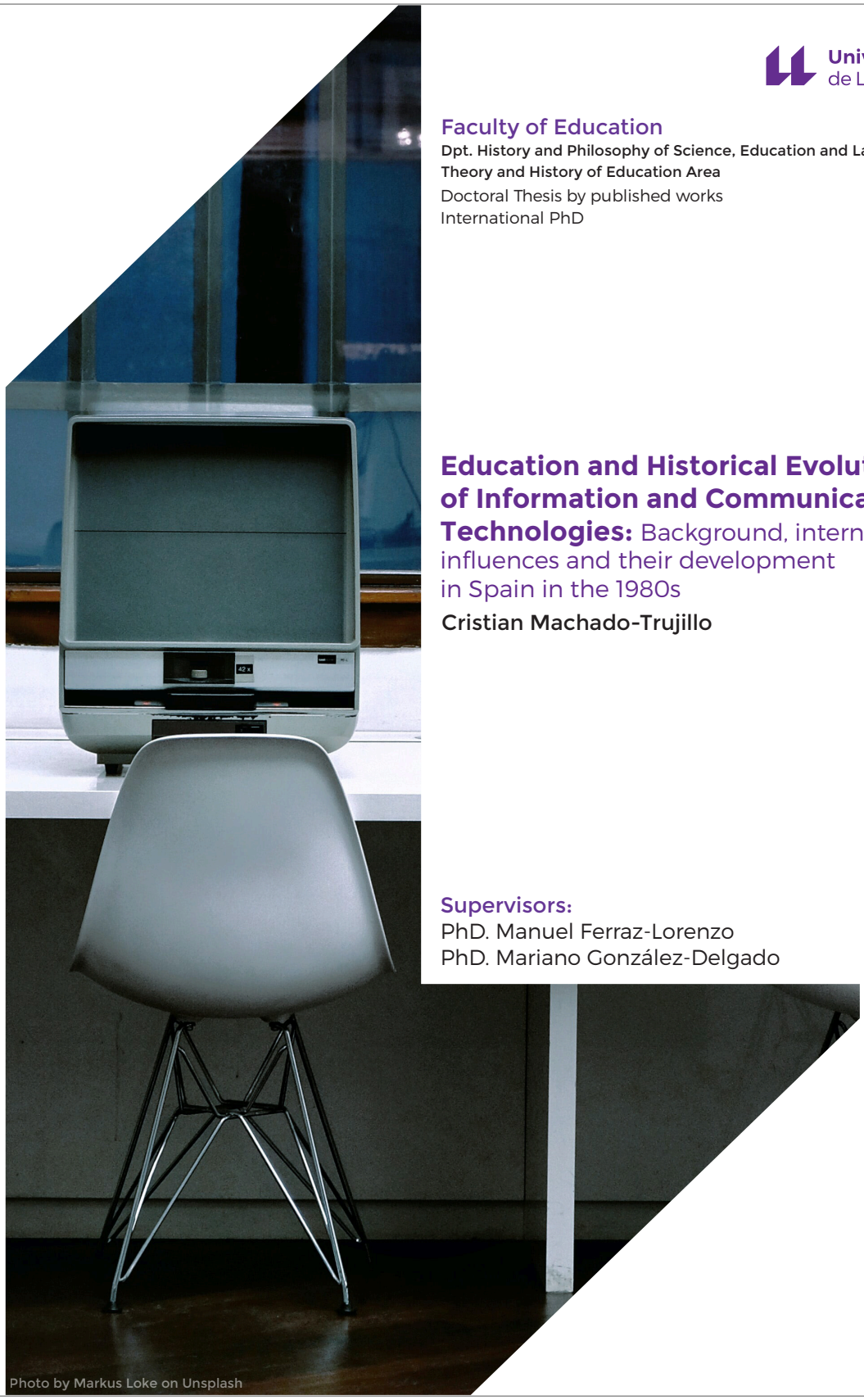

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Education and Historical Evolution of Information and Communication Technologies: Background, international influences and their development in Spain in the 1980s

Cristian Machado-Trujillo

Supervisors:
PhD. Manuel Ferraz-Lorenzo
PhD. Mariano González-Delgado

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SUPERVISOR'S ENDORSEMENT

Manuel Ferraz Lorenzo and Mariano González Delgado,

We STATE that:

The doctoral thesis entitled *Education and Historical Evolution of Information and Communication Technologies: Background, international influences and their development in Spain in the 1980s*, developed by Cristian Machado-Trujillo to obtain the Doctor title has been made under our supervision and it fulfils the necessary requirements to be elegible for the title of International Doctor.

In San Cristóbal de La Laguna, January 15, 2021.

Supervisor, PhD. Manuel Ferraz Lorenzo

Co-supervisor, PhD. Mariano González Delgado

A mis padres,
pues se lo debo todo

To my parents,
to whom I owe everything

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1. Abstract

This doctoral thesis, made up of published works, develops a historical analysis of the introduction of Information and Communication Technologies (ICT) into the educational system of Spain. The many innovations that have taken place in the development of digital tools has produced great transformations in all social spheres, and especially in educational systems. In reviewing the bibliography on ICT and Education we find massive numbers of scientific publications, but most of these are on topics related to the use of such devices to improve teaching and learning processes, or to the development of Educational Technology as a disciplinary field. This research sets out other objectives, trying to analyse the fundamental issues that led a specific technological tool - the first personal computer - to be introduced massively into schools all over the world, even when it was still an incipient and little-used device. We believe that in order to understand current digitalization we must look at the first incursions of ICT into educational systems, analysing and tracking the first programmes that were developed and the arguments used in justifying them.

Since the 1950s, with the appearance of teaching machines and following the behavioural theory proposed by Skinner, the fundamental role of the mass media and the emerging ICTs in the modernisation of educational systems has been a subject of debate. With the development of the first personal computers starting at the end of the 1960s, and the reduction in size and cost in relation to previous models, the potential of these tools for use in the classroom first began to be appreciated. This innovation occurred at the same time that access to education began to become effective for all social sectors, and when transnational bodies such as UNESCO, the OECD and the World Bank, among others, were stressing the fundamental importance of modernising education systems in order to spur economic development. To this end, technologies such as radio, cinema and television were considered the ideal tools, a realm a few decades later was taken over by the computer[1] . Given this scenario, it was not only the large organisations and state governments that saw the opportunity to implement programmes for development where the computer was the fundamental element; the computer industry also saw a virtually

[1] Hence, David Cohen (1987) goes so far as to argue the following in a skeptical tone: "Computers are only the latest in a long line of mythologized machines, endowed with near-miraculous powers" (p. 154).

infinite business niche in the national education systems. All of this led to the alignment of many interests and initiatives during the 1980s, resulting in an infinite number of state programmes that introduced computers into schools.

The Spanish case was by no means an exception. At the end of the sixties, Spain, still under Franco's dictatorship, began to implement various policies in an attempt to promote economic development. In 1968, it received a team of expert consultants led by members of the UNESCO who strongly recommended undertaking a structural reform of the education system, and what ultimately became the General Education Law of 1970 began to take shape. This reform, advised and financed largely by the UNESCO and the OECD, was the result of a series of close contacts between these bodies and Spain. It was in this context that the UNESCO itself recommended that the first pilot project proposed for the use of computers to improve teaching and learning processes (in this case for initial teacher training) be carried out in Spain. The programme was intended to be a first experiment, one whose results would then be exported to other developing countries.

After this first initiative, at the beginning of the 1980s, and especially starting in 1983, a new programme was planned which had as one of its main objectives to provide schools with computers and encourage their use to improve the efficiency of teaching and learning. Atenea, as it was finally called, was developed between 1985 and 1989, and was the first major state initiative to provide schools with extensive computer equipment, a measure that was also meant to spur on the Spanish industry in this sector. The results were questioned and disputed at length but, in general terms, the conclusions arrived at were similar to those of programmes being implemented in other countries at the same time: there were no great advances in terms of improving educational processes, and, in most cases, political and economic interests were placed above pedagogical criteria. The gap between curricular contents and educational software, the limited computer skills of the teaching staff — only logical if we take into account that the expansion of its commercialisation in Spain began in 1984[2]— and the fact that the administrations relegated it to the teachers' voluntary initiative were some of the key conditioning factors

[2] This year, IBM, Olivetti and Apple models began to be widely distributed in our country, especially because stores such as El Corte Inglés became official distributors, with this store even creating a microcomputer division. Several years later, in 1991, the number of computers in Spain only rose to just over 100,000. For more information see Valero and Mompín (2009).

of the results. Larry Cuban (2001) concluded that these programmes had failed across the board, and although the sales of computer products increased greatly, their use in schools was quite insignificant.

The interesting thing about the study of these initiatives and of the background that led to this shift in education towards ICT and digitalisation was that the arguments and interests that have historically been put forward to support their use have not changed significantly from these early programmes in the middle of the last century to the present day. Therefore, the need for critical study and analysis of the use of ICT in education is fundamental to avoid falling into the instrumentalization of education and ending up with it being exclusively at service of political and economic interests.

Keywords: History of Education, Educational Policies, Curriculum History, ICT, computers, Atenea, international influences, international organisations.

Resumen

La presente tesis doctoral, elaborada en la modalidad por compendio de publicaciones, desarrolla un análisis histórico sobre la introducción de las Tecnologías de la Información y la Comunicación (TIC) en el sistema educativo español. La infinidad de innovaciones que vienen sucediéndose en relación con el desarrollo de herramientas digitales ha generado grandes transformaciones en todas las esferas sociales, y, especialmente, en los sistemas educativos. Si hacemos un rastreo de la bibliografía sobre la relación entre las TIC y la Educación encontraremos una infinidad de textos, pero que, en su mayoría, abordan cuestiones relacionadas acerca de cómo usar tales dispositivos para mejorar los procesos de enseñanza y aprendizaje, o sobre la constitución y desarrollo de la Tecnología Educativa como campo disciplinar. Este trabajo plantea otros objetivos de investigación, tratando de analizar las claves fundamentales que propiciaron cómo una herramienta tecnológica concreta, como el primer ordenador personal, se introdujo masivamente en las escuelas de todo el mundo, aún cuando todavía era un dispositivo incipiente y de uso poco extendido. Consideramos que para comprender la digitalización actual debemos acudir a las primeras incursiones de las TIC en los sistemas educativos, analizando y

rastreando los primeros programas que se desarrollaron y los argumentos que los justificaban.

Desde los años 50, con la aparición de las máquinas de enseñar y siguiendo el modelo conductista propuesto por Skinner, comienza a debatirse sobre el rol fundamental de los medios de comunicación de masas y las incipientes TIC en la modernización de los sistemas educativos. Con el desarrollo de los primeros ordenadores personales desde finales de la década de los 60, y la reducción en tamaño y coste en relación con los modelos anteriores, comienza a vislumbrarse el potencial de estas herramientas para su uso en las aulas. Tal innovación sucede a la par que empieza a hacerse efectivo el acceso a la educación por parte de todos los sectores sociales, y que organismos transnacionales como la UNESCO, la OCDE y el Banco Mundial entre otros, pusieron el acento en la necesidad fundamental de modernizar los sistemas educativos como factor clave para el desarrollo económico de los países. Para esto, además, se consideró que tecnologías como la radio, el cine y la televisión eran las herramientas idóneas, un espacio que fue copado unas décadas más tarde por el ordenador. Ante este escenario, no solo los grandes organismos y los gobiernos estatales vieron la oportunidad de implementar programas para el desarrollo donde el ordenador era el elemento fundamental, sino que esto posibilitó también que la industria informática encontrara un nicho de negocio casi infinito en los sistemas educativos nacionales. Todo ello condujo a que, durante la década de los ochenta, fueran alineándose multitud de intereses y propuestas que se concretaron en infinidad de programas estatales que introducían los ordenadores en las escuelas.

El caso español no fue una excepción, sino todo lo contrario. A finales de los sesenta, España todavía sumida en la dictadura franquista, comienza a implementar diversas políticas intentando favorecer el desarrollo económico. En 1968, recibe a un equipo de consultores expertos encabezado por integrantes de la UNESCO que recomiendan encarecidamente el desarrollo de una reforma estructural del sistema educativo, y comienza a gestarse lo que a la postre fue la Ley General de Educación de 1970. Esta reforma, asesorada y financiada en buena medida por la UNESCO y la OCDE, fue fruto de una serie de contactos estrechos de estos organismos con España. Por otro lado, dio lugar a que la propia UNESCO recomendase que el primer proyecto experimental que plantearon sobre uso de ordenadores para mejorar los procesos de enseñanza y aprendizaje (en este caso para la formación inicial de maestros) se realizase en España.

1. Abstract

El programa tenía la intención de ser un primer experimento con la pretensión de que luego se exportase a otros países en desarrollo.

Después de esta primera iniciativa, a inicios de los ochenta, y especialmente desde el año 83, se planifica un nuevo programa que tenía como una de sus máximas dotar de ordenadores a las escuelas y fomentar su uso para mejorar la eficacia de la enseñanza y aprendizaje. Atenea, como finalmente se llamó éste, se desarrolló entre 1985 y 1989, y supuso la primera gran iniciativa estatal que dotó extensamente a las escuelas de material informático, tratando a su vez de espolear la industria de ese sector en nuestro país. Los resultados fueron bastante discutidos y cuestionados, pero, en líneas generales, condujo a las mismas conclusiones que otros programas afines y coetáneos en otros países: no hubo grandes avances en lo que a mejora de los procesos educativos se refiere, y, en la mayoría de las ocasiones, los intereses políticos y económicos se situaron por encima de los criterios pedagógicos. La distancia de los contenidos curriculares con el software educativo, la escasa competencia informática del profesorado -cuestión lógica si tenemos en cuenta que verdaderamente la expansión de su comercialización en España es a partir de 1984 —y que las administraciones relegaron al voluntarismo de los docentes—, fueron algunos de los condicionantes claves de los resultados. Larry Cuban (2001), vino a sentenciar que estos programas fracasaron generalizadamente, y aunque supuso un gran incremento de ventas de productos informáticos, su uso en las escuelas fue bastante minoritario.

Lo interesante del estudio de estas iniciativas, de los antecedentes que condujeron a este giro de la educación hacia las TIC y la digitalización, fue que, fundamentalmente, los argumentos e intereses que históricamente se han expuesto para avalar su uso no han variado significativamente desde estos primeros programas de mediados del siglo pasado hasta nuestros días. Por tanto, la necesidad de estudios y análisis críticos del uso de las TIC en educación es fundamental para evitar caer en la instrumentalización de la educación y que esta acabe sometida al servicio exclusivo de intereses políticos y económicos.

Palabras clave: Historia de la Educación, Política Educativa, Historia del Curriculum, TIC, ordenadores, Atenea, influencias internacionales, organismos internacionales.

2. Introduction

Below, we describe the development of our research, specifying the fundamental milestones that have shaped the development of this thesis and have made it possible. We also present the articles that compose this doctoral thesis, including the complete reference, the databases and impact indices of the journals in which they have been published along with a summary of each one of them.

2.1. Development and contextualisation of research

The doctoral thesis entitled *Education and the historical evolution of Information and Communication Technologies: Background, international influences and their development in Spain in the 1980s*, is the result of the interest we had in the History of Education and Educational Policy during our studies in Pedagogy (carried out between 2008 and 2012 at the University of La Laguna). During the course of these studies, the concern generated towards these disciplines by the person who eventually became the director of this thesis, Pr. Manuel Ferraz Lorenzo, began to take shape with the application and award of the scholarship for collaboration in university departments of the Ministry of Education, Culture and Sport in the academic year 2011-12. With a clear idea in mind already of developing a doctoral thesis, and with the support of this grant, we began researching various topics that could help us to outline the future project of a doctoral thesis. Initially, the fascination with the influence of Krausism in Spain, the figure of Giner de los Ríos, and the Institución Libre de Enseñanza, marked the way forward, pointing us towards issues related to education and the construction of citizenship. During the aforementioned course, we developed the collaborative project entitled *La construcción del concepto de ciudadanía en España a finales del siglo XIX* [The construction of the concept of citizenship in Spain at the end of the 19th century], which led us to carry out an exhaustive bibliographical review and to develop the first, humble scientific contributions. Focusing on the conceptualisations and reconstructions of citizenship, we began our doctoral studies, also spurred on by the example of PhD. Mariano González Delgado, who was at that time completing his doctoral thesis, and who meritoriously defended it in January 2014 at the University of La Laguna. The next milestone was reached when we were awarded a pre-doctoral contract by the Canary

Islands Agency for Research, Innovation and the Information Society of the Canary Islands Government (ACIISI, 2015, reference 010133). On 1st February 2016, having joined as a pre-doctoral researcher in the Area of Theory and History of Education in the Department of History and Philosophy of Science, Education and Language of the University of La Laguna, we were able to focus fully on the completion of this doctoral thesis, with the support of the funding obtained. Although we have already mentioned this in our acknowledgements, we reiterate the importance of this type of grants, which allow quality research to be further developed, making it easier for those with a vocation for scientific and academic careers to make their contributions to the scientific community, the University and society in general. Without doubt - and the current context corroborates this - investment in research is fundamental; unfortunately our country is not a good example of this[3] .

As with all doctoral theses (and this is no exception), the research began as a rough draft, with some initialquestions leading into other new ones, responding to and resulting from the niches and gaps that we found in the scientific literature on the subject. Both Pr. Manuel Ferraz and myself were deeply interested in addressing the role played in the issue by Information and Communication Technologies (ICT) and how they have been contributing to the reformulation of educational models and the construction of citizenship in general. We were aware of the abundant research dealing with the countless categories, methodological applications and evaluations on the benefits of their application and on the use of ICT in education, but we found few studies of a more critical nature. In particular, we found that few works in Spanish took a critical view, let alone attempted to analyse the possible economic and political interests behind their use. While, this type of article did not abound, researchers such as Jordi Adell, Ángel I. Pérez Gómez and Manuel Area, among others, included pertinent critical reflections in different texts[4]. In 2008, Area even published an article entitled *Una breve historia de las políticas de incorporación de las tecnologías digitales al sistema escolar en España* [A brief history of the policies for incorporating digital technologies into the school system in Spain],

[3] See for example the data available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/R_%26_D_expenditure. Not only does it indicate that Spain is below average, but also that the budget in Research and Development decreases in the 2008-2017 series.

[4] Some examples of this may be: Adell, J. (2009). *Políticas TIC en educación ¿un viaje a ninguna parte?*; the first chapter entitled *La era digital: nuevos desafíos educativos* in A. I. Pérez (2012), *Educarse en la era digital*; and the first chapter entitled *La sociedad de la información, las tecnologías y la educación* in M. Area (2004), *Los Medios y las Tecnologías en la Educación*.

which, as he himself argues, simply outlines some of the major ICT programmes in Spain[5]. In that first moment of bibliographical search, going beyond our frontiers, we did find extremely interesting texts from fields such as the Philosophy of Technology, with texts such as those by Andrew Feenberg (2002), Luciano Floridi (2007) and Marc de Vries (2012); generalist texts reflecting on technologies as control mechanisms, such as those by Evgeny Morozov (2012) and Jaron Lanier (2014); and research analysing the different policies and programmes for the use of ICTs in different countries and educational contexts, including those by Larry Cuban (1986, 2001), Geir Haugsbakk (2011) and Neil Selwyn (2013, 2016). In particular, the research of Larry Cuban and Neil Selwyn was a fundamental source of inspiration that represented a turning point in the development of this doctoral thesis.

The line of work began to gravitate around what had previously been postulated as a specific section of the thesis, the historical and political analysis of the introduction of ICT in education systems, and specifically the study of the Spanish case. At this point we also proposed that PhD. Mariano González Delgado should formally become co-director of the thesis, since until then he had been providing informal but very productive and enriching tutoring, and the new focus that our research had acquired fitted perfectly with some of the work he had been doing. This research had to do with the implementation of developmentalist policies beginning in the middle of the 20th century in Francoist Spain, and the influence that international organisations such as UNESCO, the OECD and the World Bank, among others, had on them. Curiously, many of these policies —which sought to modernise education in order to promote economic development— made use of the mass media, and various programmes used television, teaching machines and personal computers[6]. Therefore, the co-direction of Mariano González came to bring a fundamental value and meant new channels of collaboration. We would like to emphasize that, through the investigations carried out, we came into contact with the research of the team of professors at Linköping University, and, specifically, of Jonas Hallström and

[5] This paper summarises some of the key contextual and policy issues surrounding the use of ICTs in Spain, referring to both state and regional programmes. In this historical journey —which only goes back to the 1980s— it differentiates four stages: the innocence of educational computing in the 1980s, the lethargy and critical review of the 1990s, the transition to the 21st century and the spread of the internet, and the current moment and the need to rethink the *purpose of* its use in schools. Obviously, it was not the author's intention to make an exhaustive or historical work, but simply an attempt to define some of the key stages in the evolution of ICT policies.

[6] See for example, Gónzalez, M. and Groves, T. (2017). La enseñanza programada, la UNESCO y los intentos por modificar el currículum en la España desarrollista (1962-1974).

Magnus Hultén. Their studies raised the possibility of using other theoretical frameworks for analysis, and, after contacting them directly, a stay at their research centre was made possible. We will expound upon this below.

We would also like to highlight the fact that the doctoral thesis was linked to the Research Project of the State R&D Plan entitled *Economía, patriotismo y ciudadanía. La dimensión económica de la socialización política en los manuales escolares españoles desde el Tardofranquismo hasta la Transición* [Economy, patriotism and citizenship. The economic dimension of political socialization in Spanish school textbooks from late Francoism to the Transition], with reference EDU 2016-78143-R, of which Manuel Ferraz was the Principal Researcher. Being part of a team of outstanding researchers from the Universidad Nacional de Educación a Distancia, the Universidad de Sevilla or the Universidad de Valladolid, with renowned figures such as Gabriela Ossenbach, Agustín Escolano, Virginia Guichot or Miguel Somoza, as well as young researchers with great projection, only enriched the work we had been doing, favouring different links and channels of collaboration. Furthermore, under the auspices of this project, we carried out a series of investigations that contextualise and define the historical framework of the programmes that are the object of analysis in this thesis, delving into the periods of late Francoism and the democratic transition in Spain and into the social and curricular modernization policies that were developed in that context, and without which the analysis of the ICT programmes that took place in the second half of the 20th century cannot be understood. As a result of all this, research results were presented in such important forums for the History of Education as the International Standing Conference for the History of Education (both in Berlin in 2018 and in Porto in 2019), and in the conference of the Spanish Society for the History of Education (in 2017 in Alcalá, and in 2019 in Monforte de Lemos), and several publications were put out in article format which had their culmination in the work published in the prestigious *British Journal of Educational Studies in* 2020 and which is part of the compendium we are presenting here.

