained treatment from 2014 to date of the thematic in the literature reviewed. On the other hand, the presence of data visualization aspects in almost all the analyzed works is of great interest for this research. The issue of the importance of data and information representation in the digital humanities also appears as part of the panel and workshop analyzed. Without pretending to draw representative conclusions, the centrality of data visualization competence in the development of applied computational thinking is expressed in the pattern found.

From the teaching aspects, by adding algorithmic design skills to the teaching of humanities, it gives way to a type of student-centered teaching, leaving aside more traditional practices such as lectures in which students mostly had to memorize content and adds a playful dimension with learning environments to the dialogic participatory classes.

Another emergent of what has been analyzed is the additional time required by this type of activities in relation to the curricular space of a subject in the planning of a high school year; in general, teachers have very little additional time to dedicate to

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<sup>20</sup> <https://edmo.eu/resources/repositories/mapping-the-media-literacy-sector/finland/>

projects that are disruptive to conventional classroom practices. Although some of the proposals analyzed manage to include the activity as part of their curriculum, they do so thanks to the generality with which they are defined.

For all the above, it is important to reach an agreement between the different actors of the educational system and those who are politically responsible for decision making, for a consensual incorporation that allows not only curricular incorporation for its subsequent adoption in the classroom, but also its inclusion in the teacher training curriculum. This type of agreements is not built on generic technology inclusion projects; they are the result of complex curricular constructions such as phenomena-based teaching [13] or the digital citizenship teaching project [40].

Furthermore, the importance of legitimizing opportunities to retrain teachers on the tools and methods to be used should be emphasized, due to the time involved and considering that, in general, it is a very scarce resource for teachers. In Silander's words, "educational transformation is a systemic change and requires strong institutional support to be successful" [13].

From the point of view of competencies, beyond those of the discipline in which each proposal is included or not, the explicit mention of digital competence ([26] [29] and [15]) together with critical thinking ([24] and [15]) as the axis of some proposals stands out for this work, which shows the importance for another of the axes of this work, which is digital citizenship. Axis that we could call digital critical thinking.

Another debate arises regarding how to evaluate this type of proposals; the concrete suggestion is the evaluation by means of rubrics [40].

Although the presentation of the content in the panel developed during DH2018 is brief, it was of interest for this work, since in a scientific congress time and space were allocated for discussion in high school education and the importance of working together between both educational levels to transfer proposals to the high school classroom was highlighted.

As for the workshop held in 2022, although it had little audience due to the emergence of COVID, it is also relevant because it put on the agenda of digital humanities teaching the need to articulate the university and high school level to improve teaching practices and add digital humanities in high school.

From the presentation of special cases by multinational organizations or cases of countries, the relevance of the approach to digital citizenship at the high school level is evident, in the case of Argentina, in a complementary manner to that proposed by the Sadosky Foundation and from the emphasis on the inclusion of the NAPs in the curriculum implemented in a more concrete manner. It remains to be analyzed in greater depth to determine which aspects can be added to the proposal of the work, however, they allow us to see a more general context of the subject.

## **5 Conclusions and future works**

This paper presents a first literature review of educational proposals for digital humanities at the high school level and analyzes the findings from the perspective of

computational thinking and application methods focused on data visualization and the analysis of special cases.

It is of extreme importance to provide an adequate scaffolding from high school education to a generation that lives in a world of algorithms that influence many aspects of their lives. They need to be made aware, among other things, of the biases that algorithms introduce and how they can manipulate not only data, but also their decision making. In addition to the use of generative artificial intelligences, which generate information that in many cases lacks rigor and validity. This is why it is necessary to develop critical thinking and computational skills from high school education in digital humanities with data, both for their future professional life and furthermore, for their daily life, prioritizing from high school, the integral formation of a digital citizen.

Concrete cases of initiatives in the classroom were found to address the analyzed topic and a context of global and local initiatives that show the relevance of the topic, and the possibility of its specific approach was also presented.

Among the theoretical research topics that emerge from this inquiry we can reflect on the need to deepen and clarify the relationship between the development of computational thinking and critical thinking both for the formation of digital citizenship and for the range of hybrid disciplines that combine computational practices in humanistic environments. We wonder in the future if it is possible to develop digital critical thinking as an alternative to form a critical look at algorithmic capitalism.

It is expected to continue with the multidisciplinary work to promote the articulation between teachers and researchers of the higher level together with the different actors of the educational system of the high school level and then propose work guides that allow the adoption of digital humanities and digital citizenship in the high school level.

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