The research work continued with an exhaustive review of primary sources resulting from visits to different archives and documentary repositories. We would like to highlight the documentation available in the repository of the Ministry of Education and Science Library, which was provided to us in digital format and from which we obtained some of the reports and ICT projects (especially from the Atenea project). We also had access to

documents available in the library archive of the University of La Laguna, especially for the review of publications on ICT programmes in educational newspapers such as *Comunidad Escolar*, and in magazines that appeared punctually in the 80s and 90s, such as *Infodidac* and *Zeus.* In informal conversations at conferences, commenting on the progress of the thesis with PhD. María José Martínez Ruiz-Funes (University of Murcia), we discovered that her university conserved original documents on the Atenea project (as the evaluation was led by Juan Manuel Escudero, professor at this university) that were to be expurgated, and she very kindly sent them to me in La Laguna, for which I reiterate my profound gratitude. In turn, Mariano González, in one of his visits to the UNESCO archives, also discovered information associated with programmes for the use of computers in Spain in the 1970s, documents which he gave me and for which I am also very grateful. Finally, in January 2019 we spent a short time in the General Administration Archive (AGA) located in Alcalá de Henares, where we also had access to reports, minutes of meetings and correspondence of great interest. This documentation, which we have not even fully studied in this thesis, is sure to be useful for future work. Once again, and although it is reiterative, I must thank the work and willingness of the staff of the AGA Education floor.

Last but not least, we carried out two short research stays in prestigious centres abroad, which also allowed us to submit this thesis for consideration for the award for the International Mention for the PhD. The first of these took place between 24 September and 27 November 2017, at the University of Roehampton in London, under the supervision of PhD. Antonio Olmedo. This was made possible thanks to a grant from the pre-doctoral training programme for research staff to carry out short stays in Spain and abroad, co-financed by the European Social Fund of the ACIISI, in the call for 2017. The second was held between 23 April and 26 May 2019 at Linköping University in Sweden, under the supervision of PhD. Jonas Hallström. This stay, made possible by a grant for stays in other centres associated with the development of doctoral theses with an international mention, was in response to a call for the Training Programme for Research Staff (2019) of the Vice-Chancellor's Office for Research at the University of La Laguna. During the first stay, in London, with PhD. Olmedo we were able to develop and lay the foundations for issues related to the analysis of educational policies, establishing various methodological approaches; in the second of these, with the help of PhD. Hallström we learned about the case of the Swedish COMPIS project - similar to the Spanish Atenea -

and we worked on issues related to various debates on technologies in education and the influence and role of large transnational organisations.

With this detailed description of the research we mean to point out the fundamental milestones in the course of this doctoral thesis, an exercise that we believe provides a context for the work as well as highlighting the different grants obtained and identifying the researchers who have influenced and collaborated on it. We also feel that it helps to clarify how the subject of this thesis was shaped and how we have been responding to the different questions posed.

2.2. Presentation of the compendium of articles

The modality used to present the results of the doctoral thesis is by compendium of publications, in accordance with the stipulations of current regulations: Royal Decree 99/2011, of 28 January, which regulates official doctoral courses, BOE, no. 35, 10-02-2011; and the specification of the modality by compendium of publications in article 29 of Agreement 2/CG 25-07-2017, which approves the Regulations for Official Doctoral Courses at the University of La Laguna. These regulations stipulate that at least three articles with a thematic unit must be submitted, articles that have been published or approved for publication in scientific journals listed in the Journal Citation Reports (JCR) or in similar databases of recognized prestige such as SCOPUS.

Following are the four articles making up the compendium. We describe the complete bibliographic reference of each one of them, the databases in which the scientific journals in which they have been published are indexed —with their corresponding quality indicators—, and the abstracts as they have been published. It should be noted at this point that the articles have not been ordered either alphabetically or in the chronological order of their publication[7], but rather following the discursive thread that confers coherence to this thesis, the logical order by which the different objectives were addressed

[7] We all know how long it takes to evaluate and publish articles, which are often conditioned by the flow of proposals received by the journals and the limit on the number of issues and articles they publish annually. Therefore, it can be observed that the times and order in which we develop and send each one of the articles is not correlated with the publication dates. That is, some articles that were sent for review after another one was published earlier.

and the results obtained. Specifically, the first article provides context on the current general debate on ICT in Education and the reflections and first investigations developed in the thesis; the second article defines the Spanish context of the programmes studied (late Francoism and democratic transition), describing how Spain began to apply developmentalist policies as a result of its increasing relations with international organisations, also addressing the case of textbooks as an example of the modification of the educational model; the third article deals with the general debate which has led to the rise of ICT programmes in Education since the middle of the 20th century, defining the influence of the large organisations and the computer industry and listing programmes on computer use that are beginning to be developed around the world; and finally, the fourth article of the compendium responds to the case study of the Spanish Athena programme in the 1980s, situating its background, the national debate, and describing and analysing how the programme was developed.

2.2.1. Article 1

Ferraz-Lorenzo, M. & Machado-Trujillo, C. (2018). Cognitive Processes, ICT, and Education: A Critical Analysis. *Computers in the Schools*, *35*(3), 186-203. https://doi.org/10.1080/07380569.2018.1491772

- Indexed in SCOPUS, Education, Q2. Impact factor (2019) 0,38. H index: 23.

Abstract: Information and communication technologies (ICT) have brought about renewed spaces for the societies of today, full of possibility and transformation. Bordering on the infinite, these spaces have generated new activities and behaviors. This technological scenario is now commonplace, an everyday reality that has taken root in our lives with remarkable speed. Now would therefore be an appropriate time to open up a line of inquiry into how this is shaping educational practice and how it is affecting our cognitive structures. We have chosen to conduct a review of relevant literature that will enable us to adopt a critical analysis to our subject: education and, above all, the learner, seen from the perspective of neuroscience and social analysis. However, the principal aim of this paper is to lay bare the disparities between research findings and current educational practices that use ICT.

Education and Historical Evolution of ICT

2.2.2. Article 2

González-Delgado, M., Ferraz-Lorenzo & Machado-Trujillo, C. (2020) The concept of the State in textbooks: analysis and reinterpretation during the spanish Transition to democracy (1976-1986). *British Journal of Educational Studies*, *68*(3), 331-347. https://doi.org/10.1080/00071005.2019.1645810

- Indexed in JCR, Education & Educational Research, Q2 (position 128/263). Impact factor (2019): 1.694. JIF Percentile: 51.251.
- Indexed in SCOPUS, Q1. SJR (2019): 1,05. H index: 45.

Abstract: This article analyses the concept of the state as represented in primary school social science textbooks in Spain during the transition to democracy. The analysis of textbooks during this period has tended to focus on the importance of National Catholicism or the technocratic vision in the framing of their representations. This article points to how such representations should be viewed from a more complex perspective that lays the emphasis on how the dictatorship understood education within the context of the Cold War. The first part of the article analyses the explanations given by textbooks during the transition. The second part dissects the subsequent evolution of the representations. Lastly, we attempt to explain why these representations and changes came about.

2.2.3. Article 3

Machado-Trujillo C., & González-Delgado M. (2019). Information and Communication Technologies in the Curriculum Policies, a Critical Analysis. In M. Peters & R. Heraud (Eds.), *Encyclopedia of Educational Innovation.* Springer. https://doi.org/10.1007/978-981-13-2262-4

- Indexed in Scholarly Publishers Indicators In Humanities and Social Sciences (SPI). In 2018 general ranking, Springer has the 4th position with an ICEE of 670.000. In 2018 Education's ranking has the 2nd position with an ICEE of 94.

Abstract: This entry focuses on developing a brief critical exploration of the introduction and development of the use of Information and Communication Technologies (ICT) within the educational curriculum. In recent years, the use of ICT as a tool to produce processes of innovation, improvement, and modernization of school systems has become one of the most powerful discourses when creating new educational policies throughout the world. Both locally and supranationally, ICT have occupied a prominent place in the educational agendas of different nations and international organizations: OECD, UNESCO, World Bank, or the EU. With the aim of improving students' learning processes or linking education systems more directly with economic growth, ICT have been modifying teaching-learning methodologies and knowledge in curriculum policies worldwide. To a certain extent, the use of ICT has increasingly linked curriculum models with the new neoliberal governance in state education. In this entry, we will analyze the nature and development of ICT in education. We will begin by indicating its historical background. Then, we will continue with an analysis of the most current trends. From here, we will present the main criticisms that the use of ICT have raised in classrooms and observe to what extent these technologies have led to an improvement in education. The entry concludes with the exposition of some of the main weaknesses of the use of this type of methodologies in education and what effects they really seem to produce.

2.2.4. Article 4

Machado-Trujillo, C. (2020). El boom tecnológico en las escuelas de los años 80: una aproximación al programa ATENEA español. *Espacio, Tiempo y Educación, 7*(1), 247-262. http://dx.doi.org/10.14516/ete.249

- Indexed in SCOPUS, Education Q4 and History Q2. SJR (2019): 0,17. H index: 1.
- Indexed in Emerging Sources Citation Index (ESCI) and EBSCO Education Source among others.
- Also has de quality seal of FECYT (2019).

Abstract: Aims: This paper aims to analyse the debate concerning the incorporation of Information and Communication Technologies (ICT) by the Spanish Educational System,

specifically the background and development of the first state-sponsored experimental programme, the Atenea project (1985-1992). Methodology and sources: To this end, we performed a review of documents pertaining to the programme and its evaluation, also taking into account the debates it generated. These documents were supplemented by reports and evaluations on related programmes, the conclusions of which we analyse in comparison with some of the contemporary reports, such as the one published by the OECD in 2015. Conclusions: Some of the fundamental debates that arose as a result of these programmes promoting the use of computers, in particular the Atenea, are strikingly valid but still lack a clear response. In the case of the promotion of ICT as an educational tool, we must recognize the relevance of corporate and business interests that saw the Education System as a large market, and therefore encouraged this type of programme, favouring an application focused more on the instrumental level than on the pedagogical one.

3. State of the Art

3.1. The recurrent (and neutral?) debate on ICT in education

> The objective social reality, which does not exist by chance, but as the product of human action, does not transform itself by chance either (Freire, 1979, p. 48).
>
> The focus of any digital disruption is not the actual technology per se, but how the technology is applied and what the technology makes possible that was not possible before (Selwyn, 2017, p. 30).

By consensus, we can say that ICTs have reformulated the modes of production and dissemination of information and that the properties they possess have favoured improved connections, transforming much of our daily activities and permeating our culture. Profound changes resulting from the technologies we use become, in turn, agents of major transformations at the political, economic and social levels. It was authors such as Marshall McLuhan, Alvin Toffler, Neil Postman or Nicholas Negroponte who first began to predict the great transformations that were coming as a result of accelerated technological advances. McLuhan, back in 1964, and as a result of the boom in the mass media, began to talk about the world becoming a *global village*, given the new possibilities and connections that could be made almost immediately thanks to novel tools. Toffler (1971), in a similar vein, reflects on how social changes and transformations are being accelerated as a result of the new technologies that have appeared, generating what he coined as the *shock of the future*, an allusion to the difficulty of adapting to so many changes so quickly. Postman (1993), in his text *Technopoly*, delves into the power of transformation and the social impact of ICTs, even stating that "a new technology does not add or substract something. It changes everything" (p. 18). In his text he emphasises the idea that technologies are more than mere tools; they change how we see reality (hence the construction of *technopoly*) and they are modifying concepts such as freedom, truth, intelligence... Finally, Negroponte (1996) in talking about *being digital*, looks with remarkable optimism towards a future immersed entirely in the digital, where technology

will offer new and unsuspected possibilities. This brief overview takes us to the current scenario, which we could describe from the perspective of Zygmunt Bauman (2000). According to this author, our time is characterised by fluidity, by shaping a liquid modernity in which structures change so quickly that they do not have time to solidify. On this scenario of constant and accelerated changes resulting from rapid technological innovations quite a lot has been written, as we have already indicated.

On many occasions we observe that when analysing ICT two main interpretative groups emerge, summarised by Umberto Eco (1977) as *apocalyptic* and *integrated*[8]. By this we mean that it is common to find in both scientific literature and reality two antagonistic camps, one made up of people with unusual enthusiasm and faith in technologies (especially ICT), and the other group displaying total opposition to the changes brought on by them and by their application in different social spheres. Obviously, positions towards technologies (and especially towards the *new ones*[9]) are diverse and go beyond these two positions, but it is quite frequent to find this type of dichotomous categorisation to which many have added labels and names. For example, Cristóbal Cobo speaks of *techno-skepticism* and *techno-enthusiasm* (2016), while others, such as Evgeny Morozov (2012), who only refers to the latter group of enthusiasts —and especially the most naive sectors— define these fervent believers in the benefits of ICTs and their ability to remedy all ills, especially educational ills, as *cyber-utopists.*

In staking out a position, many have come to the fore as ardent supporters of ICT innovation, seeing it as a panacea and solution to the problems of this world. This has been especially notable in education, with all kinds of *influencers* or *gurus* appearing as technological innovators[10]. Without underestimating the many praiseworthy and

[8] Echo makes this distinction as positions in the face of mass culture, although it asks whether "the formula 'apocalyptic and integrated' would not really pose the opposition between two attitudes but rather the preaching of two complementary adjectives, adaptable to the same producers of a popular criticism of popular culture" (1977, p. 13).

[9] We make a note of this, because commonly), we continue to catalogue some of the *new* technologies that have been around for decades and have even *disappeared in* our eyes. Mark Weiser (1991) explains the latter by alluding to the fact that some of these technologies have permeated so deeply into our lives that they have even become "invisible". For example, today we would have to stop and think to realise how profoundly complex and developed a *smartphone* is, since we have normalised its use and it has permeated our behaviours, interactions and culture.

[10] It is worth noting how the computer industry has attracted the attention of teachers at all stages of education, developing programmes so that teachers, and even schools, can be certified as innovators and experts in the use of the extensive catalogue of tools they offer (and, by the way, encourage their use and the purchase of both hardware and software, it goes without saying). Examples of this are the programmes

impressive initiatives that have been set in motion there are many instances that can best be seen as responses to technological fashions and the interests of large companies in the computer industry. In the words of Cristóbal Cobo, "while some promote inclusion and pursue the promise of the 'school of the 21st century', others seek to distribute (sell) devices, programs, connectivity, training, educational content and support in extraordinary volumes and on extraordinary scales" (2016, p. 50).

On the other hand we find the opposite, strong opponents who see technology as an oppressive element conspiring against humanity, who understand them in a deterministic way, and who attack the *status quo*. Both positions —fortunately— are nothing more than caricaturizations of reality, although in some cases the resemblance of the two can be disturbing. Ideal types and dichotomous categorisations define models that help us describe the world around us, so engaging in a debate about whether technologies are good or bad *per se* would be a clear reductionism of the issue. Furthermore, the relevance of ICTs has made their presence unavoidable, to the point where they have become one more cultural element in our lives. (Weiser 1991, Burbules & Callister, 2000). In our analysis we aim for more profound considerations about their social significance and about how they are transforming educational spaces. We also examine the various interests that led to their introduction into educational systems several decades ago and those that continue to promote their use (and how they are serving as a pretext to justify certain educational policies).

One of the issues we would like to look at in depth, and which has given rise to the first research questions of this doctoral thesis, is the debate on the neutrality of technologies. In many forums of all kinds, one can find a somewhat naïve discourse on technologies, one that ignores the fact that any technological tool can also be loaded with cultural content and that its development and use can be mediated by interests beyond the mere technical ones that respond to the properties for which they have been designed. To better understand these two views and perspectives on technology, we refer to the works of Andrew Feenberg, who, in 1991, defined in one of his texts the Critical Theory of Technology, which he continued to develop until the last revision published in 2002 under

from Apple, *Apple Teacher* and *Apple Distinguished School*; the *G Suite for Education* platform from Google and the programmes from *Google Certified Educator* (levels 1 and 2), *Certified Trainer* and *Certified Innovator;* or the *Microsoft Certified Educator* programme, from Bill Gates' company.

the title *Transforming technology. A critical theory revisited.* In a very simple way, he synthesises the types of theories about technology by crossing in the following matrix the values of autonomy and neutrality, in terms of whether they are considered neutral or not and whether people have control over them or not:

Technology is	**Autonomous**	**Humanly controlled**
Neutral (complete separation of means and ends)	Determinism (traditional Marxism)	Instrumentalism (liberal faith in progress)
Loaded with values (the means form a lifestyle that influences the ends)	Sustantivism (means and ends linked in systems)	Critical theory (choice of alternative medium-end system)

Source: Feenberg (1999) in Adell (2018, p. 125).

Crossing the considerations on whether technologies are neutral and autonomous elements or not, we can define in a summarized way the four existing fundamental theories: determinism, instrumentalism, substantivism and critical theory. In order to avoid embarking on a lengthy definition of each one of them, and given the clarity of the previous scheme, we refer to Feenberg (2002). For this author,the instrumentalist vision considers that technologies are neutral tools since they have a strictly rational character, one governed by efficiency criteria, from which it is derived that they are indifferent both to the ends and to the policies they serve. The deterministic and substantive positions are the result of structural Marxism, in the case of the first of them; and of the critical perspectives of Jacques Ellul (1964 in Feenberg, 2002) and Martin Heidegger (1977, in Feenberg, 2002), the second. Both develop a somewhat pessimistic view, especially the substantivist one, which argues that technologies are acquiring increasing autonomy owing to the accelerated rate of innovation, generating cultural transformations that cause new lifestyle practices that are radically different (Feenberg, 2002). Critical theory understands them to be a non-neutral system, loaded with values but not autonomous. Although we must bear in mind that technologies often have unintended consequences, insofar as they can open up possibilities or generate transformations that were not foreseen among the purposes for which they were developed[11] (de Vries, 2012;

[11] Marc de Vries (2012) explains this by alluding to the fact that they are designed in an optimised way for a specific use, but this does not imply that a specific technology can end up being used for other functions that were not contemplated by its designer. He conceptualised this as *accidental functions*, those functions that appear by chance and are not their fundamental function.

McChesney, 2013), critical theory does not define them with the independence and pessimism that substantivism attributes to them.

It is not the object of this thesis to go deeper into this categorisation, which could well be the subject of another doctoral thesis, but it does seem to us that what Feenberg (1999, 2002) has set out here clearly defines the different positions regarding technologies and serves to emphasise the need to move from instrumentalist and deterministic positions to a critical theory. Obviously, both views serve to explain reality, and there is no denying either progress or how technologies determine it to a certain extent, but, as Jonas Hallström (2020) explains:

> The idea of (hard) technological determinism, or over-determination, is thus in itself problematic, regardless of the actual existence of any deterministic technology in history or in the present, because what we think about technology will necessarily affect how we act in relation to it. (p. 12).

Therefore, with these contributions from the Philosophy of Technology, we are underpinning the fundamental idea of understanding them not exclusively as tools devoid of values. Marc J. de Vries (2012) adds that technology should not be conceptualised only as artefacts defined by their physical properties and functions, but also as knowledge, in relation to which they are applied knowledge, and that from their application new knowledge is developed; as activities, in terms of the design, development and use processes; and as values, which have to do with the socio-cultural load they can have, as we have pointed out.

After briefly introducing some definitions that help us to go deeper into the complex conceptualisation of technology, this serves to affirm even more strongly that most analyses that have been made from educational technology have only touched on the surface of the issue. The commentary on this by Jordi Adell (2018) is interesting, when he explains that "most of today's research on educational technology is instrumentalist (technology is neutral and we humans control it)" (p. 125). In view of this, he urges us to not overlook the fact that they are more than artefacts, that they also give rise to political dispute and that they represent a market (Adell, 2018).

Education and Historical Evolution of ICT

Research and arguments on educational technologies and technology are not only instrumentalist, but are also thought of in the abstract, decontextualised from the place and historical moment in which they have been developed. Discussing technologies, and in particular ICTs, without paying attention to their history, can lead to attributing to them advances that have already happened, as if they were the first technologies that have caused a revolution (Morozov, 2014). On the other hand, it means uprooting them from the context in which they arise, and the possible political and economic implications that have encouraged their development or the uses that are being made of them. Robert W. McChesney (2013) summarises it as follows:

> Both sides, with few exceptions, have a single fault [...]. Both the optimists and the sceptics lack an economic-political context. Their works tend to consider capitalism as part of the background landscape and to think of technology as being absolutely alien to history (p. 28).

This statement reminds us that, in addition to the rational logic of technology, its technical nature also means that it is developed and used in specific contexts under specific policies, which is why its extrapolation to other contexts is not always satisfactory[12]. More critical positions in this respect take these arguments closer to the extreme. Morozov (2012), for example, points out that "they often completely forget the political nature of technology" (p. 21), which is actually central to the forms of power and market they are generating, more than the uses or design of the technology. Thinking about technologies in the abstract, without context, implies the indifference of a specific means in relation to the ends it serves, but today the technology we use is not only related to knowledge and innovations, but it is also influenced by power structures that skew knowledge and/or make possible or diminish its advancement (Feenberg, 2005).

While factors such as the economic crisis have affected development insofar as they have meant cuts in scientific research and innovation programmes, on the other hand, the large market that ICTs are generating through the sale of devices and information itself also show that the wind is blowing in favour of policies promoting this media, including their

[12] If we go back to Feenberg's (1999) previous scheme, from the instrumentalist theory, which affirmed the neutrality of these, that they were not value-laden, and that they did not serve any kind of policies, it is also stated that they could not be transferred without any kind of problems to other contexts since they were not linked to the keys of the place of development and use. Obviously, we do not share this position.

use in other areas such as education[13]. Technological innovation does not happen in the abstract, in isolation, but rather depends on the context, the state of knowledge, the institutional, industrial, economic environment... The relationship between technology and society is not as deterministic in both directions as some people claim, but it must be recognised that while society can stifle the development of technologies, technology — or its absence— can also shape the capacity of societies to transform themselves.

Tomás Neira (2011) emphasises this idea, stating that "instruments are symbols of the recreation we make of the world, so they are not mere devices, but agents of change" (p. 17), an issue that has been accentuated by the nature of the medium we are using insofar as these medium directly influence information and communication. It is necessary to analyse not only their functional relationship with reality and with the practical ends they serve, but also their design and implementation, that is, the reason for using certain technological options and the ends they serve, understanding these now in a broad way (Feenberg, 2005). Nicholas Burbules and Thomas Callister (2000) define it as follows:

> The tools may have certain established uses and purposes, but they often acquire other predictable ones and generate new unpredictable effects [...]. We never use them without them "using" us; we never apply technologies to change our environment without being changed ourselves (p. 21).

As the previous quotation states, such transformations in communication technologies often occur involuntarily, even generating changes – which may be intensified - in other areas or activities that have nothing to do with the purposes for which they were created. (McChesney, 2013). Therefore, there are aspects which are beyond our control and which modify issues for which they were not originally intended, generating social transformations which sometimes have a greater impact than the technology itself (Burbules & Callister, 2000). Hence, we are being "used" by technology in this construction process. As Manuel Castells points out (1996), the deterministic dilemma posed in some forums is not truly a problem, since technology is part of society insofar as it comprises the set of technical tools that have been developed in response to specific

[13] I refer to footnote 8. We will now also address the fundamental role of the computer industry in spurring the use of ICT in schools, and how schools have been a key business niche on which they have based their marketing strategies.

progress and ways of life. David Nye (2006) highlights this idea, stating that, "defining technology as inseparable from human evolution suggests that tools and machines are far more than objects whose meaning is revealed simply by their purposes [...], and they express larger sequences of actions and ideas" (p. 2).

For all these reasons, technologies must be accepted as a natural part of the order of things, constituting the product of a particular economic and political context, of a specific agenda and programme, and representing the object of struggles of political and economic interests, struggles which have also been transferred to the educational space (Apple, 1991; Postman, 1993; Selwyn, 2017). Geir Haugsbakk (2011) summarises this quite well in relation to educational technology, explaining that "the use of technology in schools is transformed into an arena for politicians, school administrators and technologists" (p. 245)

All of the above does not mean that before the emergence of ICTs there were no major technological revolutions that caused major social transformations (for instance, the appearance of the printing press in the 15th century or the appearance of steam engines and the beginning of industrialisation and mechanisation of work centuries later), as this would be to deny both history and the great technological revolutions. What is new within what we could call the new informational paradigm in which we find ourselves is that the information and communication technologies that have been developed are having a great capacity for transformation in the way that, as their name indicates, they directly affect information, an integral part of all human activity (Castells, 1996). This fact is even more relevant if we take into account that nowadays one of the main sources of power lies in the control of information[14]. The ease with which large companies and governments can access information about anyone and the sheer amount of information available to us thanks to the Internet and digital technologies is mind-boggling. Large companies make enormous profits from selling information they have previously acquired from us for free, resulting in the possibilities of control being more diversified, more subtle and more seemingly legitimate, as Jaron Lanier (2014) explains. The Internet favours all these

[14] In the past, the great sources of power were control of oil or other raw materials that people needed, but today the primary good is information. That is why we are even offered apparently free services (such as the use of a social network) simply because of the value that the information we put into them has for certain institutions. Lanier even goes so far as to say that accepting such a service for free means empowering others to decide how we live (2014).

emerging forms of exercising power that are based on the control of information and on generating areas of influence and control in digital spaces such as social networks (Cobo, 2019).

Despite this more sceptical view, other emancipatory initiatives may also emerge through ICTs, but they are not comparable to the big business generated around the control of information, where the role played by digital technologies has been crucial (J. Lanier, 2014). This has favoured a technocratic model —in which the free market and fierce competition rule— based on automated efficiency achieved through algorithms that attain a level we can hardly imagine. ICTs have made it possible to exacerbate the differences already generated by the capitalist model and have favoured certain monopolies, as predicted by Metcalfe's law, which states that the value of a network increases proportionally to the square of the number of users it has. An example of this can be found in companies such as Google, which, initially stood out for the efficiency of its search engine algorithms. As the company gained users, its networks and possibilities expanded —along with its algorithms— with this system of expansion leading to the monopoly of this search engine over others. A gap such as this only widens (Vaidhyanathan, 2011). This example is meant to briefly illustrate how technologies have perpetuated a specific political and economic system, the consequences that they have on the system, and how specific technological developments have also been promoted precisely to perpetuate it; we can conclude therefore that the choice of a technological design or model, instead of attending to exclusively technical criteria, is in many cases based on political and economic interests.

We have dealt with various fundamental aspects of ICTs, including the different theories regarding characteristics such as their neutrality and autonomy, the relationship with a context, the interested use of ICTs from spheres such as politics and economics, and how they are generating a technocratic space and imposing the values that these tools favour. Another important question, especially in the field of education and educational technology, refers to the fact that they directly affect how we process information. As authors like Nicholas Carr (2010) have explained, this implies that they provide the material for thought, affecting the thought process even at the level of cognitive structures. This phenomenon not only has to do with the way in which they structure information and allow for a greater number of connections and leaps between different

contents as opposed to the linearity of physical formats; rather, the expansion of mass media and the immediacy and ubiquity offered by the internet have meant that today the problem is not access to information, but rather an excess of it. Some have coined this situation of information overflow with terms such as *infoxication* or similar terms (Mayos & Brey, 2011; McChesney, 2013). Luciano Floridi (2007), defines the term *infosphere*, understood as the environment that has been generated and which is made up of all the informational entities, their properties, interactions, processes and relations. The author himself differentiates it from *cyberspace*, since the former also includes all the information available offline as well as analogue information. He argues that "the infosphere constitutes an intellectual space whose density and extent are constantly increasing, although at disparate rates in different ages and cultures" (Floridi, 2007, p.9). ICTs have led to a renewed onthologisation of the infosphere, due to the transformation they have brought about in the design, structure, functioning and even in the very nature of information. But of course, we must be aware that, as a result of this very infoxication, and of how information is structured on the web, "ICTs are great in making information available; they are less successful in making it accessible, an even less so in making it usable" (Floridi, 2014, p.86).

Given that some of the most widely used formats in education today involve digital tools, we must bear in mind the point made by Manuel Area (2004, p. 76): "the media are not only new depositories of information, they are also structuring the learning process and activity. Each medium [...] demands users to activate different strategies, skills and cognitive operations". We are interested in pointing out that the very means through which we present and disseminate information also define how our thinking works, how our cognitive structures are modelled and how they condition the learning process, directly affecting basic cognitive processes such as attention, understanding and memory, among others (Small & Vorgan, 2009; Ortiz, 2009; Carr, 2010).

In addition to offering us information, they also restructure and modify our forms of processing and our cognitive structure, as Julio Cabero and Ignacio Aguaded (2013) point out, while the Internet, together with the new devices or the hypertextual structure promote another type of reading and access to information that is totally different from

that used with a physical text[15]. The structured presentation and linearity of physical texts give way to hypertexts in which the information now appears in the form of a more or less ordered network of nodes through which the reader jumps from one link to another. Such a presentation does not allow us to make a mental map of the information at first sight, and as a result our attention is more dispersed among the multitude of stimuli offered to us (Small & Vorgan, 2009). Therefore, they lead to the development of cognitive skills that are different to the classic media we have been using, as well as promoting specific ways of presenting information and access to knowledge, issues whose study is of great relevance from the educational point of view.

As was mentioned above, this is just another way in which technologies «use» and transform us, making a preferential option for certain models of thought and legitimizing a specific information, mode of access to knowledge, behaviour and culture. These elements play a crucial part in the teaching and learning processes, as the means we use condition the rest of the educational processes. Furthermore, let us not forget what we have been reiterating: ICTs are not mere artefacts, they can be mediated by specific interests, among which we should pay special attention to the political and economic ones, given the market they represent. In short, in this section we have brought together some relevant questions underlining the broad nature of the general debate on ICT and their use in education. We have sought to avoid both reductionist and naïve analyses, as well as deterministic and apocalyptic ones. The matter is well summarised by Neil Selwyn, Selena Nemorin, Scott Bulfin and Nicola F. Johnson (2018), when they state that "the poor quality of debate surrounding schools and digital technology (characterized by hyperbole, misinformation and unfounded optimism) must be challenged" (p. 186).

In the following section we will describe how, since the middle of the last century, programmes for the use of the mass media have been developed with great fervour. We will also look at the way in which computers were introduced into schools on a massive scale in the 1980s. Although we will go into this in greater depth later on, these technologies were not introduced specifically in response to a strong demand by teachers or students, but rather because of other external imperatives (Selwyn, 2017). We could

[15] Multiple studies from Neuroscience and Cognitive Psychology verify these transformations. We will go deeper into this and provide an extensive list of studies in the first article that makes up the compendium, entitled *Cognitive Processes, ICT, and Education: A Critical Analysis*.

summarise through Michael Hammond (2014) the three principles by which ICTs began to be promoted in education and which are still valid today: they cause a greater economic impact; they can improve educational standards; and they are proposed as a catalyst for educational reform. At different historical stages, some of these virtues have weighed more than others, but, at the heart of the matter, we should not forget the following:

> It is important to recognise that many of the key questions surrounding education and technology are not technological questions *per se*. Instead, they are related to wider questions of what education is, and what we want education to be (Selwyn, 2017, p. 35).

3.2. Brief historical overview of ICT in Education: technologies, programmes and international influences

> By thinking of technology in this way, by closely examining whether the changes associated with "technological progress" are really changes in certain relationships after all, we can begin to ask political questions about their causes and especially their multitudinous effects. Whose idea of progress? Progress for what? And fundamentally, who benefits? (Apple 1991, p. 59)

In the previous section we reviewed the debates and questions about technologies that correspond to the first research questions addressed in this thesis, and which revealed the need for a historical analysis of how ICTs were introduced into education systems. At this point, we will make a synthesis of the contextual keys, historical milestones, agents involved and specific interests that intervened in the process. Our research focuses on the 1980s and, as we will show in the following pages, the strong technological development that schools underwent in that decade actually began in the 1960s, as a result of the proliferation of radio programmes, educational television, teaching machines and the incipient personal computers. This does not mean that there were no previous programmes that, in one way or another, tried to adapt different technologies to the educational field, but we will focus our attention especially on what has happened since the 1960s because of its direct influence on our object of study. Nor will we attempt an

exhaustive review, which would be practically impossible given the large number of programmes that have been developed around the world with the different technologies and the agents involved in the process. For this reason, we will take a look at the most important factors that allow us to trace the development to the great emergence of ICT programmes in the 1980s.

In beginning this historical review, we cannot ignore one of the classic works that made a historical synthesis of how various technologies have been used in schools. We are referring to the book *Teachers and machines. The classroom use of technology since 1920*, by Larry Cuban (1986), which includes some examples of educational programmes that began to use audio visual media at the beginning of the 20th century. For Cuban, the use of films marks the origin of these media; he describes how the rise of silent commercial films starting in 1890 in American culture led to their use in schools in the first decade of the 20th century. Their importance was such that, "as early as 1910, George Kleine published a 336-page *Catalogue of Educational Motion Pictures*, listing over 1,000 film titles that could be rented by schools" (Cuban 1986, p. 12). In 1906 a first monograph on the benefits of visual instruction had already been published under the title *Visual Education*, edited by the Keystone View Company (Saettler, 1968, p. 152). Along these lines, Kleine himself tried to promote a "school film service" before the New York City Board of Education, although the constitution of the latter did not prosper due to a lack of funding (Saettler, 1968, p. 98). Amidst this widespread enthusiasm for films, its proponents presented them as instruments that would favour the transition to new progressive educational models that were being developed. Personalities of the time also spoke out, and, among them, Thomas Edison went so far as to say that books would soon become obsolete and that instruction would be based on the moving image (in Cuban, 1986, p. 11). Other experts, along with voices of authority, claimed that they would reduce the costs of instruction and bring educational practices into line with the new times. On the other hand, we cannot lose sight of the fact that some commercial companies had already begun eyeing the educational system, and that "schools became potential markets for projection equipment and for the rental and purchase of films for instructional purposes" (Saettler, 1969, p. 99), a potential that grew with the demand generated by World War I. Between the 1920s and 1940s a variety of studies on educational films were carried out in an effort to ascertain their effectiveness, many concluding that "educational films could convey the same content as effectively as other

methods, but 10 to 20 percent faster" (Ferster, 2016, p. 24). Between 1941 and 1946, the US alone produced "457 visual aid units, 457 sound motion pictures, 432 silent filmstrips, and 457 instructors' manuals" (Saettler, 1968, p. 163). This rise in the 1940s was spurred by the advent of World War II, which for the first time in history demanded the fastest and most effective instruction for millions of industrial workers, hence the creation of the Division of Visual Aids for War Training, which later became the US Office of Education Training Films (Saettler, 1968, p. 159).

The interesting thing about this is, as Cuban points out, that the "classroom use of films became a symbol of progressive teaching approaches, just as the microcomputer is today" (1986, p. 12). This statement is of great interest for us, since, as we will argue, regardless of the decade in which we are situated and of the specific technology we are talking about, the arguments that have been used to justify the introduction of one or another technological tool in schools are very similar. The idea of progress, of moving towards a progressive teaching approach that breaks with traditional methods, of improving the effectiveness of teaching and learning processes in relation to other instruments such as books (and even teachers themselves), of reducing costs, of more personalised attention, of better sequencing and adaptation to the students' learning rhythms; all of these have been recurrent. As we point out in some of the articles that constitute this doctoral thesis, all of these arguments can be found in one form or another in the justification of the various ICT programmes which have followed upon each other historically, regardless of whether they have focused on the use of radio, television, teaching machines, computers or the immensity of digital applications and platforms which we have today (Cuban, 1986; Cohen, 1987; Selwyn, 2017). All of them share the same initial expectation, presenting the different technologies as the tools that would facilitate the resolution of some flaw or specific problem in education[16]. A look at the historical evolution of ICT programmes and their constant replacement over time inevitably leads us to what Selwyn, Nemorin, Bulfin and Johnson (2018) described as infinite "cycles of hype, hope and disappointment" (p. 8). In other words, they have raised high expectations about their usefulness and effectiveness, expectations which have not been met. But this does not mean that they have not had an impact on education and that some programmes or applications have not made great progress. We are all aware of the complexity of the

[16] We refer here to that naive and techno-utopian vision that prevails in most of the discourses on ICT and Education that we discussed in the previous section.

processes of change in education and of the multitude of agents and interests involved, so to expect a technological innovation to work as a panacea for all educational ills is to expect too much[17].

We have seen through the example of the introduction of films in schools at the beginning of the 20th century that the fundamental arguments and debates on the introduction of ICTs being used up to the present day were there from the very start, with no more than a variance in the specific technology referred to at each historical moment. After these first initiatives with audio visual media, a variety of programmes using radio and television for instructional and educational purposes were implemented around the world. In order to understand how these experiences with audio visual media in education have continued to develop since the middle of the 20th century it is essential to understand the role that international organisations and different foundations began to have as they turned their attention towards education. The role of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Organization for Economic Co-operation and Development (OECD) and its Centre for Educational Research and Innovation (CERI) is especially noteworthy, although the World Bank (WB) and the Ford Foundation and its Fund for the Advancement of Education project have also been fundamental (Cuban, 1986; Druick, 2006, 2020; McAnany, 2012; Selwyn, 2013; Tröhler, 2013; Ferster, 2014; Duedhal, 2016; Machado-Trujillo & González-Delgado, 2019; Ydesen & Grek, 2019; Martín-García & Delgado Gómez-Escalonilla, 2020). As we detail in one of the published texts making up part of this thesis (the chapter found in the *Encyclopedia of Educational Innovation),* we could describe the justification for the use of ICT in education since the 1950s and 1960s as resting on three basic pillars:

> The popularization of Daniel Lerner's thesis (1958) on the modernization theory and the use of mass media as a key factor in achieving economic development; the work of Wilburn Schramm (1964) on the central role that mass media has in the development of countries through their implementation in education systems; and the credence and political direction that UNESCO gave to these ideas as key factors for social transformation and the generalization of Western values within the context of the Cold War (Machado-Trujillo & González-Delgado, 2019, p.2).

[17] With this we refer again to the importance of overcoming utopian and naive positions in relation to technologies in education, as we developed in the previous section.

As can be seen from the above quotation, a number of ideas related to the importance of investment in education for economic growth, and the fundamental contribution that new media and technologies can make to improving educational effectiveness and efficiency were beginning to be widely accepted and relevant. Furthermore, "organizations such as UNESCO, the OECD, and the WB functioned as forums for the circulation of educational discourses that echoed the theories of modernization and human capital elaborated in Western universities, mainly in the United States" (Martín-García & Delgado Gómez-Escalonilla, 2020, p. 9). Therefore, a synergy is generated which gives rise to a scenario in which both the educational policies developed by these large organisations in their different programmes (especially in developing countries) and specific national policies are aligned. Modernization, educational planning, the media and new technologies are terms that began to underpin all educational discourses and justify a multitude of programmes that begin to be developed around the globe.

UNESCO, which has been involved in education since its inception in 1945, and especially since 1954, began with experimental activities seeking methods to improve teaching (especially in developing areas) through the use of radio and television in the 1960s. The OECD, which was established in 1961 and which grew out of the Organization for European Economic Cooperation (OEEC) that emerged in 1948, created a specific sub-division dedicated to education, the CERI, in 1968. From the beginning the OECD showed a strong interest in education, placing it in line with what we have been pointing out as a key element for economic development. That is why it organised its first conference on the subject in Washington DC in 1961, under the title *Economic Growth and Investment in Education*. In it, one of the speakers, Walter W. Heller, stated the following: "May I say that, in this context, the fight for education is too important to be left solely to the educators" (in Ydesen & Grek, 2019, p. 6). We can see how at this conference (in which prominent figures from UNESCO and the Ford Foundation's Fund for the Advancement of Education also participated), leaders were already making clear their interest in education as a means for progress and economic development, while the idea of giving a new economic orientation to education policies was lurking in the background[18].

[18] This conference also shows the existing tensions between UNESCO and the OECD, leading in the following decades a history of disputes for hegemony in the educational field, characterized by the

As a result of the first experimental programmes being developed by UNESCO, the organization asked various experts for studies and reports in order to assess the impact and results of these programmes promoting the educational use of the media. In 1960, it published a series of studies entitled *Press, Film and Radio in the World Today*, and in the volume *Television Teaching Today*, produced by Henry R. Cassirer, made an analysis of the educational reality, pointing out some problematic factors to which the experimental programmes were contributing. We partially reproduce the graph in which they are summarised:

THE PRESENT SITUATION
More children to educate.
More knowledge needed by everyone.
More years of education sought by each generation.
More competition for tax funds.
Proportionately fewer qualified teachers available each year.
More college graduates (one-half of all for the next 10 years) required as new teachers.
More emergency sub-qualified teachers employed each year.

Source: Adaptation of Figure in Cassirer (1960), p. 28.

Later, in 1967, under the direction of Wilbur Schramm, Philip H. Coombs, Friedrich Kahnert and Jack Lyle, UNESCO published a four-volume collection in which the first three volumes, entitled *New educational media in action: case studies for planners*, detailed the diversity of educational radio and television programmes they had launched in such places as American Samoa, Thailand, Niger, Peru, Chicago, Japan, India, New Zealand and Honduras, among others. In the fourth volume, *Modern Techniques and Educational Planning*, the authors make a global analysis and offer conclusions on the progress and results of all these programmes. In this volume, the Director General of UNESCO, René Maheu, highlighted the important work involved in taking advantage of the possibilities offered by the audio visual media to respond to social and educational transformations (Schramm, Coombs, Kahnert & Lyle, 1967). In this document, they argue that educational challenges are common to all countries, even if the problems in developing countries are more urgent. The authors of the report state the following:

development of overlapping programmes of both organisations. Ydesen and Grek (2019) go into more detail about the relationship between the two organisations.

> The audio visual aids can be and are used to solve various pedagogical problems, both in school and outside. In particular, they are used in various places, and in different forms, for the purposes defined at the beginning of the chapter, namely: improving teaching; teacher training; school teaching outside school premises; literacy and fundamental education (Schramm, Coombs, Kahnert & Lyle, 1967, p. 75).

This report served a summary of the lines of intervention in which radio and television had been used in the various programmes that had been launched or in which UNESCO collaborated, and which this collection of documents includes. Among them were not only programmes that sought to improve the efficiency of teaching and learning processes, but also others meant to alleviate the shortage of teachers with the necessary training to respond to the increase in schooling rates, as well as to bring schooling to rural and/or remote areas.

At the same time, educational radio programmes, which had begun to develop between 1925 and 1935, saw a considerable decline beginning in the 1960s due to the eagerness with which educational television and teaching machines were embraced (Saettler, 1968). The decade of the 1950s was the decade of educational television, which had undergone rapid growth and diffusion thanks to the initiatives of UNESCO as well as those carried out by the Ford Foundation's Fund for the Enhancement of Education (Ferster, 2014, 2016). The data reveal that this last organization, between 1955 and 1965, invested 70 million dollars in educational TV programmes (Saettler, 1968). UNESCO, in turn, used television as a tool for education in rural environments in France, giving rise to «teleclubs»; it also extended education to remote locations in Australia and New Zealand; in Poland and Japan it facilitated the broadcasting of university courses for students who could not attend classes during the day because of work; and it also collaborated in the development of the *Telescuola "Non e mai troppo tardi"* programme in Italy for basic literacy. While these are some of the programmes that the organization developed or collaborated with, the pioneers were the school TV programmes in Samoa and the so-called "Hagerstown experiment" in Washington (Schramm, Coombs, Kahnert & Lyle, 1967).

This programme started in Hagerstown in 1956 and received funding from the Ford Foundation (around $1 million). It is interesting because it does not arise from any

specific problem or need (as was the case with most school TV initiatives), but rather it came about when a number of educational centres realized that television could be used to set an educational trend and that it would be beneficial to use this technology in the centres. To this end, they opted for a closed-circuit television system that allowed for six broadcast channels, a greater number than would have been possible with an open television system. In 1956 they began broadcasting four-course lessons to about one-third of the upper secondary school students on a trial basis, and by 1960 the system had been extended to all schools in the district. 28 daily programmes were broadcasted, 140 per week, with sessions arranged so that about 100 students met to watch the classes simultaneously before then being divided into groups of 20 with one teacher (Schramm, Coombs, Kahnert & Lyle, 1967, pp. 24-27). This was one of the most successful programmes, and its example helps us to understand the idiosyncrasies of school TV programmes and the operation of closed-circuit TV in schools.

Notwithstanding, the results of the school radio and TV programmes were very diverse and received criticism, particularly about the relationship between the large investment required and the poor results obtained. Many reports concluded that the benefits of the new media had not been satisfactory and that they had failed to improve in any meaningful way on other educational methods being developed. Similarly, and as we have already mentioned, Saettler (1968) states that "the history of instructional technology clearly reveals that many of the bright promises being made for instructional television were essentially the same held out for instructional films and instructional radio" (p. 248).

In this historical review in which we are situating the antecedents of computer use programmes in the 1980s, another milestone that must not be overlooked is the development of teaching machines and programmed teaching models. The first teaching machine model, developed in 1925 by the psychologist Sydney L. Pressey, served as the precedent of the teaching machine that was later designed in the 1950s (Skinner, 1958; Saettler, 1968). Pressey built a simple model of a machine that allowed students to see specific questions through a small viewer and then answer with one of the options available through five buttons. It allowed two quite simple modes of use. One of them presented the sequence of questions and recorded the student's answers, so that, once the programme was finished, the teacher could review the record of answers and then carry out the corresponding review of material with the student. The second mode of use

required that the student correctly answer the question shown in order to be able to move on to the next one. This last mode of operation, which facilitated immediate feedback without the need for the teacher, better fit the behavioural model and the objectives for which it was designed: to provide automatic and immediate reinforcement and to adjust the learning rates to each student, all of this in an efficient way that saved time and effort to the teacher.

Despite Pressey's first attempts to develop teaching machines, it was not until the 1950s that another psychologist, Burrhus F. Skinner, published the article *Teaching Machines* (1958) in the prestigious journal *Science*. Skinner was devoted to experimental psychology, and by then he had already defined theories about behaviour in his book *Science and Human Behaviour*[19] (1953). Interested in Pressey's work and in developing a more efficient model of instruction in view of the increase in the school population, he sought to perfect the teaching machines. In the article published in *Science*, he reflects on the new media being used in education (films, television and audio recordings), stating that they are quite useful for presenting information but that they do not contribute to improving the exchange between teacher and student, and that, furthermore, given the increasing number of students now attending schools, the teacher does not have enough time for interaction. This results in the students assuming an increasingly passive role (Skinner, 1958). From this we can deduce Skinner's interest in teaching machines, which had the potential of becoming tools that would make education more efficient, promote constant student activity, personalise teaching, provide immediate feedback and positively reinforce appropriate responses. This articulated the basic principles of programmed teaching or instruction, where the fundamental element was the «programme», regardless of whether it appeared in a «programmed textbook» or in a teaching machine; obviously it was more effective in the machine. The sequencing of items and questions and the system of repetition of behaviours and immediate feedback were the basis of this model, which responds to Skinner's theories on behaviour.

[19] Skinner worked for the Army during World War II, and in this book he defines «operant conditioning» and behaviour modification by transferring the conclusions of his famous wartime pigeon training to people. This led him to later publications such as *The Science of Learning and the Art of Teaching (*1954) and the book *The Technology of Teaching (*1968) where he compiled his work on teaching and learning.

As Skinner continued to experiment and develop the basis of teaching machines and programmed teaching, he reached an agreement with International Business Machines (IBM) in 1955 which established the production of 10 test teaching machines, which were to be marketed in 1958. This agreement ended before distribution materialised, although Skinner managed to develop a new design thanks to a grant from the Ford Foundation (Ferster, 2014). This grant was not obtained by chance but was a direct consequence of the shock caused in the USA by the successful launch and putting into orbit of the Soviet Sputnik I satellite on 4 October 1957. At the height of the space race, the United States saw its hegemonic position in space technology falter, leading to the articulation of different programmes and investments in research and education, both public and private (Rudolph, 2002; Lövheim, 2014). In the United States, a strong debate began on the effectiveness of the educational model, with Skinner himself harshly criticising the progressive education model introduced by John Dewey, which Skinner accused of plunging American education into an inefficient and misguided direction (Skinner, 1954). Faced with this panorama of criticism and mistrust of the current educational policies and models, Skinner found himself in a scenario in which the ideas of education as an investment (Theory of Human Capital), of educational planning, and of modernisation and the use of new technological means all culminated in what Daniel Tröhler (2013) has defined as «technocratic momentum». In this context of the technification of education and adaptation to the modernisation of industrial societies, teaching machines and programmed education were positioned as an effective tool for the new direction demanded of education (Haugsbakk, 2013; Trölher, 2013).

The programmed teaching and the teaching machines brought together very interesting ideas: individual pacing, mastery learning, rapid feedback and adaptability (Ferster, 2014). The model developed by Skinner was more complex than the first Pressey machine, allowing various contents and activities to be worked on, such as spelling and arithmetic. To this Skinner (1958) adds the following:

> The machine itself, of course, does not teach. It simply brings the student into contact with the person who composed the material it presents. It is a laborsaving device because it can bring one programmer into contact with an indefinite number of students. This may suggest mass production, but the effect upon each student is surprisingly like that of a private tutor (p. 971).

Two Skinner disciples, Ben Wyckoff and Lloyd Homme, founded Teaching Machines Incorporated, and in 1960 manufactured the Min/Max Machine (minimum time, maximum learning) which cost about $20 and was distributed through Grolier's encyclopedia publishing house, selling over 150,000 machines in five years (Ferster, 2014; Watters, 2018). However, they were far from being the only company to develop or market models. In 1961, Felix Kopstein and Isabel Shillestad of the Aeronautical Systems Division (ASD) *of* the United States Air Force (USAF), in a report entitled *A survey of Auto-Instructional Devices*, catalogued the different models (nearly 60). Their purpose was to define the state of the art of self-instruction, to make such information available and to suggest possibilities for local educational applications. Their report not only included the extensive catalogue of models, but also categorised them according to various types: Skinner machines, Pressey machines, Crowder technique, Self-Organising Systems, Audio-Visual Machines, Digital Computers as Teaching Machines, and other Miscellaneous Devices (Kopstein & Shillestad, 1961). It is no coincidence that this report came out of the USAF, for, as Saettler (1968) notes, "the great volume of instructional media research during the 1945-1965 period was made possible largely by unprecedent financial support from the United States Army, Navy and Air Force in the late 1940s and the 1950s" (p. 320). Research and works such as those of Douglas Noble (1991) or J. Dexter Fletcher of the Institute for Defense Analyses of the USA (2009), among others, highlight the fundamental role of military research and financing and its bearing on the development of these technological programmes in education, especially with the technocratic shift occurring in the 50s and 60s. In this respect, Noble situates military research "as a pivotal catalyst in the historical linkage between education and technology" (Noble, 2018, p. 2).

Thus, the line opened by Skinner triggered an abundant amount of research and initiatives focused on programmed learning and teaching machines. As Tröhler (2013) states, "between 1955 and 1957 the notion of «programmed learning» was used mostly in air force contexts or in training for medical assistants. However, after Sputnik (in October 1957), the idea became a global one" (p. 10). In fact, in analysing the scientific literature in search of the term «programmed instruction», from zero results in 1955 we jump to an exponential growth of publications containing the term, especially between 1959 and 1961, with a great many publications on the subject continuing to be put out through

1964[20]. Even Wilbur Schramm (mentioned above for his important role in international organisations) in 1962 published through the Fund for the Advancement of Education (Ford Foundation) a document entitled *Programmed Instruction: Today and Tomorrow*. In the text he defines programmed instruction as a «truly revolutionary device» with an enormous untapped potential to meet the challenges of education (Schramm, 1962).

In spite of the immense amount of research taking place, teaching machines quickly became obsolete and fell into disuse owing to the fact that although they worked acceptably for certain subjects such as mathematics, there were considerable limitations to their use in other disciplines (Ferster, 2014). John Searle, a philosopher critical of this type of computer model, stated, in questioning the effectiveness of teaching machines and the behavioural model itself, the following: "can a learner actually know a topic by properly responding to only small requests? (in Ferster, 2014, p. 89). In fact, these tools evidenced formidable limitations for the learning of certain contents, and with the appearance of the first computers, and the evolution from Behavioural to Cognitive Psychology, we can observe a turning point that put the focus on the new computer, leaving the teaching machines behind. As we pointed out, after World War II, and especially from the 1960s onwards, this technological orientation of education became more notable, with many different countries setting up projects along these lines and introducing new curricular subjects (Hultén, 2012; Hallström, Hultén & Lövheim, 2014). Magnus Hultén (2012), in a study on the Swedish case, goes so far as to explain that at a curricular level we can talk about "a twist that can be called «technology education as the language of schooling», a subject providing the base for a lingua franca, a (technical) language that all subjects could contribute to" (p. 590).

Although this great technological revolution began unfolding in the 1960s as a result of the evolution of computers to more compact and economic models —among other factors—, it was in the 1980s that the phenomenon took on a greater dimension. The first models, developed in the 1940s, were of little use in education owing to the complexity of their use and their large size and weight. Their development and use at the time was

[20] Tröhler (2013, pp. 10-12), produces various graphs where he compiles the number of times the term appears in scientific publications in English, German and Russian. There has been an exponential growth in English publications since 1959 (before 1955 the term had not appeared, and until 1958 there were no more than 50 publications per year containing the term). Between 1961 and 1964 there were between 350 and 450 publications each year which referred to «programmed instruction».

more related to military purposes. We can identify as precursors of the computers the *Z3* model, built in 1941 by Honrad Zuse in German aviation laboratories for aerodynamic calculations of Nazi planes in the World War II; and the *Colossus Mark I*, in 1944, developed by Howard Aiken and Grace Cooper, in collaboration with IBM. The latter, designed for ballistic calculations and built at Harvard University, consisted of some 750,000 pieces and 800km of cable, and weighed around 5 tonnes). However, these prototypes were relay-based, so the first electronic computer is actually the *ENIAC* model (*Electronic Numerical Integrator and Calculator*) created by Prespert Eckert and John Mauchly, who replaced the relays with vacuum valves (Valero & Mompín, 2009). Presented in 1946, and designed for the US Army's Ballistic Research Laboratory, it measured around 27 metres and weighed almost 30 tons. The changeover to valves made it about 300 times faster than the *Mark I* and its expense was considerably less, costing some $400,000 as opposed to the $5 million cost of the *Mark I* (Valero & Mompín, 2009; Pedreira, 2018; Wiltshire, 2020). The creators of *ENIAC* founded the company Electronic Control, which in 1950 bought Remington-Rand, and it was this company that developed the *UNIVAC* (Universal Automatic Computer), which would become the first commercial computer in history. As well as serving to take the US census in 1951, it was used to predict the results of the US elections in 1952[21]. Despite attempts to commercialise the computer, only 46 units were sold – for over $1 million each –, these units going to the public administration, insurance companies and the army (Computer History Museum, 2015). Obviously, the excessive size, weight and cost of this model and its contemporaries made it very difficult for it to be mass marketed.

The computer industry continued to research new materials and new designs, evolving the performance of computers exponentially, and continually reducing their size and cost. In relation to the educational applications of these technologies, a landmark was the development of the PLATO system (Programmed Logic Automated Teaching Operations) in 1960 at the University of Illinois. This represented the first computer-based learning system,[22] leading to the first outline of the Computer Assisted Instruction

[21] Anecdotally, the machine's prediction caused a great stir. UNIVAC predicted a landslide victory for the Republican candidate in the face of all odds, as the experts considered the Democrat to be the favourite. They even had Remington Road modified the UNIVAC programme to estimate what the experts claimed, but the elections finally proved the computer's first estimate right. This, in turn, unleashed a mixture of fascination and fear at the capacity of these machines (García, 2016).

[22] This teaching system is defined as the origin of the current Learning Management System (LMS), the basis of current eLearning, and which has made possible the existence of such recurrent platforms as

(CAI) model. The fact that PLATO was developed by a team of engineers – headed by Donald L. Bitzer – was bound to mark a certain distance from radio and television programmes (directed by educators or specialists in the field), and teaching machines, which responded to behaviourist theories from Psychology. Moreover, "the PLATO system had no real educational or psychological theory as a foundation" (Ferster, 2014, p. 99). In fact, Bitzer tried to distance himself from the drill-and-practice model of the teaching machines, diversifying the tasks through graphic and algorithmic simulations. Although the educational outcomes resulting from the application of this system may be debatable, it was the father of many modern technologies such as e-mail, forums, online games and eLearning platforms, and it continued to be used for more than 40 years, until well after 2000 (Ferster, 2014).

Meanwhile, another computer-based education system was being developed, one that we would like to highlight for its educational value: LOGO[23], developed by Seymour Papert in 1968. Papert, a mathematician, had attended a lecture given by the psychologist Jean Piaget during a research stay in Paris which left a deep impression on him. He was invited by Piaget himself to work with him at the University of Geneva, where they carried out research together between 1959 and 1963. After this, Papert began working at the Massachusetts Institute of Technology (MIT) where he founded the Artificial Intelligence Laboratory and began research on computers (Ferster, 2014; LOGO Foundation, n.d.). Strongly influenced by Piagetian constructivism, he developed the LOGO system, which, as we have pointed out, was conceived of with a well-defined concept of education and teaching and learning processes in mind. Papert himself admits to having been impressed by the way in which Piaget considers the child as an active constructor of his own intellectual structures, hence the learning environment fostered by LOGO is designed in a way that is diametrically opposed to the behavioural model: here it is not the computer that programs the child, but the child himself (even in pre-school age) who programs the computer. We are speaking, therefore, of a programming system that goes beyond behavioural drill-and-practice models and beyond approaches that were devoid of any

Moodle, GSuite for Education (Google), or the infinite number of digital platforms on which the great range of MOOCs (Massive Online Open Course) is developed.

[23] At that time there were already quite widespread programming languages such as FORTRAN, COBOL, BASIC and PASCAL, which were widely used

theoretical pedagogical support in their design and development. In short, Papert (1980) summarises it as follows:

> The child programs the computer. And in teaching the computer how to think, children embark on an exploration about how they themselves think. The experience can be heady: Thinking about thinking turns the child into an epistemologist, an experience not even shared by most adults (p. 19).

These advances in computer technology, both in terms of hardware and software, meant that Computer Assisted Instruction (CAI) programmes were now at the forefront of educational innovation. The first of these was at the Institute for Mathematical Studies in the Social Sciences of Stanford, which had been running an experimental CAI programme since 1963, eventually becoming *Stanford's 1965-66 Arithmetic Program*[24]. This programme began thanks, firstly, to funding from the Carnegie Corporation of New York[25] , and later to funds received from the National Science Foundation. But the real work began 1964, when they reached an agreement with the US Office of Education:

> In the summer of 1964, the Institute was granted a contract by the Unites States Office of Education to establish a computer-based instructional laboratory at a public elementary school for the purpose of investigating computer-assisted instruction over an extended period of time (Suppes, Jerman & Dow, 1968, p. 11)

In the academic year 1964-65 they started to investigate the benefits of computer assisted instruction through an experimental program to teach arithmetic through drill-and-practice lessons. They began with a programme consisting of 2 lessons of about 23 mathematical problems each involving two groups of six-grade children, two very capable second-grade boys, 26 gifted second-grade children and 41 fourth-grade children. The program was run by remote control (from a school located just over 10km from the laboratory). Initially there was one medium sized computer and 6 workstations for the

[24] The first course to be launched was in 1965-66, with Patrick Suppes, Max Jerman and Dow Brian publishing a detailed report on its development in 1968. The programme has a second edition between 1966-68 of which a report is also published in 1972, this time by Patrick Suppes and Mona Morningstar, and continues to evolve in other programmes during the 1970s. They diversified the use of the CAI model, so that, for example, in the course of 1972-73 they developed a complex programme with 180 computers to attend to students with hearing problems (Fletcher & Suppes, 1976).

[25] Foundation established in 1911 by the philanthropist Andrew Carnegie, who invested mainly in scholarships and educational projects.

students, but by the 1972-73 school year they had 180 personal computers, of which 90 could be used simultaneously. Patrick Suppes, one of the fundamental promoters of this model, affirmed after applying the CAI model during the first course that "one of the computer's most important potentials is in making learning and teaching more personalized" (1969, p. 45). They also recognized that "while CAl is not an educational panacea, it can perform certain educational functions effectively and much more efficiently than a regular classroom teacher is capable of doing in those Instances" (Jerman & Suppes, 1969, p. 4). This makes it clear that the underlying idea was a quest for efficiency and personalisation in teaching, understood as that proposed by the model of programmed instruction, but now taking advantage of the new possibilities offered by computers. As a result of these first experiments, CAI programmes began to spread all over the world, although most of them followed the scheme of the programmed instruction models. This was due, to a large extent, to the still notable limitations of computers and to the scant exploration that had been made regarding their possibilities in the educational field. Again, the role of international bodies was crucial, and UNESCO, which in 1969 had received numerous requests for advice and information on the CAI model, organised a meeting between 16 and 18 March 1970 under the title *Consultation on Computer Assisted Instruction for Developing Countries.* At this meeting many experts debated the incipient use of computers and pointed to Spain as an ideal context (due to the modernisation processes that were taking place and the structural reform of the education system that began in 1970) in which to carry out an experimental teacher training programme which, if successful, could be exported to developing countries (UNESCO, 1972). We will go into this CAI programme in depth in the following section, where we will look at the state of the art in the case of Spain.

The year 1971 saw the advent of one of the innovations that was to define the field of computing: the birth of the microprocessor. The application of new materials allowed the construction of chips that could perform multiple functions at a very low production cost and a tiny size, and, most importantly, "the microprocessor enabled mass production for the mass market" (Wiltshire, 2020, p. 7). There was great expectation that these tools, which had previously been quite expensive and bulky, could also be utilized for personal use. Spontaneous groups of enthusiasts started to meet and discuss their implications, with the Homebrew Computer Club acquiring notable importance. Founded in 1975 in Silicon Valley (California), this club brought together people working in the field as they

sought to make computers more accessible to everyone. They launched a highly relevant newsletter, through which they defined the term «personal computer» for the first time (Wiltshire, 2020). These meetings were attended by the likes of Stephen Wozniak and Steve Jobs, the founders of Apple, and it was Wozniak who stated that, without these clubs, Apple computers would probably not have come into existence, given that Apple I and II were designed as a hobby resulting from these meetings and common interests, not as a product of a company or part of a marketing strategy (Wozniak, 1984).

As a direct consequence, the *Altair 8800* appeared in 1974 and, in 1977, several companies introduced three models of computers, of which the *Apple II* and the *Commodore PET* 2001 were marketed under the label of «personal computers». A new market had been born. From this moment on, computers were no longer thought of only as tools for specialized sectors, but for the general public. At the launch of the *PET 2001*, Commodore CEO Jack Tramiel had a forceful statement to make: "computers for the masses, not the classes". (Wiltshire, 2020, p. 8). Tramiel wanted to mass market his products, so the *PET 2001* had been designed to include all the elements necessary for its operation (integrated screen, recording tape and keyboard) at the very competitive price of $795. The computer's size had been reduced significantly (hence it was initially called a «microcomputer» or simply «micros») as had its cost, and the rest of the computer industry soon followed suit. Models such as IBM's *PC 5150* from 1981 (with 40,000 units sold on the first day it went on sale), the *Commodore 64* from 1982, or the *Apple Macintosh* from 1984 set the standard. It was no longer a luxury item, or a tool intended exclusively for companies and research, but had a place in all kinds of companies, homes and even schools.

The 1980s are undoubtedly the decade of the computer and the revolution in the computer industry. The influential magazine *TIME*, in its January 1983 issue, created a new section entitled «The Machine of the Year», awarding that position to the computer, which served to spur an entire media campaign that focused attention on this device (Taylor & Johnsen, 1986). Schools all over the world began to fill up with computers because of the logical intuition that this was going to be the tool that would define the future and that they had no choice but to become familiar with its use. But their proliferation in schools was also due to an overt campaign of propaganda on the part of the computer industry. Apple, for example, began to make extensive donations, and, without going into the philanthropic

aspirations of the company with these donations, "the clear marketing strategy is to sell computers to schools with an eye towards parents [...] who are likely to purchase machines compatible with those used in schools" (Olson, 1987, p. 196). To illustrate this interest of large companies in the education system, José A. Sotelo (1985) came up with a simple estimate of the market share that would be gained by introducing computers into the education system, using figures for schools and students in the USA in 1984:

> Calculating for the 50 largest school districts in the country, with over 9,000 schools, and setting an average of one computer for every 170 students (the ideal ratio would be one for 3 or 4 students) at a cost of $500 per computer, the resulting potential demand reaches $15 billion (p. 155).

This figure, which referred only to the USA and calculated computer-pupil ratios downwards, showed the potential market that the school system represented for the industry, whose market had hitherto been limited to public administrations and some large companies. As Juan Delval (1986) rightly argues, it is not surprising that computer companies were (and are) competing fiercely for the school market, given that schools represented a practically inexhaustible business niche[26].

Apple not only spearheaded technological innovation, but also marketing strategies, directing much of its advertising to families and students[27]. IBM, in addition to, trying to compete with Apple in the US market, replicated the strategy in Europe with a plan to donate 770 computers to secondary schools in 6 countries (Delval, 1986). These massive donations were accompanied by the development of programmes that sought to insert the new, powerful personal computers into the curriculum. On the one hand they were promoting computer literacy (resulting in the appearance of the subject of Computer Science for the first time in educational centres), while at the same time encouraging its use for the rest of the curricular content. In view of these new technological resources, "specialized curriculum subjects such as science, mathematics, and computer studies

[26] We have previously mentioned the various current programmes that seek to make teachers and schools ambassadors of one brand or another (by becoming users of the Google suite or Apple applications, for example). With this we see that nowadays the market is focusing more on software than on hardware.
[27] Many of the posters and brochures use the image of a student doing homework in front of an Apple computer. In 1989 they hired Matt Groening (who later created the long-running animated series *The Simpsons*) to illustrate a brochure explaining the benefits of their computers in attracting the attention of university students.

embraced these technologies and began to re-orient their curricula to accommodate them" (Goodson, Nobel, Lankshear & Mangan, 2002, p. 1). Apple accompanied its entire market strategy with the *Apple Classrooms of Tomorrow* (ACOT) programme, which ran from 1985 to 1995[28] and was defined as follows:

> The Apple Classrooms of Tomorrow research project provides classroom sites with equipment, ongoing support, and training to find out what's possible with networked learning environments. As a result, teachers and students from primary through high school levels are in various stages of discovery. ACOT networks link together technology from Apple IIe computers and Image Writer printers, to Macintosh II systems, synthesizers, laserdisc players, scanners, and LaserWriter printers. Curriculums include the 3-R's to trigonometry, and networked software ranges from drill & practice to word processing and curriculum management tools. Teaching approaches that utilize the network span from directing students to work through electronic workbooks, to coaching them as they create entire curriculum units (Knapp, 1989, p. 4).

A number of companies launched similar programmes or created divisions related to education, but what is relevant in terms of education is that public administrations in many countries began to develop state programmes that sought to provide schools with computers. Some examples are *Micros in the schools* (UK, 1981), COMPIS (Sweden, 1981), the Norwegian Plan of Action (Norway, 1984), *L'Informatique pour tous (*France, 1985), *Piano Nazionale per l'Informatica nella scuola* (Italy, 1985), the Minerva-Plan (Portugal, 1985), the OBSTAP-Project (Netherlands, 1989), the *US National Information Infrastructure* (USA, 1991), *Red Enlaces (*Chile, 1992), and the Spanish Atenea programme (1985) whose origin we will discuss in the following section, and about which we will go into more detail in one of the articles making up this compendium (the article published in *Espacio, Tiempo y Educación*). As we can see, the use of computers became the fundamental educational trend, and a complex network of programmes was formed in which the proposals and interests of both state educational administrations, international organisations and companies in the computer industry were intermingled (Selwyn, 2013).

[28] Although the programme ended in 1995, other initiatives are still being implemented, and in 2008 they are resuming the programme under the name ACOT2.

To fully appreciate the rapid expansion of these programs and how they reached schools on such a scale, it is worth looking at several reports and evaluations conducted in the mid-1980s for the purpose of understanding the magnitude of the phenomenon and how computer penetration in schools was occurring. Again, we are providing data on the United States, the pioneer country in this respect, where it was in the Silicon Valley area that the entire computer industry began to be centralised. In 1983, the first national survey was carried out in the USA, led by de Jay Henry Becker of the Center for Social Organization of Schools of the John Hopkins University. This study surveyed 2,209 elementary and secondary schools, both public, private and parochial. They published a summary in 1985 in which they noted that as yet few schools had computers, and that very few had more than 5 (less than 10% of the schools in the study had more than 15 computers). The average ratio was still very low and, looking at the real time that these computers were used by the students, we can observe that in the primary stage each student used the computer an average of 23 minutes a week, while in secondary school the figure was 45 minutes. This use consisted mostly of introductory computer activities, drill-and-practice activities, problem solving and demonstrations or simulations. The US Congress' Office of Technology Assessment published in 1988 the report *Power On! New Tools for Teaching and Learning*, which also provides an overview of the penetration and use of computers in American schools. The report states that in 1981 only 18% of the country's schools had computers (around 81,000 public schools), but that in 1987 this figure had risen to 95%. The peak of acquisition by schools occurred in the 1983-84 school year, when 55% of schools that did not have a computer acquired at least one. These data show the rapid arrival of computers in schools, although the average ratio was still quite low: one computer for every 30 students (1:30). The paper argues that these tools needed to be advocated for and that the ratio should be reduced to 1:3; attaining such a ratio was estimated to require an investment of $4.2 billion per year.

To get a broader picture of the phenomenon, the International Association for the Evaluation of Educational Achievement (IEA) conducted in the early 1990s the *Computers in Education study* (Comped). In it, they made a comparative analysis of the penetration of computers in 18 different countries. Without going into the details of this study, the synthesis made by William J. Pelgrum and Tjeerd Plomp (1993) reflects a great diversity among countries. In the primary stage, the ratio of computers per student in countries such as the USA, Japan, France or Israel was between 15-25, whereas in

countries such as the Netherlands or New Zealand, the number of students per computer was double or triple that figure. In secondary schools, the data were fairly similar, reflecting greater penetration and use of computers at this stage. On the other extreme, the case of Portugal is noteworthy, since at all stages we find a ratio of around 1:300.

While all of this may provide us with an idea of the access and use of computers in schools in quantitative terms, many analyses have also been made about the benefits of their use as well as the problems generated by them. First of all, studies were carried out on the costs of extending their use to all students. Previously we indicated that the estimates of the US Congress' Office of Technology Assessment of annual investment to achieve a ratio of 1:3 were in the region of $4.2 billion. But the expenditure per student was also detailed, Henry Levin (1986) made one such analysis. Estimating that a computer at that time cost just under $1,000, that it could have a useful life of 3 years, and that one is purchased for every 20 students, the cost for a school of 1,000 students would be $17,000 per year, $17 per student. In order to reach that goal of a 1:3 ratio, the cost per student would be about $110 per student per year. This calculation does not include costs such as maintenance, purchase of educational software, teacher training and other indirect expenses, so the cost per student per year could come to $119, for a 1:20 ratio (Levin, 1986). Could we say that this investment was profitable in relation to the benefits? This question was the subject of much discussion owing to the diversity of results obtained by the programmes and the problems that came to light as a result of the difficulties in integrating them into the curricular activities. Between 10 and 14 March 1986, co-sponsored by the Stanford International Development Education Committee and UNESCO, the Symposium *Computers and Education: The Role for International Research* was held at Stanford University School of Education. Martin Carnoy, Hugh Daley and Liza Loop (1987) published a report with its conclusions, and we quote below three textual fragments which perfectly define the state of the art of the issue:

> In terms of cost-effectiveness, then, using computers as a teaching supplement may produce better results per $100 of investment than reducing class size or increasing instructional time. But peer-tutoring under present conditions of computer usage is much more cost-effective than any of these interventions (p. V).

> Fueled by commercial interests, computer specialists, and the popular communication media, the microcomputer rapidly superseded the mainframe as the proposed key to global educational success (p. 5).

> Is the promise of computer technology fundamentally different from that of the other technical innovations offered to education over the years - books, blackboards, radio, films, language labs, and television? (p. 8).

This summarises some of the fundamental issues that we have been describing and analysing. On the one hand, we can observe the debate about whether these technologies have led to credible improvements in learning outcomes, as it is very difficult to define positive results. Obviously, the scarcity of resources, especially educational software, the scant training of teachers in the use and application of these new technologies, and the meagre knowledge about possible curricular applications strongly conditioned the results. Cuban (2001) also states that the evolution in the history of ICT in education has been marked by "the striking emergence of a large, diverse ad hoc coalition seeking to replicate in public schools the technological transformation that had occurred in the corporate workplace" (p. 156). Hence, on many occasions, ICT policies in education have been implemented without much pedagogical reflection on their relevance, or without differing from already existing programmes with other types of technologies, an observation alluded to rhetorically by Carnoy, Daley and Loop (1987) in the last of the three fragments just quoted.

3.3. Background and triggers of the technological modernisation of the Spanish education system in the second half of the 20th century

After reviewing the educational policies regarding the implementation of technological resources that have occurred globally since the beginning of the 20th century, in this new section we will look at the specifics of the Spanish case. Our main interest lies in defining the keys that led to Spain's launching of the Atenea programme in 1985, the development of which we discuss in depth in the last of the articles that make up this compendium,

published in the magazine *Espacio, Tiempo y Educación*. In this case, we are not going to go as far back in time as we did in the previous section, but rather we will start from the second half of the 20th century, to end up focusing on the 1980s.

The Spanish political context of the 20th century was marked by the Franco dictatorship —of national-Catholic ideology— between 1936 and 1975. The regime's policies varied somewhat over this long period but in the educational field, to simplify matters, we can define two major stages as identified by Antonio Viñao (2014): from 1936-1957 and from 1957 to 1975[29]. The first stage adhered quite strictly to totalitarian and national-Catholic principles, while the second stage was marked by technological developmentalism, stemming from the arrival of «technicians»[30] at the Ministry of National Education, which was renamed the Ministry of Education and Science in 1966. As Manuel de Puelles (1992) points out, the term was imported in a decontextualised way, as the Spanish situation did not really resemble that of a technocratic government. Despite this, this term was used to "refer fundamentally to a group of people who had some common characteristics, especially their belongin, directly or indirectly, to a certain religious group" (Puelles, 1992, p. 15). This group, whose members began to take over different bodies – in particular the Ministry of Education[31] – gave a new impetus to Spanish educational policy. Puelles continues (1992): "rationalization, efficiency, good sense, a superficial apoliticism, economic freedom and development, transplantation of private techniques to the field of public administration are, therefore, the dominant notes of Spanish technocracy" (p. 17). If we add to this Spain's membership in the UNESCO in 1952, the treaties with the United States in 1953, its admission to the UN, the development of the Stabilisation Plan of 1959 (which was influenced by the USA, the OECD, the International Monetary Fund and the World Bank), its participation in the OECD's Mediterranean Regional Project (1961-64) and the first Economic and Social Development Plan (1964-74), among other factors, we can see that Spanish policies were gradually being linked to what was happening on the international scene[32] (Viñao, 2004);

[29] Although other authors, in a more detailed way, situate this stage until 1973, coinciding with the year in which José Luis Villar Palasí leave the Ministry (Puelles, 1992).
[30] This was the name given to a group of people from the catholic sector called *Opus Dei* who did not have that political profile attached to the National Movement but were defined by their more technical profile (Puelles, 1992; Viñao, 2004; Delgado Gómez-Escalonilla, 2015).
[31] Manuel Lora y Tamayo arrived at the Ministry in 1962, and was succeeded by Villar Palasí, one of the architects of the 1970 General Law on Education.
[32] This also resulted in Spain no longer being considered an underdeveloped country in OECD reports, stating that it was in an "intermediate development" situation (Ossenbach & Martínez, 2011, p. 693.

Ossenbach & Martínez, 2011; Martín-García & Delgado Gómez-Escalonilla, 2020; González & Groves, 2020).

As Gabriela Ossenbach and Alberto Martínez (2011) point out, this «semantics of modernization» was a global phenomenon thanks to the fact that, to a large extent, international bodies played a key role in producing and disseminating discourses and practices, especially in education policy (as we described in the previous section). The confluence exercised by the multitude of interconnections between different countries made the education system a fundamental element for modernisation and economic growth, an idea which took hold internationally after World War II, giving rise to a convergence towards the same idea of education despite the different realities of each state (González, 2020; González & Groves, 2020). Spain was not an isolated entity in the face of this international trend and, as we have pointed out, thanks to the technocratic group, it took part in a number of initiatives along these lines and was present in many forums of the UNESCO and other organisations[33]. All of this resulted in the introduction of "a pedagogy of efficient intentions and criteria of technological rationality in teaching methods, which allowed the modernization of the education system without questioning the ideological foundations of the regime" (Ossenbach & Groves, 2013). Puelles (1992), in this same sense and referring to the group of technocrats, states that they had no wish to engage in politics, but rather to solve problems, seeking a «new legitimacy» for the regime through economic welfare and liberalization[34]. Therefore, one of the issues we want to highlight here, and which is detailed in depth in the article that makes up this compendium published in the *British Journal of Educational Studies*, relates to the fact that, despite Spain's being ruled by an authoritarian regime closely linked to the more conservative faction of the Catholic Church, in education (and in other spheres) the Francoist era was by no means an immobile or static period. In fact, it underwent major changes in line with what was happening in the international context (González, 2020). A new model of state underpinned this new logic. As Mariano González and Tamar Groves explain (2020):

[33] Lorenzo Delgado and Patricia de la Hoz (2020) specifically point out the fundamental role of Joaquín Tena Artigas and Ricardo Díez Hochleitner as informal diplomats, holding various positions at UNESCO and the World Bank.

[34] When he refers to the fact that he was not interested in doing politics, he refers to the fact that he did not come from the regime's National Movement and that his profile was a technical specialist (see Puelles, 1992, p. 16).

> For the first time [in the 1950s], Franco's educational institutions accepted and converged with a fundamental idea that had just been put on the table by UNESCO. We are referring to the idea that education systems and their universalization were a fundamental axis for economic development. But not only. At the same time, a new concept of education was considered valid. We are referring to the idea that education systems should be established in relation to countries' economic development needs. Therefore, the MEN accepted a basic premise of the Theory of Modernization and, at the same time, the idea of Educational Planning was observed as desirable (González & Groves, 2020, p. 11)

Hence, the research in the article published in the *British Journal of Educational Studies* asks the following questions: "Did National Catholicism and the technocratic vision form the backbone of all knowledge? Did education under the Franco regime revolve exclusively around these values?" (González-Delgado, Ferraz-Lorenzo & Machado-Trujillo, 2019, p. 322). To answer these questions, school textbooks are an ideal source, given their presence and extensive use as a fundamental tool containing the programme, contents and values to be transmitted. Their study, in the specific case of this research, is not focused on their role within the school culture or the analysis of textbooks *per se*, but rather they have been used as a fundamental documentary source that has allowed us to go deeper into and analyse the changes in the definition of the State model and the educational conception during the democratic transition. In the textbooks, as detailed in the aforementioned article, it is easy to see that, notwithstanding the authoritarian regime, there is a conception of the social state, one that explains the appearance of various assistance programmes beginning in the 1950s. It can also be seen how, little by little, technology-related models were introduced as tools that represented modernity and social welfare in a more accentuated way in the transition (González-Delgado, Ferraz-Lorenzo & Machado-Trujillo. 2019). Indeed, the results pointed out in the article match perfectly what we have been stating about the political and educational context; they evidence a new conception of the State and a new idea about education, the latter converging with the international trend of modernization of the educational system as an economic engine. Obviously, we cannot lose sight of the fact that a good part of this process took place during the Francoist period, and although these ideas and proposals existed at a macro level, in the educational reality at the school level they arrived very slowly —or not at all— and the national-Catholic ideology and repression still predominated. Nonetheless,

these ideas on the modernisation and technification of the education system provide the background for the different initiatives that were set in motion in Spain, especially when justifying the interest in the application of new technologies to improve the efficiency, rationalisation and technologization of the education system, all of which motivated the implementation of various programmes, especially in the 1980s.

Within this general context, we will now detail some of the fundamental initiatives that led to the introduction of ICT in the classroom in Spain, and we will lay out the background as well as the incentives that spurred the Atenea project, the first to attempt to introduce computers massively into the Spanish education system. Just as at the international level we situate the use of *films as* one of the fundamental proposals at the beginning of the 20th century, in Spain, in 1911, the Royal Order of 26 December was already recommending the use of cinema in educational centres, the result of different initiatives that had been taken in specific schools since the end of the 19th century (Camarero, 2013). In 1918, the Ministry of Public Instruction, again through the Royal Order of 11 April 1918, extolled the benefits of the use of projections in teaching, stating that when it is not possible to show reality, there is no more suitable material than to project the image of reality (Camarero, 2013). The usefulness of cinema as an educational tool began to be agreed upon, and various initiatives were taken during the first decades, using it as an instrument for mass literacy[35]. In this respect, the San José de Calasanz Institute of Pedagogy was entrusted with the Pedagogical Missions that already existed and that had reached their peak during the period of the Second Republic. Beginning in May 1942, the Institute took over these missions, whose function was that of making sure that culture reached remote rural areas. They were also in charge of distributing children's libraries, school material, and the provision of new technologies - referring to material that enabled projections to be shown. Specifically, in 1946, they delivered 850 silent films and 92 sound films (García Hoz, 1969). Later, through the Decree of 18 December 1953, the Commissariat of Cultural Extension —in charge of the development of audio visual media— created the National Educational Cinematheque and the Visual and Auditory Media Services in collaboration with the Ministry of National Education, for the purpose of elaborating materials for educational centres (Cabero, 1992).

[35] Articles such as those by María del Mar del Pozo (1997) and Fernando Camarero (2013) go deeper into this topic.

Between 1958 and 1966, Televisión Española independently created various programmes such as *Aula TV* [TV classroom], *Lecciones de Inglés* [English Lessons] and *Imágenes para saber* [Images to learn] to help eradicate illiteracy. It was in 1963 when the Ministry of National Education took on school radio and TV initiatives for the first time, creating the National Centre for Secondary Education by Radio and Television, better known as *Bachillerato RTV*, and in 1964 the Teleclubs project was started (González-Delgado, 2020). The *Bachillerato RTV* represented a continuation of the radio-based Baccalaureate experiment stipulated in the Orden of 9 November 1962, which specified that, "with the aim of extending secondary education and perfecting teaching methods [...] a teaching experiment should be carried out by means of radio broadcasting and, if appropriate, the press and television" (in the Official State Bulletin, BOE, of 28 November 1962). Ossenbach and Groves (2013) explain that, among all these proposals for the introduction of audio visual media in schools in the 1960s, the most relevant was the *Televisión Escolar* [School Television] project, which began broadcasting in January 1968 during school hours on a daily basis to complement the work of teachers (although this initiative ended in June 1970). While radio and television programmes had become quite relevant by this stage, they would soon give way to personal computers and the CAI (Computer Assisted Instruction) model. As González-Delgado (2020) points out, "the CAI gradually positioned itself as the main technique for improving the curriculum with a view to educational planning" (p. 618).

At the end of the 1960s, with the arrival of Villar Palasí at the Ministry, a structural reform of the education system was quickly set in motion, containing the different ideas on educational planning which were being promoted and expanded by UNESCO and the OECD, and which had first been put forward in the 1969 White Paper. This reform, the General Education Law —in which international bodies had considerable influence— was set in motion in 1970, and it stipulated in its article 18 that "audiovisual techniques will be widely used" (in the BOE 187, of 6 August 1970). In order to achieve these goals, it was considered necessary to strengthen certain areas such as teacher training and research into new techniques, which is why in 1969 the National Research Centre for the Development of Education (CENIDE) and the Institutes of Educational Sciences (ICEs, fifteen in total, and attached to each of the universities) were created. These institutions formed a fundamental network through which innovations related to the media and

computers, among others, were implemented[36]. In the creation of CENIDE and the ICEs, international organisations played a fundamental role as advisors and provided funding to different areas. UNESCO, the World Bank and the Ford Foundation took a very active part in the process, as reported by Delgado Gómez-Escalonilla and de la Hoz (2020):

> By an agreement signed in June, the WB [World Bank] granted a loan to cover half the cost of a program-whose total budget was to be $24 million-dedicated to the construction and start-up of educational centers and ICEs, together with the acquisition of equipment for CENIDE. The Ford Foundation donated $400,000 to fund scholarships for Spanish educators and the visits of foreign consultants who would assist CENIDE and the ICEs in the propagation of innovative pedagogical methods (p. 50).

The CENIDE-ICEs network was presented as a central element for the modernization of the educational system and for the introduction of new techniques, both through educational research and through the training and renewal of teachers. This is why a system of grants was set up with funds from UNESCO and the World Bank so that teachers could stay at CENIDE and abroad, also making it possible for many experts from different countries to come and give seminars (Bousquet, 1972). The Order of 20 January 1971 includes the first call for grants for specialisation abroad for university teachers and collaborators of the ICEs, financed by the United Nations Special Fund, the International Bank for Reconstruction and Development and the Ford Foundation. Among the fundamental lines of specialization that were included both in that call and in the training given at CENIDE were micro-teaching (a model of teacher training using closed-circuit television), computer-based teaching, the development of CAI programmes and pedagogy, and programmed teaching. As indicated by Jacques Bousquet (1972), UNESCO's chief technical advisor in Spain, UNESCO experts and consultants conducted 98 training seminars during the 1970-71 academic year, 47 of which were held at CENIDE and 51 at different ICEs.

As we have already pointed out, one of the lines of work was research and experimentation on CAI, once again the result of the influence of UNESCO, which chose Spain to set up an experimental teacher training programme using this technique.

[36] The Decree 1678/1969, July 24 on the creation of the ICEs states that one of the objectives of the reform is the study of education "both in the social order and in the modern methods and means that this task requires".

Education and Historical Evolution of ICT

UNESCO convened experts in the field of CAI in Paris between 16 and 18 March 1970, in response to the numerous queries they had received the previous year about the application of computers in teaching. At that seminar they discussed the worthwhile uses and benefits that such tools could bring, especially for developing countries. They agreed that Spain, due to the process of structural reform of the education system which it was developing, the expectation that the number of students in the education system was going to double and the mechanisms which it was programming for the modernisation of teacher training through CENIDE and the ICEs, was an ideal place to carry out an experimental trial, one which could be of great interest for later export to other developing contexts (UNESCO, 1972). Therefore, the team of experts went on several missions to Spain in June and November 1970 to define the programme that would end up being called *The Plan for the Use of Computers in the Education of Teachers*[37]. Bousquet (1972), in presenting this CAI project, alludes to the fact that:

> It was thought that, in order to make effective the project, it was reasonable to start with teacher training; on one hand, because this is a relatively small area, and also because the introduction of the computer in teaching first needed teachers to be familiar with the computer and its educational possibilities (p. 157).

Subsequently, in a detailed report published by UNESCO in 1972, they outlined the lines of work, programme costs, and list of consultants, in addition to setting out the need to form two groups within CENIDE: CAI Research Group and CAI Teaching Group. An investment of around $1,500,000 was estimated for the purchase of computer equipment, while the cost of CAI teaching was calculated to be less than $2 per terminal and hour (including all indirect costs such as maintenance, teacher training and so on), which in overall numbers was a small and bearable investment. The project was designed on the basis of the following criteria:

a) The innovation shall be profitable in the sense than an adequate return on investment can be expected.
b) A framework shall be established in which bold innovations in pedagogy can be carried out.

[37] Under the signature Project No. PNUD/SPA/19/CENIDE.

c) An environment shall be created in which new developments in equipment technology can be exploited.
d) The reserve computing capacity in Spain can be employed in support of the network.
e) The program will create a basis for extending the innovation of CAI directly into the schools.
f) The program will stimulate the emergence of an educational technology industry in Spain.
g) The experience will be of value to other nations as a prototype for the introduction of CAI into their national programs (UNESCO, 1972, pp. 4-5).

In these criteria we can clearly see ideas related to educational planning, human capital, modernization and interest in the development of a local computer industry. With this, not only was it understood that the use of computers could be productive at an educational level and could lead to better training and an improvement in human capital, but that, indirectly, it could also function as an economic motor by stimulating a sector that was at the time underdeveloped. Despite all of these good intentions, problems with the arrival of funding prevented it from materializing

In Spain, as in the global trend, a certain boom and fascination with computers began in the 1970s, a phenomenon that really took off in the 1980s. As early as 1969, thanks to the Decree of 29 March, the first Institute of Computer Science was created in Madrid under the Ministry of Education and Science to promote the teaching of computer science under different specialities[38]. Decree 2880 of 12 September 1970 created the Interministerial Commission on Information Technology and the Central Information Technology Service, which in article 10 stipulated that "in each of the civil ministries there will be an Information Technology Commission to coordinate the activities of the Ministry and its autonomous bodies in this field" (in BOE number 243). One of the first tasks carried out by the Ministry of Education and Science's (MEC) IT Commission was to gather

[38] It also served to regulate the training of a sector in which nearly 40,000 people were already working, which is why, in the early years, a large part of the work of the Institute consisted in the validation of the degree to professionals who were working. The Institute was governed by a Board of Trustees, which, in the minutes of 20 June 1969, appointed a Commission to draw up study plans. In 1971 a five-year plan had already been structured, and it had 132 teachers on its staff. On the other hand, the creation of the Institute also attracted the attention of large companies, and in the first meetings of the Board of Trustees there were strong disputes between the valued members of a national industry, as opposed to others who had links with large companies, such as IBM. This is explained in detail in section 3.3. of Jordi Fornés' doctoral thesis (2016).

information through a questionnaire on the use and needs of IT equipment in the universities. In the minutes of the third meeting of the Commission, on 20th January 1972, the results of this survey were discussed. Ten universities replied, all describing a situation that, along with being very much in its early stages, was quite disparate, with some universities not even having a single computer and relying on the computing services of other universities[39] .

In 1975 the total number of large and medium computers stood at around 1500 units, all centralised in large companies or the public administration, and it was at this time that the first attempts to develop a Spanish compact computer also began, the most notable effort being that of the company Ditesa, which manufactured the *Ketelek 8* in 1973 (Valero & Mompín, 2009). With the appearance of the first microcomputer at the beginning of the 1980s the market began to expand and a great leap was made in Spain between 1982 and 1984, especially in terms of the devices' penetration into homes. The unusual expectations of these new tools even led the Cabinet of the Presidency of the Government to commission a team of experts headed by Manuel Castells to carry out a research project which they published in 1986 under the title *New Technologies, Economy and Society in Spain*. In this exhaustive study, it is acknowledged that:

> In 1982 the microcomputer was practically unknown (if we exclude a few population segments), in 1984 the leading brand in the Spanish market sold more than 120,000 units and surveys indicate that 2% of families own this device (Castells, 1986, p. 833).

Despite the data affirming the exponential growth of sales, it was evident that Spain was lagging behind the rest of Europe. In the United Kingdom —the world leader in the number of computers in homes– there were in 1983 some 900,000 homes computers (11%); in Germany 450,000; in France 120,000; in Sweden 95,000; and in Spain 70,500 (Castells, 1986). Mateo Valero and Josep Mompín (2009) define 1984 as the year of the «microcomputer revolution» (p. 332) due to the strong irruption of IBM, Olivetti and Apple models in the Spanish market, thanks in large part to the creation of a microcomputer division by the company Investrónica, which began to distribute them massively, especially IBM models (Valero & Mompín, 2009). This led IBM to reinforce

[39] In *Actas de la Tercera Sesión de la Comisión de Informática* (1972, January 20),

its monopoly in the Spanish market, and if in 1983 it was already at the head of computer equipment sales with a value of 78,772 billion pesetas compared to Olivetti —which was second with 11,850—, in 1984 IBM grew exponentially to 139,052 billion pesetas, compared to the modest growth of Olivetti (which remained second) with 12,950 billion pesetas (Castells, 1986, p. 79). IBM's monopoly became even more evident; the company, which had dominated the Spanish market since the beginning of the 70s, even generated unease in the government due to the fact that its hegemony made the development of the national industry unviable. Through the Decree 2593/1974, the Government stipulated that companies and public administrations could only acquire nationally manufactured electronic material, in response to which IBM quickly set up a factory in Valencia. They, together with the Catalan company Telesincro, were the only ones who managed to be classified as a «national manufacturer» (Fornés, 2016). While some companies attempted to develop some a "Spanish" model, the intense competition in the market made the profitability of the different projects almost impossible. One of the most successful was that undertaken by ADP (Algorithms, Processes and Designs), which in 1985 designed a model whose sales reached 5,300 billion pesetas in 1990 (Valero & Mompín, 2009). Save for this honourable exception and the various agreements with companies such as IBM, NIXDORF and SECOINSA, which installed production plants for some specific pieces, the state of national computer production and its market were in general quite deficient.[40]

Finally, to complete our picture of the penetration of computers in Spain in the 1980s, it is worth analysing the evolution of the number of microcomputers by type of application. Between 1982 and 1983 there was an exponential growth in purchases of microcomputers for use in the home, going from representing 35% of the computer stock in 1982 to 76% in 1983. The use of equipment in business and scientific applications grew little in total numbers, but as a percentage it went from representing 52% in 1982 to 20% in 1983. Their use in the education system did not grow significantly in total numbers either, but in percentage points it went from 15% in 1982 to 4% in 1983. As stated by Castells (1986):

[40] The report drawn up by Castells (1986) shows that Spain had a much smaller market size than would correspond to its Gross Domestic Product in relation to the other European countries, an issue which can clearly be seen in Table I.2.14 (p. 77). Relating the market to the number of inhabitants, in the years 1983-84 Spain had a consumption of $8.8 per inhabitant while the European average was $35.9.

> The microcomputer has a clear buyer, the parent, and also a specific motivation: that the children learn. For his part, the child is revealed as an element of pressure in the purchase, coinciding with the paternal feeling that it is necessary for tomorrow (p. 834).

The computer, therefore, had gone from being a tool for certain professional and scientific sectors to a learning, play and hobby-oriented element. This last data, seen together with the scarce market of national computer products, justified the weight that was beginning to be accorded to the computer as an educational tool. It also helps to explain how, in the different programmes for computer use, the promotion of the national computer industry was stated to be one of the aims, albeit indirectly [41].

This great computer evolution and the impact it was having on the economic and social structure led Spain, along with other countries, to try to develop a comprehensive programme to integrate the computer into the educational system. Although the article published in *Espacio, Tiempo y* Educación delves into how this Spanish programme was developed, its scope and the discussion of its results, we would like to detail some key aspects of its proposal and design, which serve to complement the aforementioned article. On 13 September 1983, the minutes of the meeting of the Ministerial Committee on Information Technology of the MEC, chaired by Pedro Maestre Yenes[42], stated that there was a notable contrast between the situation of computer equipment in non-university educational centres in Spain as compared with other countries. In addition to calling for initiatives in this regard he also stressed the need for improvement on the CAI model and for the promotion and development in Spain of a microcomputer with suitable characteristics for use in schools. Finally, the following was unanimously agreed:

> To set up a working group to study and make appropriate proposals on the introduction of computer technology in non-university educational establishments, both in terms of the provision of computer equipment and software and teacher training.[43]

[41] We observed this previously in relation to the CAI experimental programme which could not be completed, and it also appears in relation to the Atenea programme and is explained in more detail in the article of this compendium published in the magazine *Espacio, Tiempo y Educación.*

[42] Deputy Director General of Organisation and Automation of the MEC. Pedro Maestre had shown a clear interest in applying computers to teaching, publishing an article entitled *Informática y Educación* in issue 263 of 1980 of the Ministry of Education's Journal *Revista de Educación*, which was a monographic issue entitled *Nueva Tecnología Educativa*.

[43] In *Actas de la Reunión de la Comisión Ministerial de la Comisión de Tecnologías de la Información del Ministerio de Educación y Ciencia* (1983, September 13).

This working group was made up of representatives from the General Technical Secretariat, the General Directorate of Basic Education and Secondary Education, the General Directorate of Personnel and Services, the Board of Construction, Installations and School Equipment, and representatives from the Polytechnic Universities of Madrid and Barcelona. This group met for the first time on 2 November 1983 and agreed that the project should be called Atenea. They also agreed to carry out an analysis of the use of computers in teaching by means of questionnaires addressed to experts and to university and non-university teachers, to analyse the experiences implemented abroad and to organise a seminar with the Autonomous Communities. The memorandum of the meeting details the proposal to produce publications such as the *Comunidad Escolar* newspaper, which was published fortnightly by the MEC. At the next meeting, which took place two weeks later, on 24 November, Manuel Colomina, the magazine's director, was present. The collaboration was ratified, making the magazine a channel for the dissemination of the project and the incorporation of studies on ICT in education.

The dissemination of the project was not long in coming, and in the journal's issue from 15-30 December 1983, information on Atenea already appeared under the title *El proyecto "Atenea" estudia la forma de introducir la informática en la enseñanza* [The "Atenea" project studies how to introduce computer technology into education]. Regarding this article in which the first steps are described, Pedro Maestre points out two relevant data: the current Spanish investment in the field should be multiplied by ten and an attempt should be made to develop software in Spanish in order to obtain subsidiary advantages in the Latin American market; and, on the other hand, Atenea was intended not only to provide computer literacy, but also to promote the computer as a teaching tool for all disciplines. The issue of the first fortnight of February 1984 featured a fairly complete dossier setting out the challenge of computing in the education system, with a presentation of the CAI model and a more in-depth look at the design of Atenea. This dossier also included the work being carried out by several Autonomous Communities —which had their own educational jurisdiction—, and which were finalising programmes similar to Atenea. The publication also gave an overview of European countries such as France, the United Kingdom and Denmark, among others, describing their initiatives in this area. The project received coverage from the general press, and on 21 February 1984 the daily newspaper *ABC* carried a report entitled *Proyecto «Atenea»: Dos mil millones*

para llevar la informática a la escuela [«Atenea» Project: Two billion to bring computers to schools], written by José Luis González-Besada. This publication contains sensationalist affirmations such as "computers will improve the level of education" or "in the United States school failure has been reduced by 70 or 80 percent since the introduction of computers". This last statement does not say which study affirmed such things; the only study carried out at the time was that conducted by the Center for Social Organization of Schools of the John Hopkins University in 1983 (which we present in the previous section), which, in no case, claims such "miraculous" results[44]. Not only does the article "sell" the computer as a panacea for all educational ills, but, in a somewhat contemptuous tone, offers statements based on a vision that seems to be taken from a book by Skinner. The following is an example of this:

> The Atenea project would mean, in practice, that the teacher would not have to dedicate so much time to the "clumsier" pupils, those nine or ten children who are behind in all the classes, but that the repetitive tasks could be channelled via the computer, which would free the teacher from insisting on the same thing a hundred thousand times (González-Besada, 1985. p. 49).

The debate on the introduction of computers into the education system spread to all levels, and between 11 and 14 July 1984 the First National Conference on Computers in Education was held, organised by the Barbastro Associate Centre of the National University of Distance Education. This conference was attended by 158 participants from all parts of Spain and brought together a variety of experiences that had been carried out on an individual basis. The Conference on Computing and Education in Basic and Secondary Education was held in November of the same year in Madrid, and the following year, the First Conference on Educational Software was celebrated in Ceuta. We can see therefore, that initiatives were not only being taken by the Ministry; teachers were also experimenting with computers in their work and researchers were establishing forums for debate on the issue. There was also an increase in the publication of studies on computers and education in scientific journals, the most notable being issue 276 of 1985 of the *Revista de Educación*, which includes various works on the subject. In one

[44] Rather, the study shows that in 70-80% of cases there is no significant difference between using and not using the computer in teaching, as stated by the report's director, Jay Henry Becker in subsequent summaries (1985)

of these, Joaquín Arango Vila-Belda, the Secretary General of Education at the time, presents the Atenea project.

By October 1984 the project's working group had prepared the basic document for the discussion and drafting of Atenea. A considerable amount of dissent had been generated, and in meetings where the final draft was worked on much debate took place, especially on issues such as the general objectives, teacher training and the destinations of the financial allocation[45]. First, it was pointed out that one cannot speak of «computer literacy» if one does not also consider the "applications and implications —social, economic and political— of the new Information and Communication Technologies". It was also questioned whether other possibilities of the computer such as Special Education or applications in Communications and Information Systems services were being left aside. The point that generated most conflict was teacher training, owing to the fact that drafting of the base document had left many aspects up in the air; it was not clear, for instance, whether, apart from training in the instrumental use of these tools, it was going to be possible to integrate them into the curricular activities. It was also suggested at the outset that most of the training funds should be used to set up round tables, an issue which was strongly criticised from various quarters, as it was argued that this model was not the most effective given the limited computer skills of most teachers, and that it would only encourage dabbling by the teachers. Finally, another of the points of dispute that we would like to highlight had to do with the rate at which schools were to be equipped, which in theory should have been subject to teacher training and the existence of educational software. It was stated that if no previous training had been given or if there was no provision for it to be offered immediately upon the equipment's arrival, then it did not make sense to furnish the centres with computer resources. Although many aspects of the project were discussed up to the drafting of Atenea, it was the general objectives, teacher training and the breakdown of the budget that were the most complex points to define.

Another area of struggle prior to the development of Atenea was the competition for the supply of computer equipment, which amounted to some 6,427 billion pesetas between 1985 and 1989 (approximately 37 million dollars in those years). As indicated above,

[45] All this is set out in the document *Observaciones al "Documento base para la discusión y redacción del Proyecto"*, presented at the meeting of the Working Group on 18 October 1984.

IBM was the dominant company at the time, having resorted to a number of strategies in order to be included in the category of national companies. On 4 March 1985, the newspaper ABC published an interview by Juan Manuel Sáez with Javier Trepat, deputy director of MICPE, which had recently become the Spanish distributor of Apple. Although it dominated the American school market, until then Apple had had an insignificant presence in the Spanish market. Trepat recognised the interest that the Atenea project represented for Apple as a potential means of enabling Apple products to gain ground in the country, but he was also aware of the government's interest in the contract being awarded to a Spanish company. He indirectly points to IBM as one of the big rivals in the competition, especially due to its being considered Spanish because it had a factory in Valencia; Trepat explains that "we all know about companies that claim to be Spanish and then in practice have little of that" (p. 40). The same newspaper, pages later, reflects on the malaise of the Spanish computer industry in the face of the lack of definition of the rules of the competition with the headline: *Desconcierto de la industria ante el proyecto del Ministerio de Educación* [The industry's consternation with the Ministry of Education's project] (p. 48, and also signed by Juan Manuel Sáez). The MEC and the Ministry of Industry had convened a meeting with Spanish companies - or those that manufactured in Spain - to establish the conditions of the tender, but this only increased the unease, given that the delay in the call for tenders had put the national sector at a disadvantage with regard to large foreign companies based in Spain. This situation, and the already traditional reticence towards IBM's strategies and monopoly, are clear in the following passage of the article:

> Meanwhile, and as always, IBM is waiting: quiet, but working. In this company, it will not be understood that they are being told that the competition must be for the so-called Spanish industry. Talking about Spanish industry is a certain euphemism, when the right thing to do would be to say that they provide Spanish added value, since the technology and main components are foreign. On the other hand, which is a more Spanish industry: a Secoinsa whose main products, despite what it says, come from Japan, or a branch of the American multinational IBM, which last year exported nearly 70 billion pesetas from its factory in Valencia? (Sáez, 1985, p. 48)

The Ministry's promise to give priority to national industry was a fallacy in itself, given that the Spanish computer industry did not have the capacity to meet the demand that

Athena was going to represent, let alone compete with the large foreign companies. As far as the outcome of the case is concerned, the distribution of purchases of equipment for the Atenea project presented by the Monitoring Committee of the project at the meeting of 6 November 1985 gave the following purchase data:

Company	Equipment acquired in 1985	Equipment acquired in 1986
Computer Technology	235	0
Honeywell Bull	15	0
Hispano Olivetti	80	2430

Source: drawn up by the Commission from the minutes of the Follow-up Committee meeting of 06/11/1985

Computer Technology was a company that defined itself as "one hundred percent Spanish" in the words of its general manager Gaspar Granados, although in an interview with the *ABC* newspaper in July 1985 he explained that most of the active components of its products were foreign. On the other hand, Honeywell Bull was the result of an agreement between the respective American and French companies (Bull was in charge of supplying computers to the project that was being developed in France), and Hispano Olivetti was the Italian company's Barcelona-based subsidiary. Ultimately, the promise to purchase domestic products was not kept, as was foreseeable.

Atenea sparked great interest not only in the educational field, but also in the political and economic spheres. The intense interest and disputes that we have noted in the latter marked the development of the programme in its drafting and its beginning stages. This is why various voices of authority felt impelled to speak up and remind us of the fundamental goals of the project's pedagogical approach, of the very reason for having computers in the classroom; and in part, to avoid such a large investment from quickly becoming a lot of outdated and dust-covered school equipment. An example can be found in the article published by Juan Delval in the Revista de Educación in 1985, in which he asks "why is there so much interest in introducing computers into schools if the uses being made of them are so uninteresting and often they go unused?" (p. 31). Delval himself responds that we must be careful, since one of the answers has to do with the business that the whole matter entails. Julio Carabaña, director of the National Centre for Educational Research and Documentation at the time, and a member of the Atenea Follow-up Commission, published a reflection in *Comunidad Escolar* entitled *Una espléndida promesa y una pobre realidad* [A splendid promise and a poor reality] (in the

October-November 1985 issue). In it he warns that "the idea that the new technologies are a train that we cannot miss, can induce us to climb up the stairs of the first one that passes" (p. 18). Carabaña advocates for a greater reflection on the uses and applications we want to give to the computer, and on the need to first generate a human and material structure that allows us to take advantage of these new tools, and of the monumental investment that is going to be made in Atenea.

Although this reflection and the details of Atenea's development appear in the last article of this compendium of publications, we would like to end with a conclusion that Pierre Duguet (1989), the main administrator of OECD's Centre for Educational Research and Innovation (CERI), presents after an analysis of the different national policies:

> National, regional, State or local policies for introducing computers into schools have largely responded to pressures from outside education. The pressures exist in every country; they differ only in the degree to which they have influenced policies and strategies (p. 46)

He goes on to specify that these pressures relate to economic demands, industry interests, commercial pressures, social pressures, cultural dimensions, political pressures and technological innovations (Duguet, 1989). In the face of such interests, it was essential to develop a solid pedagogical discourse that could keep these projects from being governed by the market. The reality, as we have been indicating, was moving in quite a different direction.

4. Objectives

As explained above, the first research questions proposed in this doctoral thesis placed us before the historical analysis of the phenomenon of ICT in education, and to do so they focused on the description and critical analysis of the fundamental policies and debates, first in a general way and then in the particular Spanish case. This line of research is quite extensive, due both to the broad temporal period it covers and because of the multitude of contexts and ICT programmes in Education carried out throughout history. In order to make the research comprehensible, we limited it to the following criteria: on one hand, we focused the research on the second half of the 20th century, and specifically in the 1980s. This temporalisation is in line with the boom in the application of technologies related to the mass media, which dates fundamentally since the 1950s — although there are various precedents which we have already mentioned— as a result of the changes which took place in the conception of education. This led to a kind of technological boom in the classrooms in the 1980s thanks to the appearance of the first personal computers and the computer revolution they generated. This last milestone is of special interesting, both at a macro level —in relation to the academic debate and the research that was carried out on the subject, the influence of international organisations and the interest of the computer industry in introducing computers into schools— and at a meso and micro level, through the specific analysis of the Spanish case and the Atenea programme.

Therefore, we decided to focus more specifically on the objectives at this historical moment and on the debates about the use of computers in schools by studying the Atenea programme in depth. This was the first state programme that mobilised a large number of resources for the use of computers in the education system, and its development generated, in turn, a great deal of debate and contradictions in education, politics, etc. Obviously —and we have included this in some of the articles of this doctoral thesis as well as in the precedents mentioned in previous sections— educational television programmes, closed-circuit television teaching, the use of teaching machines and computer-assisted teaching are also of great interest. However, including all of these ventures would have led to an unwieldy work, difficult to evaluate in time and in the form of a doctoral thesis, given how broad a subject it would have constituted for research. In the future, we hope to delve deeper and develop research work along these lines, and this

will be one of the ways in which we will continue to complement and extend this research, given the information we have available and the interest that the subject holds.

The final list of objectives that have been developed is as follows:

- To analyse historically the phenomenon of ICT in Education.
- To contextualize within the international policy framework the background and initiatives that gave rise to the first ICT in Education programmes.
- To define the scientific, political, economic and educational factors that led to the emergence of multiple ICT programmes around the world from the 1960s onwards.
- To analyse the role of international organisations and the computer industry in the processes of modernising education systems and introducing ICT, looking in depth at the specifics of the Spanish case.
- To analyse the Spanish case through the in-depth study of the Atenea programme.
- To define the fundamental debates based on the different national and international evaluations about the use of ICT in Education.
- To reflect on the similarities between the debates, criticisms and results of the different ICT programmes.

5. Methodology

This research belongs to the field of the History of Education and has been carried out using the historical method. First of all, we would like to make some very brief notes on the new perspectives and research that have been developed from the History of Education, in order to lay out the foundations on which our research is based. As stated by Manuel Ferraz (2005):

> The History of Education, detached from the common core of History, has had an autonomous development and a charter of its own, despite following the original general source in matters of method, techniques and a good part of its content (p. 16).

This discipline and field of research, as an entity of its own, faces several challenges at present. Although this is not the place to discuss such issues, works such as those by Gary McCulloch (2011), Thomas S. Popkewitz (2013), Rosa Bruno-Jofré and Daniel Tröhler (2014) and Antonio Viñao (2016) are fundamental references when it comes to defining the reality of research in this field, at a time when teaching "has been dominated in recent decades by a technocratic model whose basic concepts and criteria [...] leave aside the undeniable fact that education is a political and moral practice" (Viñao, 2016, p. 30). On the other hand, there has been a remarkable increase in the research focused on international influences and interdependencies (Mangan, 1993; Fuchs, 2007; McCulloch, 2009; Popkewitz, 2009; Bruno-Jofré & Schriewer, 2012; Droux & Hofstetter, 2014), educational transfer processes (Ochs & Phillips, 2004; Phillips & Ochs, 2004; Sobe, 2013; Duedahl, 2016), the concept of transnational turnaround (McCulloch & Lowe, 2003; Popkewitz & Rizvi, 2009; Burke, Cunningham & Grosvenor, 2010; Fuchs, 2012; Fuchs & Roldán, 2019; Ydesen, 2019; Westberg, 2020), the influences and programmes of international bodies such as UNESCO, the OECD and the World Bank (Ossenbach & Martínez, 2011; Delgado Gómez-Escalinilla, 2015; Terrón, Comelles & Perdiguero, 2017; Corrales-Morales, 2020; González-Delgado & Groves, 2020), and, within the latter, research related to the promotion of the use of technologies in education (Hallström, Hultén & Lövheim, 2014; González-Delgado & Groves, 2017; Machado-Trujillo & González-Delgado, 2019)[46]. This doctoral thesis is not unconnected with the

[46] For a more detailed approach, see the monograph published in *Foro de Educación*, vol. 18, number 2 of 2020, entitled *Transfers, transnationalization and transformations of educational policies (1945-2018)*.

development of the field and, specifically, it is part of this line of research that analyses the influences and processes of international transfer and the role of large organisations.

After this brief note on the state of the field, we continue to define the historical method. We must first dismantle the vision of history that sees it as the mere linear reconstruction of an event or the background to a problem. Traditionally, this definition of history has permeated quite a bit of collective thinking, and it is common to hear this reductionist definition of the field in various forums. As defined by Julio Aróstegui (2001), history and its method are much more complex than the exercise of sequencing a series of events.

> Studying, therefore, the temporal development of a certain social variable, or the changes of a total social phenomenon [...], either leads, through more complex procedures, to a true historiographic reconstruction, or it is simply a temporal sequencing, not a historical method (p. 348).

The historical method has its particularities; being made up of singular processes that cannot be experienced, the empirical material with which history works consists of the traces left by the phenomena. The historical document, which includes "all that material that serves to give us news of the educational past" (Ruíz Berrio, 1976, p. 453) takes on a fundamental relevance. Therefore, after setting out the objectives of the research, specifying different research questions and formulating hypotheses, the work that we have developed has required a process of searching for and analysing documentary sources. It is not superfluous to recall the classic classification of sources into primary or secondary according to their direct or indirect relationship with the phenomena. Julio Ruíz Berrio (1976) differentiates them as follows:

> The *primary sources* include all those documents produced by observers or direct participants in the events. *Secondary sources* are those that inform us indirectly about the past; they are those made by people who were not eyewitnesses of what happened (p. 456).

This monograph, which we have coordinated jointly with Manuel Ferraz-Lorenzo, includes several works on this subject.

5. Methodology

This archival work was followed by another phase of analysis, historiographic reconstruction and the drawing of conclusions in relation to the objectives set. In addition, given the format of this thesis, we have sequenced the work, producing different articles that have been published as the thesis was being developed.

The research undertaken has inherently led to processes that have induced us to rethink and reconstruct that which we were developing, a result of the fact that, implicitly, "historical research emerges from 'findings', from new sources, from new connections between things, from comparisons" (Aróstegui, 2001, p. 364). The diversity of sources consulted played a fundamental role in this, with the use of written archive documents made up of various materials such as reports, minutes, memorandums, publications and correspondence (some of these sources are even provided in digital form), and, on the other hand, the study of school textbooks. It also involved extensive work in reviewing secondary sources such as specialised literature and publications. The documents and information we discovered opened up new horizons, putting us on the trail of other key events, actors and agents and of relationships and interests that had not been defined, along with new interpretations. Among the sources and archives visited and/or consulted are the following:

- General Administration Archive (Alcalá de Henares, Madrid).
- UNESCO Archives.
- Ministry of Education and Science Library Repository.
- The library archive of the University of La Laguna.
- Documentation deposited in the Department of Theory and History of Education of the University of Murcia.

Similarly, one of the sources used for research, and especially for the preparation of one of the articles in this compendium, consisted of the textbooks of a particular historical moment, context and subject. Although this is detailed in the corresponding article, we would like to indicate that the analysis of School Textbooks has been a recurrent line of research since the end of the 70s (Fuchs, 2011; Ossenbach, 2018), when scholars first began to appreciate their value as a perennial, fundamental and widely used curricular tool, one that reflects both the values and ideology as well as the methods used (Escolano,

2009; Ferraz-Lorenzo, 2020). Manuel de Puelles (2000) highlights the interest of research in this field as follows:

> If to the symbolic, pedagogical, sociological, ideological and political dimensions we add that represented by the study of its own evolution as a school material (design, printing, illustration, etc.) and its consideration as a commercial product that has a considerable economic entity, we have to admit that what in the past was considered a "minor literature" is today a source of extraordinary value for the knowledge of formal education and of the history of education itself (p. 6).

On the other hand, in order to carry out an analytical and critical reconstruction of the historical phenomena we are dealing with in this thesis, it is essential to undertake this task of laying down the methodological foundations on how to deal with the various sources of information we have accessed, which are also quite diverse. The textual analysis of all of them has been carried out from the perspective of Critical Discourse Analysis (CDA), which was first defined by Teun van Dijk (1993), and to which authors such as Ruth Wodak and Michael Meyer (2003) have also made contributions. We share the idea that "most of what gives meaning to discourse is «invisible»". (van Dijk, 2010), so it is fundamental for CDA to attend not only to linguistic or cognitive aspects —as in most traditional discourse analysis— but also to social, cultural and contextual aspects from a critical socio-political perspective (van Dijk, 2010). As already stated by Jürgen Habermas (1982):

> Language is also a vehicle of domination and a social force. It serves to legitimise the relations of organised power. To the extent that the legitimations of power relations [...] are not articulated, [...] language is also ideological (p. 259).

Language itself and official speeches may be reproducing and legitimising power relations, highlighting the role of certain social groups or information or making others invisible. This methodological proposal serves to highlight what Michael Apple pointed out in *The Official Knowledge (*1993), which examines, for example, how governments or socio-political actors manipulate knowledge, what kind of knowledge and information the media highlight or hide, or, on an educational level, what sort of knowledge can be defined as official knowledge, i.e., that which will underpin curricular content and school

textbooks. The Sociology of Education has had a great deal of influence on this clash between school culture and the official curriculum defined by the dominant classes —as opposed to the subordinate classes— this being one of the fundamental causes of the reproduction of inequalities[47].

However, CDA is not a specific method *per se*, because depending on the objectives of the analysis it can take on a variety of forms (depending on whether it focuses on purely stylistic, grammatical, rhetorical aspects, on argumentation...). In addition, the CDA can be crossed and complemented with other methods from the Social Sciences such as ethnography or observation, which will serve to define the different relationships existing between the actors and/or actresses of the discourse. Norman Fairclough stresses that this method[48] must be complemented in a dialogical and transdisciplinary way with other social theories and methods, that is, not only does it not exclude the use of other methods, but it complements them (2000). Therefore, according to van Dijk (2010):

> By *epistemic discourse analysis* we understand here the multidisciplinary study of the way knowledge is expressed, presupposed, omitted, distributed, etc., in texts and speech, for example, in the form of presuppositions, structures of theme and commentary or focus, in the diversity of levels and details of description, etc [...]. Of course, a critical approach also incorporates a social component, since it is possible to investigate the relationship between these representations of knowledge and the structures of power relations, for example, in groups, institutions and organisations (p. 179).

Wodak and Meyer (2003) add that any textual analysis along these lines must include the concept of *power*, the concept of *history* and the concept of *ideology*. Therefore:

> The CDA stresses the need for interdisciplinary work in order to obtain an adequate understanding of the way language operates in, for example, the constitution and

[47] There is no need to develop these ideas in this section, but it is interesting to take into account the contributions of authors such as Basil Bernstein (1971), Pierre Bourdieu and Jean-Claude Passeron (1977) and Claude Grignon and Jean-Claude Passeron (1991) who defined the theory of reproduction. Likewise, Young (1971) and Layton (1973) delve into these processes of domination and reproduction from a perspective more attached to the analysis of the curriculum.

[48] Fairclough (in Wodak & Meyer, 2003) even shows his reservations about the concept of method, as he considers that the ACD is not merely technique, but is also a theory and a method, a theoretical perspective and an element that gives rise to ways of analysing language or semiosis, and which is inserted into other more general processes of social analysis.

> transmission of knowledge, in the organisation of social institutions or in the exercise of power (Wodak and Meyer, 2003, p. 31).

All of the above confirms the need for and relevance of this methodological resource in our research in a transdisciplinary way (as Fairclough points out), since it serves to define power relations and establish political and ideological nuances in the various sources studied. In short, it all helps to define the methodological bases that have structured this research, which is situated within the history of education and which makes use of the method and resources of this discipline and field of research.

6. Results and future lines of research

The results of this research are the articles that constitute the compendium of publications presented in this doctoral thesis. Not only are they the main result of the work carried out, but they also contain and develop the fundamental findings of this research, responding to the objectives. Although it would be ideal to include the four articles in this section following the discursive order of the research (which, as we have already mentioned, does not coincide with the order in which they were published), due to questions of format it is not possible. Therefore, in order for them to appear as published and thus comply with the stipulations of the regulations for the presentation of doctoral theses by the University of La Laguna, we have included them in the Annexes section[49]. Three of them were published in English and one in Spanish, and in the annexes appear both the article in Spanish in the format in which it was published and a translation made later to facilitate understanding of the text, as the doctoral thesis is entirely in English. After these indications, we invite you to read the articles, because in them lies the essential core and results of this research.

With regard to the articles, one aspect that stands out is that this thesis was not conceived as a closed and exhausted work; rather, there is information that has yet to be explored that simply did not fit within the limits and format stipulated by the scientific journals in which the articles were published. While opting for the compendium of articles to present this doctoral thesis has the advantage of providing indispensable learning for the future researcher related to the world of scientific publications[50], it has also constrained the work by having to adapt the time, format and extension of the research to the stipulations of the journals. On the other hand, on some issues we felt that we had hit the tip of the iceberg, discovering paths that have yet to be explored and issues of interest related to this research on which to continue working. Although we do not list the potential lines of investigation

[49] In the Regulations for Official Doctoral Education of the University of La Laguna, RESOLUTION of 17 January 2013 published in the Official Bulletin of the Canary Islands No. 17, on Friday 25 January 2013, Article 29.2 b) specifies that "A complete copy of the works must be included between the introduction and the summary mentioned, or as annexes".

[50] Everyone knows how complex and competitive the academic world is, the need to publish in order to strengthen the curriculum and to apply for scientific positions and projects, and the difficulties of publishing from minority fields that have fewer journals with high impact rates.

in a strict or specific order, those that have a greater affinity with this doctoral thesis and for which we have information appear first.

- To analyse the problems of teacher training of participants in the Atenea programme. We found a correspondence in the AGA describing different conflicts, profiles of the participating teachers, problems related to voluntarism in order to participate in the project and the fact that the participating teachers were not freed of their teaching schedule (they had to carry out many of the activities outside working hours). Neither were their classes covered by substitutes when they had to travel to receive the stipulated training.
- To carry out a comparative study between the Atenea programme and some regional programmes, specifically with the Ábaco programme, which was developed in the Canary Islands. We know where some of the documentary collections are located and we know who was involved in the project (some are even still active at our University). In this respect, we also know where there are documentary collections belonging to the Institute of Educational Sciences of La Laguna, which played a key role in the training in digital competences of the teachers participating in Ábaco and similar projects in the eighties and nineties.
- To carry out a comparative study between the Athena programme and other related programmes established in the same decade in other countries. We are especially interested in making the comparison with the COMPIS programme, as during our stay in Linköping, Jonas Hallström and his team provided us with a wealth of information about it; given the existing research links we believe it could be of great interest to pursue this work together
- Research about the design process and the nature of the Computer Science subject within the curriculum in our country. Given that this subject has also been worked on by Linköping's teachers in Sweden a collaboration could also be of great interest.
- To analyse CAI programmes in Spain in the 1970s, specifically the UNESCO experimental programme for initial teacher training, developed between 1970-72.
- To deepen our understanding of the debates, the recommendations of international bodies and the influence of computer companies in the expansion of computer use programmes in schools. For example, we have evidence that Apple began in the

United States to donate computers to educational centres to encourage families to buy these tools, and that it developed programmes such as *Apple Classrooms for Tomorrow* (ACOT).

- To investigate the influence and relationship between the experimentation of CAI programmes for the training of US army soldiers and the first CAI programmes in the education system. In this regard, we find that the first CAI program as such was developed at the Institute for Mathematical Studies in the Social Sciences at Stanford University by Patrick Suppes in 1970. We have the reports of these projects, and as pointed out by collaborators such as J.D. Fletcher (a researcher who has held various important positions in the White House, the Defence Cabinet, the Navy and the US Army), many of the funds initially used for CAI programmes in schools came directly from the Army, which sought to test new methodologies to improve the training of soldiers (through simulations that helped to avoid risk situations). The work of Seattler (1968) or the more recent contribution of Noble (2018) develop these themes.
- Another line, perhaps somewhat distant from our field but which caught our attention powerfully, is the way that advertising and publicity for personal computers used the pretext of their educational value to stimulate consumption by individuals. In this respect, we have been compiling different advertising images that appeared both in the media and in computer magazines as well as in specific journals from the field of education.

7. Conclusions

Despite the fact that each of the articles already contains the different conclusions we have arrived at, we would like to unify and summarise the conclusions of this research. First of all, we were able to corroborate the fact that the debate on the use of different audio visual and digital technologies in education has been a constant since the beginning of the last century, regardless of the decade and the technology that was being tried in schools. Especially from the 1950s onwards, the historical situation of the post-war period —and after that, the Cold War— favoured the dissemination of a new educational concept. Education systems began to develop policies under the umbrella of the ideas of modernization, educational planning, economic development, human capital and the improvement of educational efficiency. ICTs were put forward as the ideal tools to achieve these ideals because they promised to facilitate teaching and learning processes, to personalize teaching and to perform a variety of functions more efficiently, especially when mass schooling was gradually becoming a reality. In this process, the role of large international bodies is particularly noteworthy, as they began to set the tone and influence national education policies and to develop a diversity of radio, television and computer use programmes in many contexts (especially in developing countries).

The development of computing and the appearance of the first personal computers marked a turning point in all spheres. They quickly began to be used in schools and the computer industry saw that education systems represented an immeasurable market niche, not only because of the enormous sales potential of equipping schools in a given area with computers, but also because it would stimulate the purchase of equipment by families. With a market strategy that was clear, large companies began to establish relations with various countries, to make donations and to promote the extensive use of these new tools in the 1980s (even creating their own educational programmes). An infinite number of state programmes emerged all over the world along these lines, with Spain developing the Atenea programme between 1985 and 1989.

Despite the fact that Spain was under a dictatorship for almost forty years, the evidence shows that this type of debate came about in Spanish circles at the same time as elsewhere, so in this sense the country was not isolated. The many contacts that technically-oriented members of the Spanish government had made with the large organisations led to various

initiatives in education, especially in the use of ICTs. In 1970, at the same time that a structural reform of the education system was being approved, UNESCO proposed the development of an experimental CAI programme in teacher training, although this did not become effective due to problems with funding.

In the 1980s, with the debate revolving around the use of computers, the Atenea programme began to be designed, representing the first programme in the country meant to provide and promote the extensive use of computers in the classroom. This programme dedicated a large budget item to both the purchase of computer equipment and teacher training, but many factors led to the results falling far short of the proposed objectives. Atenea, like other homonymous programmes in other countries, did not meet the expectations of the technological promise, largely because there was no structure, either human or material, to facilitate the integration of the computer as a teaching medium and tool in the curriculum. Similarly, in this research our focus has not been to try to determine the degree of success of these programmes, but to describe and analyse the factors that led to their implementation and the diversity of interests that conditioned them, especially political and economic factors.

It has been a constant from the beginning of this research to try to make a historical analysis through the different milestones and ICT programmes that preceded the boom that began in the 1980s. We have attempted to carry out a critical analysis, avoiding the mere description or instrumental analysis of the effects of ICT programmes on education. We have tried to reflect the way in which the new educational conception developed starting in the 1950s found in ICT an ideal ally, conferring an air of progress, innovation and efficiency to the educational systems. However, all of these premises came up against the monolithic structure of education systems that were (and still are) largely similar to the nineteenth-century canons, making it very difficult for technologies —usually presented as the tools of the future— to succeed in transforming educational practices to the extent promised. In the same way, we have also shown that those who claimed that the personal computer would be fundamental in our lives were indeed right. However, this does not prevent its introduction in the classrooms in the eighties from being strongly mediated by economic and political interests, which at times took precedent over pedagogical criteria.

Therefore, we consider that this historically-oriented analysis facilitates the establishment of connections between different processes of change that were operating in the political sphere, in international relations, in the economy, in education and in the realm of technological innovations, and which explain the reason for this technological boom in education systems in the 1980s. We also examine all of this in the specific Spanish case, with its particular context and idiosyncrasies. Furthermore, this work provides us with a clearer vision for analysing the digital scenario in which we are currently immersed, and also shows us that in essence, the debates on ICT in education and the arguments used today for their use are strikingly similar to arguments used in the past (more so than some would like to admit). We have seen that technologies change but that the ideas behind the programmes and initiatives are still often based on utopian and/or naïve positions about the potential of technological tools in the processes of educational transformation. Little good will come from actions that do not take into account considerations such as who benefits from the concrete use of a specific technology, whether these applications are generating, reproducing or exacerbating gaps, or if the design of such programmes is based on educational principles that are stuck in the past (it is notable that many of the most innovative applications we use today, despite their futuristic format, operate on behavioural principles that do not facilitate meaningful learning). In short, in line with Neil Selwyn's (2018) statement, “the poor quality of debate surrounding schools and digital technology (characterized by hyperbole, misinformation, and unfounded optimism) must be challenged” (p. 186). Which is why with this research we have attempted to offer some keys to enrich the debate, through historical analysis and critical reflection.

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9. APPENDIX

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9.1 Article 1

Cognitive Processes, ICT, and Education: A Critical Analysis

Manuel Ferraz Lorenzo and Cristian Machado Trujillo

Department of History and Philosophy of the Science, the Education and Language, Universidad de La Laguna, San Cristóbal de La Laguna, Spain

ABSTRACT

Information and communication technologies (ICT) have brought about renewed spaces for the societies of today, full of possibility and transformation. Bordering on the infinite, these spaces have generated new activities and behaviors. This technological scenario is now commonplace, an everyday reality that has taken root in our lives with remarkable speed. Now would therefore be an appropriate time to open up a line of inquiry into how this is shaping educational practice and how it is affecting our cognitive structures. We have chosen to conduct a review of relevant literature that will enable us to adopt a critical analysis to our subject: education and, above all, the learner, seen from the perspective of neuroscience and social analysis. However, the principal aim of this paper is to lay bare the disparities between research findings and current educational practices that use ICT.

KEYWORDS

Educational reality; critical pedagogy; educational technology; cognitive load

Introduction

In this article we review some aspects of the use of ICT in schools. Nowadays, the digital has a profound transcendence in our daily lives, and ICTs have opened innumerable ways for innovation in education, making new environments and methodologies possible. We make a critical analysis from two fronts: on the one hand, in relation to the variety of interests that promote ICT use (e.g., didactic, political, economic) and, on the other hand, the results and indications that empirical studies and large evaluations have developed on their educational use. Understanding the multiple possibilities of ICT in education is not a case of taking an apocalyptic or integrated perspective as defined by H. Eco (1984) or of placing ourselves in one of the positions of the dichotomy between technoutopists and techno-sceptics defined by E. Morozov (2012). In this regard, we highlight the fact that "the use of technology in schools is transformed into an arena

CONTACT Manuel Ferraz Lorenzo mferraz@ull.edu.es Department of History and Philosophy of the Science, the Education and Language, Universidad de La Laguna, Avenue Trinidad, San Cristóbal de La Laguna, Spain 38204.

for politicians, school administrators and technologists" (Haugsbakk, 2011, p. 245), so we cannot ignore that educational technology has also become a field or struggle of different interests, with different stakeholders involved: national, supranational, public, and private (Selwyn, 2013).

On the other side, large reports such as the one carried out by the OECD (2016) show results that indicate that the technological promise in the field of education is still far from being achieved. In the same way, studies from cognitive psychology analyze how multimedia environments produce a cognitive load very different from traditional learning situations because of the large amount of information and stimuli they present. Floridi (2014), one of the most relevant authors of the philosophy of technology, emphasized that "ICTs are great in making information available; they are less successful in making it accessible, and even less so in making it usable" (p. 86). Therefore, a critical review of the uses that we are making of them in education is fundamental, understanding that the use of ICT does not directly translate into an optimization of teaching and learning processes and that the choice of these tools may be influenced by factors of a nature that go beyond merely educational.

We develop these different points, presenting first of all different empirical studies from cognitive psychology that show some of the evidence mentioned above, and then we present a critical analysis also alluding to the social, economic, and political spheres, and in particular, to educational policy.

ICT and brain plasticity: A cognitive analysis

We begin with an eye on neuroscience and cognitive psychology and address the concept of brain plasticity. This property of the brain determines its great possibilities for change in terms of its capacity to be reprogrammed and to adapt to different stimuli as a necessary condition for further and lifelong learning (OECD, 2007). We also appraise the classic confrontation between biological limits and the potential for adaptation to the environment which, in relation to plasticity, are categorized as experience-expectant, which is dependent on genetic factors, and experience-dependent, the result of interaction with complex environments (Gonçalves, 2012; OECD, 2007). The two variables define what are termed *critical* and *sensitive periods*: The critical periods are associated with the early years of life when neural connections develop on a mass scale; the sensitive periods, with education and the complex processes that connect structures and areas other than the brain (Ortiz, 2009). The traditional view of these two periods confined them to specific stages of development, but advances made by studies on brain plasticity and neuronal

reprogramming have led to the conclusion that neither of the critical periods are as rigid as previously thought nor are the sensitive periods related only to stages of development (Ortiz, 2009). Such findings justify the great possibilities for learning throughout life and the importance of stimulation as one of the factors that influence the intensity with which our neural structures change and adapt. In 1949, D. O. Hebb, in *The Organization of Behavior*, claimed that the use/disuse of certain skills was an important trigger factor in brain connections. Doidge (2008) expanded on this claim, stating that if we cease to exercise our mental capacity (meaning a skill or specific activity) the brain does not simply forget, but the space dedicated to the old skills is given over to the new skills that have taken their place.

From the field of cognitive psychology, various studies have analyzed cognitive processes in complex learning situations in which technology and internet tools are also used. One of the most interesting contributions that justifies the thesis that we defend in this paper is that expounded in *cognitive load theory*, by J. Sweller (1988), which has been developed in recent decades through studies on instructional design and complex learning situations (Amadieu, Van Gog, Paas, Tricot, & Mariné, 2009; Chandler & Sweller, 1991; DeStefano & LeFevre, 2007; Merriënboer & Sweller, 2005; Paas, Renkl, & Sweller, 2003; Sweller, Ayres, & Kalyuga, 2011). This contribution to the field of education demonstrates how cognitive resources are used during learning and task solving, linking up elements such as working memory, prior knowledge, schema construction and acquisition, the design of learning situations, and the acquisition of new knowledge.

Another key aspect is the relationship of cognitive load with working memory, which Baddeley defined as "a system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language comprehension, learning and reasoning" (Baddeley, 1999, p. 57), also showing this storage capacity to be limited. The design of learning situations should therefore avoid situations that could generate additional cognitive load and that entail more effort and a greater mental burden, thus negatively impacting performance by encouraging the creation and automation of schemata to free up cognitive resources (Merriënboer & Sweller, 2005). Sweller, Merriënboer, and Pass (1998) defined *total cognitive load* as the sum of three possible load types, which have also been studied by Kirschner (2002) and by Merriënboer and Sweller (2005): *intrinsic cognitive load*, *germane cognitive load*—though later revisions contend that it is probably inappropriate to use this term because it refers more to cognitive resources than to a type of cognitive load, as argued by Ayres and Paas (2012) and Choi, Merriënboer, and Paas (2014)—and *extraneous cognitive load*. The former is influenced by the nature of the task and the latter by the way it is presented.

Without going too deep, we can see how the cognitive load generated by a specific task has to do with the environment and the way it is presented and the characteristics of the learner and the interaction between these factors (causal factors). All this can be measured through *mental load* (related to the task and the environmental demands) and *mental effort* (capacity allocated to the task), and both, combined with causal factors, determine the subject's performance (Kirschner, 2002).

Armed with this knowledge, it is important that we design learning situations that generate a manageable cognitive load. It is therefore necessary to control the number of elements in interaction and how the new information is presented, since these are the key to improved processing when performing tasks and understanding new information, facilitating its storage in the form of permanent schemata in the long-term memory. Having recognized limitations in processing, the interaction between working memory and long-term memory becomes just as, if not more, relevant (Paas, Van Gog, & Sweller, 2010). We can influence the germane cognitive load by presenting structured learning situations, controlling the amount of information and its interactivity to avoid overexerting the working memory (Paas et al., 2003). If we show the information in a highly complex environment with multiple elements that interact through hypertext environments with an unclear hierarchy, the possibilities of filtering and working with that information will be the main constraint when faced with so much information. Weinberger stated that "it's not information overload. It's filter failure" (Weinberger, 2014, p.10).

On this basis, we will review different studies that analyze how activities in multimedia and network environments influence attention and cognitive load. Returning to the example of hypertext against regular text, multiple studies agree on the notion that the former requires more cognitive effort since attention is overloaded by the amount and variety of stimuli presented. Thus reading becomes more stressful and exhausting, it slows down, working memory is more saturated, and the resulting pressure directly affects the understanding of the text and performance. This was indeed pointed out by DeStefano and LeFevre: "The flexibility and interactivity proposed as advantages of hypertext result in a complex product that may increase cognitive load relative to processing of regular text" (DeStefano & LeFevre, 2007, p. 1617). Multimedia environments contain so many distracting elements that they force our attention to work much harder, especially in its selective facet. Hence authors like Small (2009) have argued that ICT leads us into a state of continuous partial attention that hinders our ability to focus on anything concrete due to overstimulation and that this can lead to stress or techno-brain burnout. Despite this, it appears that it also contributes to the development of the ability to

multitask, although there are differing opinions on the efficiency of this multi-layered process because performance levels are lower as information is accessed more superficially (DeStefano & LeFevre, 2007; Small, 2009). Although the unification of categories and methods makes for diverse findings in research on this subject, there is general agreement that it may all have a negative impact on skills related to cognitive control, academic performance, and the socioemotional sphere (Schuur, Baumgartner, Sumter, & Valkenburg, 2015).

The new ways in which information is presented, together with the possibilities offered by audiovisual, graphic, and similar formats, have led to information being displayed in a more transient and less reiterative way. Consequently, the process of retaining information requires more effort and further saturates working memory in comparison with other formats (Wong, Leahy, Marcus, & Sweller, 2012). Studies on this subject also refer to the fact that pleasant and appealing presentations often require greater cognitive resources; this means that they are not always the best option for understanding and learning since they provide a greater amount of ancillary information and elements that can distract from the essential ideas (Schmeck, Opfermann, Van Gog, Paas, & Leutner, 2015).

Other more specific studies suggest that the hypertext structure increases cognitive demand since, apart from the processes associated with reading, there is a significant additional cognitive load relating to processes of decision-making and visual processing when compared to regular text (Shapiro & Niederhauser, 2004). Other studies have attempted to demonstrate the importance of the structure of the text, or even the number of nodes or links, on performance and the understanding of content in hypertext. Lee and Tedder (2003) noted through their research that hypertext interrupts continuous processing because of the jumps required to read it, making it difficult to understand the text as a whole and to extract the main ideas or to process it deeply. Balcytiene (1999) also analyzed the different reading patterns in relation to hypertext, noting that this format is more accessible for self-regulated readers who are able to read in an exploratory way than for readers who prefer a linear and systematic structure since they encounter more difficulties in creating reading itineraries and in considering the relevant links.

Calisir and Gurel (2003) contributed new ideas when they added that the greater the number of nodes or links the greater the increase in cognitive load and the use of working memory; reading and in-depth processing will be more complex for those who do not have as highly developed an exploratory capacity. Burin, Kahan, Irrazabal, and Saux (2014) classified hypertexts indicating that linear and hierarchical structures promote understanding and performance in learning tasks, compared to more highly

branched hypertext environments with a more diffuse hierarchy and structure. Amadieu, Van Gog, et al. (2009) concluded that flexibility in exploring increases cognitive demand and that the dependent and not very highly self-regulated student may suffer from problems of disorientation since he or she is not able to trace paths through the information; the difficulties in creating mental representations thus become more pronounced. Amadieu, Tricot, and Mariné (2009) developed these conclusions a step further by analyzing prior knowledge and noting that the structure of the text does not significantly affect students with high knowledge levels, but that a hierarchical structure does significantly help those with low acquired knowledge or with learning difficulties.

All this evidence indicates that, despite the great advantages of ICT for presenting information and making it interactive, it can generate specific barriers and alterations in the neuronal structure and cognitive processing in learning situations and task solving. Through a synthesis of the significant studies that we have outlined, we may reflect, with deeper knowledge of the facts, on what ICT tools mean for our classrooms. Indeed, "their impact on student performance is mixed, at best. In fact, PISA results show no appreciable improvements in student achievement" (OECD, 2015, p.15). It is also worth examining how its incursion into curricula through various education policies is performing: We can indeed find schools that are blazing a trail in applying ICT-related methods, but they are based on entirely traditional educational schemes, pedagogical ideologies, and evaluation approaches. In this regard, "the use of technology in schools is transformed into an arena for politicians, school administrators and technologists" (Haugsbakk, 2011, p. 45). It is also necessary to undertake an analysis to ascertain what interests and values this technological momentum serves (McChesney, 2013; Selwyn, 2015). In short, as claimed by Rueda and Ferraz in their respective work, there is an urgent need for pedagogical criticism and, of course, critical pedagogy (Ferraz, 2012; Rueda, 2001).

ICT and the interests served by its application to education

Having demonstrated the enormous adaptability, re-programmability, and flexibility of our brain when coping with new challenges and unexpected situations, let us now pause to examine new technologies and the interests served by their incursion into education. In principle, none of these new technologies has been created ex professo for use in education—not even the internet or email, those all-powerful and boundless information channels, the precursors of which were military projects such as Arpanet.

All of these ICT tools have evolved at breakneck speed, in only two decades, since what Carr (2014) called the "dotcom bubble" began to inflate to

alarming proportions. Large multinational companies have sought out new markets and come up with products to excite consumers, and no sector is as broad, dynamic, and responsive to innovation as education throughout the world and across its many stages and levels. It is no coincidence that the Santillana Foundation and the Telefónica Foundation have recently signed an agreement to review technology-related educational processes in Spain and Latin America, integrating technology as something imperceptible and natural. As Weiser (1991) has stated, "the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (in Paiva, Morais, Costa, & Pinheiro, 2016, p. 229).

Optimal effectiveness without risks and cost reduction appears to be the formula adopted by large corporations in educational settings. As argued by technology guru and founder of the MIT Media Lab and *Wired* magazine, Nicholas Negroponte, in just 30 years from now we will be able to learn whatever we want simply by popping a pill: "You're going to swallow a pill and know Shakespeare. And the way to do it is through the bloodstream. So once it's in your bloodstream, it basically goes through it and gets into the brain, and when it knows that it's in the brain in the different pieces, it deposits it in the right places" (Ayuso, 2014; Negroponte, 1995). Negroponte appears to have solved at one fell swoop three problems of enormous magnitude in which pedagogy has historically been found wanting: the economic and social differences in access to knowledge, the selection of appropriate content to be learned and assimilated by future citizens, and the methods—widely debated for over two thousand years—for truly engaging with content and fixing it in the memory. Of course, this begs the question: Who will create these quasi-miraculous pills, for what purpose, and for whom? We should bear in mind the fact that these pills or robots will play their part in a growing industry that moves more than 19 billion euros a year. The European Union (EU) announced an investment of 2.8 billion euros in a sector in which Europe has a 32% market share. The scale of this market is made quite clear when we consider that Google has purchased eight robotics companies in recent years (Altares, 2014).

But from the point of view of governments, at least for some, due attention is also being paid to this market: The subject of robotics, under the title "technology, programming, and robotics," has been introduced regionally as an optional subject in all schools of the Autonomous Community of Madrid in the first three years of compulsory secondary education, starting from the 2015-16 academic year. The fact that the Madrid regional government has made a commitment to this field illustrates its potential to promote practical activity and to maintain a certain pro-business educational line, which impedes the introduction of other disciplines that are more

given to thought, reflection, and debate, a criticism that has been leveled at the new curricula in almost all countries (Schuessler, 2013).

The commitment of multinational companies and governments to promote the internet and robotics has been repeated in the case of mobile phones—so much so that the vast majority of bureaucratic procedures both in and out of schools, and in most government offices and in all kinds of institutions, only admits users of this technology. In the case of Spain "the proportion of children (10 to 15 years) using information technologies is generally very high" (Instituto Nacional de Estadística [INE], 2016, p. 3). The same source reveals that at age 10 the percentage of students who have a mobile phone is 25.4%, although that number skyrockets for 15-year-olds, at almost 94% (93.9%). Spain leads the way in the EU in terms of smartphone numbers, with 23 million units. Also, Spain leads the world ranking of unique mobile users with 88% penetration, compared to 82% in the United States and the global average of 66% (DITRENDIA, 2017). Only 24% of Spaniards prefer to communicate in person (Aguayo, 2015). If we consider that teenagers send an average 3,000 text messages a month, this gives us an idea of their enormous communicative and empathetic needs (Turkle, 2011, 2015). According to a study made by Common Sense Media (2015) on U.S. teenagers (13-18 years), they spend almost nine hours a day on media devices (not including time spent for school or homework). What had been interpreted until now as a broadening of social communication has become mere connectivity and personal isolation. Worse even is the perhaps unsurprising profusion of new terms to define the dependence that mobile phones as a technological device generate: nomophobia (fear of being without it), techno-stress (tiredness caused by permanent use and by other electronic devices), phubbing (snubbing someone in favor of a mobile phone), sociophobia (fear of the society that surrounds you and taking refuge in the virtual world), infoxication (too much information without selecting or applying rational criteria), etc. And as these pathologies are classified, detoxification centers are beginning to proliferate in high-tech countries like the United States, South Korea, China, Japan, Australia, and Spain. There are even dedicated sidewalks in China for mobile addicts so they do not have to step aside or bump into anything or anyone. Quite the opposite of what is happening in certain American states, like Hawaii, Arkansas, New York, and Illinois, where there is a ban on using mobile phones on sidewalks, crosswalks, and road edges or shoulders because of the danger that they pose.

In a small-scale study that we conducted with 79 first-year students of the Early Childhood Education degree at the University of La Laguna (group 1), participants were asked to switch off their mobile phones for one weekend (starting at midnight on Friday), having first notified their relatives and acquaintances of their intentions. The most dependent of the students

(63%) only endured being disconnected while they slept (6-9 hours); others (27%) switched them on by noon on Saturday (12-14 hours disconnected), and only 10% managed to last for between 20 and 30 hours without their mobile phone. Of this sample, none lasted the scheduled 48 hours of an entire weekend without connection; most acknowledged orally that they were in thrall to their mobile phone. We should not therefore be surprised that educators and psychologists warn of the damage caused by these devices at an early age and the importance of going on "digital diets" when a moderate and rational usage threshold has been exceeded.

As mentioned above, this is all taking place in developed countries since in the 39 countries classified as "least dynamic" by the ITU (International Telecommunication Union, a specialized agency of the UN), with a combined total of 2.4 billion people, these health problems do not exist. However, it has been pointed out that these countries cannot "enjoy" the "great improvements in areas such as education, health, or employment with greater access to these technologies" (EFE, 2013). As we see, even the highest level international bodies insist on the idea of the benefits that are derived from new technologies in educational settings; and it is not the case that ICTs per se (i.e., as mere tools) have perverse effects. It is more the case that—as claimed by Jaron Lanier, a computer expert who coined the phrase "virtual reality"—"we should understand that we have entered a game governed by zero-sum mindsets, in which we try to make the world fall into the trap of ignoring reality" (Lanier, 2014, p. 349). More explicit than that, if possible, were the remarks of Morozov, who said that "often ["cyberutopianists and internet-centrists"], completely forget the political nature of technology" (2012, p. 21; also McChesney, 2013). The problem is not the existence of technology, the use that we make of it, or the level of sophistication that we allow it to have to make life more comfortable; rather, the problem lies in the ways of thinking about technology to the point where we have transformed it into part of ourselves, an extension of our being, unaware that it is a commercial tool of domination and control that "attracts our attention only to scatter it" (Carr, 2011, pp. 143–147).

Indeed, the real world is confusing, chaotic, and incomprehensible, and we try to halt its onward march by using machines that engulf us in a more pleasant and desirable virtual reality, to such a point that we lose the sense of active physical presence. It hardly seems necessary to mention the Oculus Rift VR headset, the major business venture of Facebook and its owner, Mark Zuckerberg, which creates a feeling of immersion and "how the real world and the virtual world merge" (Jiménez, 2016, np.) As we have seen in the first part of this article, the automation that new technologies of all kinds are exposing us to restructuring and reconfiguring the

activity that we do, the environment in which we do it, and most pointedly and disconcertingly, those who are making use of the technology.

Education and its permanent uncertainty

From the 1990s, publications of considerable interest began to emerge, highlighting the advances that new technologies could bring to education. The beneficial influence of computer systems and software has been felt in all forms and stages of education, from formal, through nonformal and informal, and including higher education. A cursory search for documents containing the search terms *educación* and *nuevas tecnologías* on Dialnet (the Spanish academic search engine) from 1994 (although on a mass scale from 1997 onward) to the end of 2016 returned 276 results pages—a total of 5,505 documents. In none of the documents consulted did we read a critical assessment of the purported aims of such widespread diffusion of technology, the soaring stock market value of the companies that had climbed aboard the bandwagon of social and educational progress, or how the hardware and software for these ICT systems are selected at will from other fields of knowledge to be adapted (sometimes forcibly) to teaching. Even less was written on how these technologies distracted the attention of students, distanced them from reality and fractured knowledge, and turned them into completely dependent beings. The focus was on ICTs as simple work tools, as instruments to facilitate the transmission of knowledge—or rather, information—and as mechanisms that are devoid of any negative or minimally questionable connotations regarding their functionality or operability. New technologies, and the megabusiness that surrounds them, have firmly established themselves in schools, colleges, and universities, convincing them of their potential and becoming a permanent feature.

But despite the use of new technologies, the contradictions in educational systems are on the up. Virtual classrooms, interactive whiteboards, mobile applications, laptops, interactive programs, online searches from any terminal, digitization of much of the content and materials, smart devices used for tracking purposes, digital environments of all kinds, exchanges through chat rooms, text messaging, social networks, blogs, wikis—all of these formats—continue to coexist with traditional presentation modes, with archaic methods, with rote evaluations and test-based assessment that only value certain skills and require simple answers but do not evaluate the process of acquiring knowledge and the critical experience-based knowledge acquired through synthesis of the whole. In other words, such widespread acceptance of ICT has not been accompanied by a holistic and innovative vision of the change that such resources entail for a 21st-century classroom. Or, to frame it in the words of a teacher, De Pablos (2015, p. 16): "The

quality of education outcomes is not so much to do with the presence or absence of technology as with applied pedagogical models and the conditions under which they are applied in the classroom."

But perhaps the solution to the education/technology equation is not so readily apparent and even less manageable; it may not even, strictly speaking, be pedagogical. With the digitization of the classroom and with the new education laws enacted in these times of globalization and neoliberalism—what has been called "new capitalism"—educational reality has changed considerably. Selwyn stated that "[m]any of the 'new' forms of digital education being driven by commercial interests are based around decidedly different agendas and ideologies than we are used to encountering in public education" (Selwyn, 2016, p. 131). Let us take an example known worldwide: In 2002, the George W. Bush administration passed a literacy law called the *No Child Left Behind Act*. With all the technologies at their fingertips, American teachers were forced, thereafter, to choose between teaching general knowledge or teaching to pass exams, which was what essentially was being asked of them.

What began as a kind of laboratory test in 2002 has since spread all over the world as education laws have been amended to adapt them to the demands of the markets. Perhaps here we have a first clue as to the origins of the technological avalanche: its adaptability to new policy needs and to cuts in public spending and its enormous business potential. If technology use and information overload are distracting, if multitasking reduces the possibility of learning complex skills, if there are certain cognitive loads that cannot be exceeded without clear risks for the health of students, if virtual reality distorts and manipulates authentic social reality, if empathy decreases as technology advances, if new technologies motivate enjoyment but not effective learning, if computers dehumanize the process of acquiring knowledge, etc., as evidenced by the most recent research, then why spend so much effort and energy in its defense? Have we truly considered—as did educators of the past—what the purpose (and means) of education should be in this new learning context? Have we paused to reflect on the type of student and citizen that we want to educate in times of such uncertainty, on the real, sustainable society that we want for our descendants? Or, are we shaping an education for tomorrow that is at the mercy of the latest algorithms, computer applications, and robotic pills? Who will be the new education specialists: teachers and pedagogues or computer programmers and tech gurus? In his report to the European Parliament in 2010, psychologist and neurophysiologist Aric Sigman warned of the harmful effects of screens on children and concluded his presentation with the following presage: "There is nothing to be lost by children watching less screen media but potentially a great deal to be lost by allowing children to continue to watch as much as

they do … . we may ultimately be responsible for the greatest health scandal of our time" (in L'Ecuyer, 2015, p. 210).

In light of this, and assuming that, far from disappearing from our lives, technology will continue to increase exponentially to satisfy the many interests vested in this market of unprecedented growth (and unscrupulous when it comes to health concerns; Briones, 2016), it seems clear that we must change the logical assumptions on which we have based current educational expectations. This has already been done by certain members of the tech elite. In Silicon Valley, the children of the famed computer technicians of Google, Apple, Yahoo, and Hewlett Packard go to the Waldorf School of Peninsula where computer science is only taught from the age of 13, pencil and paper are the tools used for writing, traditions are fostered, the bond of solidarity is nurtured between pupils, and there is a constant search for a culture of "disconnection" or "digital retreat" (de-teching). Pierre Laurent, the father of one of these children, is quite clear about their aims: "Screens disrupt learning. They diminish physical and emotional experiences" (Abundancia, 2016; Richtel, 2011, p. A1). Moreover, Steve Jobs, co-founder and CEO of Apple, was another who did not encourage the use of technology among his children. According to information that has recently come to light, he did not allow them to use an iPad and limited the use of other technologies because he did not deem them necessary during their formative years. There are other similar accounts. For example, one of the founders of Blogger and Twitter has stated that his children use traditional books instead of iPads and that they have been forbidden access to the internet until they reach the age of 16 (L'Ecuyer, 2015); this is true for a host of leading experts in information and communications technology, who consider instruction received by children and young people through any kind of screen display to be ineffective.

At this juncture we are able to better understand the OECD report (2015) entitled *Students, Computers and Learning: Making the Connection* in terms of its questioning of how new technologies are used to achieve real and effective learning and to reduce school drop-out rates. Francesco Avvisati, the author of this report, stated that "[w]hile there is too little credible evidence on this issue, positive findings are limited to certain contexts and certain uses of ICT" (OECD 2015, p. 190). In fact, class time or teacher/student relationships have a greater influence on results than the technologies used. Avvisati continued: "They [countries] can more clearly identify the goals they want to achieve by introducing technology in education, and strive to measure progress towards these goals" (2015, p. 191). In his foreword to the report, Schleicher claimed that "we may overestimate the digital skills of both teachers and students, because of naïve policy design and implementation strategies, because of a poor understanding of

pedagogy, or because of the generally poor quality of educational software and courseware" (OECD, 2015, p. 4). Therefore, we can say that technology, sensu stricto, does not seem to have an effect on academic achievement beyond being a simple and additional aesthetic, recreational, and educational complement. In light of new research, we shall have to keep asking ourselves whether it is worth defending from the demanding and vigilant vantage point of pedagogical responsibility; as Edith Litwin stated, "It is not the technology that allows us to bring about change, but our decision to imagine with and through it" (Falco & Kuz, 2016, p. 44).

Conclusions

At this technological pinnacle in all spheres of life, particularly in education, we have tried to draw on research and on reports to demonstrate that the advances and results that have been brandished with such keen interest and exuberance are not all that they seem. We have also seen how technology did not arise to tackle pedagogical or educational problems but to meet other political requirements and to capitalize on a booming education market that had no great demands or expectations. In fact, if we return to the OECD report (2015) we can categorically declare in the strongest terms that "the reality in our schools lags considerably behind the promise of technology" and that technological promise also announced that it would reduce the gap between different students; however, the report concluded that "technology is of little help in bridging the skills divide between advantaged and disadvantaged students" (2015, p. 3), as was foreseen. Following this line of argument, the introduction into educational practice of any technology should be conceived and justified from the perspective of pedagogical knowledge, which enables us to reflect on the whys and wherefores of its use and whether it really optimizes the teaching and learning processes. We have gone from graphite (pencils) to graphene (mobile phones and other electronic terminals) without giving thought to the positive and negative changes that this mental and cerebral process generates. We are convinced that the teacher/student relationship is indispensable for complex cognitive processes and rigorous analysis of concepts and interpretive approaches. As Emilio Lledó, a teacher who received the 2015 Princess of Asturias Award for Communication and Humanities, stated:

- The mission of the teacher transcends the subject that they teach.
- In the real space of the classroom, in the words they utter, they encourage a beautiful phenomenon of love. It has been written that teachers have to love what they teach but, above all, those whom they teach (Lledó, 2015, p.14).

Therefore, we can conclude that no technology, however cutting-edge it may be, can replace the teacher in making students understand, feel, touch, transmit, and manage the immediate reality that affects them, with his/her exceptional experiences and his/her particular economic and social background.

Therefore, one might ask whether democratization is being given priority in the processes of individual autonomy in politics and whether production relations are imposing a model of information control that is far removed from the interests of citizens. If the school, as a privileged institution in the creation and transmission of learning, is activating the necessary mechanisms to create awareness about the transformations that result from use and abuse of ICT (Haugsbakk, 2011; Selwyn, 2013), the necessity of creating both medium and long-term political and research agendas—capable of accompanying these techno-educational transformations—becomes evident and should not culminate in the delivery of devices but begin at that point. All this offers us indications of the new lines of research to be undertaken in future studies.

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9.2. Article 2

THE CONCEPT OF THE STATE IN TEXTBOOKS: ANALYSIS AND REINTERPRETATION DURING THE SPANISH TRANSITION TO DEMOCRACY (1976-1986)

by MARIANO GONZÁLEZ-DELGADO, MANUEL FERRAZ LORENZO and CRISTIAN MACHADO-TRUJILLO, *Department of History and Philosophy of Science, Education, and Language, Universidad de La Laguna, La Laguna, Spain*

ABSTRACT: This article analyses the concept of the state as represented in primary school social science textbooks in Spain during the transition to democracy. The analysis of textbooks during this period has tended to focus on the importance of National Catholicism (Nacionalcatolicismo) or the technocratic vision in the framing of their representations. This article points to how such representations should be viewed from a more complex perspective that lays the emphasis on how the dictatorship understood education within the context of the Cold War. The first part of the article analyses the explanations given by textbooks during the transition. The second part dissects the subsequent evolution of the representations. Lastly, we attempt to explain why these representations and changes came about.

Keywords: textbook, state, the Spanish transition, Franco regime, curriculum

1. INTRODUCTION

School textbooks continue to be a rich seam of research material on the history of education.[1] Insofar as education cannot be envisioned without some type of resource or means for the transmission of knowledge, textbooks have been an ever-present in our classrooms. This is one of the reasons why so much interesting research is being conducted on them today. It is not, however, the only reason that we pore over their pages as we unravel the history of education. Textbook analysis also provides us with an insight into the kind of knowledge that was taught in classrooms. In a way, these materials are used as a resource with which to reconstruct aspects related to knowledge and socialisation models that were transmitted in the classroom at different historical periods.

In Spain, this type of study has been conducted widely, and one of the most researched periods in relation to the use of textbooks is the Franco dictatorship.[2] The majority of these studies have illustrated the profound influence that the values of National Catholicism or the technocratic vision had on schools under the Franco regime. Conservative religious values, sexist values and class values made up the bulk of their pages and, by extension, of education during the Franco era. This was

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clearly a defining feature of the transmission of knowledge during the dictatorship and the transition to democracy. However, it may be worth our while asking ourselves the following questions: did textbooks at the time only present the values of National Catholicism or technocratic ideology? Did National Catholicism and the technocratic vision form the backbone of all knowledge? Did education under the Franco regime revolve exclusively around these values? Were these values the cornerstone and the fundamental conceptual framework that guided Francoist educational policies? Answering these questions is not easy. The theoretical frameworks that have been developed to date on the dictatorship, the Spanish transition and school textbooks provide us with a perspective that may not be able to capture this complexity.[3] During the dictatorship, educational models such as programmed learning, the revision of school textbooks under UNESCO programmes and even television education projects were introduced with the aim of democratising secondary education (González-Delgado and Ferraz-Lorenzo, 2018; González-Delgado and Groves, 2017, 2018).[4] A whole range of curriculum proposals were incorporated into educational policies born of *modernisation theory*.[5]

All actions of this kind originated around an idea of education attached to the context of the Cold War. For this reason, it may be necessary to begin to analyse the educational reality of the Franco era from another approach or perspective. Rather than focusing on National Catholicism or the technocratic vision as a driving force of all education under the dictatorship, another dimension that centres on the concept of education and the idea of society needs exploring. This will enable us to see that these ideologies were present, but that they did not contradict other types of educational proposals that, paradoxically, the technocratic vision helped to encourage. The problem may have arisen from the assumption that the ideology of National Catholicism was the defining factor of education during the long Franco regime and that it did not allow for the introduction of other types of curriculum policies. We think it is time to reassess the Franco dictatorship as a regime that underwent changes throughout its existence and to focus on the conceptual underpinnings of the educational system that it shaped. This will give us a greater understanding of why certain representations from the economic sphere appeared in the textbooks of the Spanish transition and how they subsequently evolved.

This article aims to analyse the concept of the state that textbooks of the transition tried to convey to students in the last three grades of primary education.[6] As we set out to explore this concept and as we analyse the textbooks, through their explanations, demonstrations, debates and examples, we become aware of a reality that is much more complex than that revealed in prior studies on textbooks, the Franco era, and the transition to democracy. The concept of the state contained within these textbooks expressed a representation that adhered closely to the protectionist ideas that facilitated functionalist social cohesion; ideas that, on the other hand, lost ground during the first years of democracy and moved towards a model based on a less protectionist outlook.

The choice of this topic, in its economic sphere, brings to light the importance of the conception and idea of the individual in society, which helps us to understand the changing content of social science textbooks. Therefore, it enables us to analyse textbooks from a perspective that focuses not exclusively on the political aspects of the dictatorship, but also on the educational framework that was to be built.

To carry out our research, we analysed the social science textbooks of the main Spanish publishers – Santillana, Anaya and Bruño – during the years of the third stage of EGB: sixth, seventh and eighth year of primary school. We began by performing a classic analysis, consisting of extensive reading of the sources in order to ascertain the main arguments pertaining to the concept of the economic state and to identify the elements characteristic of this topic in the various texts. This allowed us to track and compare the way that the concept of the state was addressed throughout the years covered by the study. In doing so, we adopted a 'content analysis' approach based on a general reading of the texts and the selection of arguments pertaining to consumption in contemporary societies. This approach also took into account previous research related to social studies (geography, history, civic and ethics education),[7] as well as methodological aspects proposed by other specialists within the fields of the history of education[8] and textbook research.[9] In the first part of our study, we analyse the concept of the state during the final years of the dictatorship and the transition to democracy. The second part takes the same approach, but with the textbooks from the democratic period. Finally, the third part of this article provides explanations that have helped us to complete our analysis of the complexity of curricula during the Franco dictatorship.

2. An Organicist and Social Vision of the State: Protection, Security and Economic Responsibility as Unquestioned Spaces

Ascertaining the concept of the state in the textbooks of the Spanish transition is not an easy task. There is no specific appendix or unit where the state is spoken of autonomously and independently. This does not mean that the desired state model was not addressed. The state is present in their pages and there is a clear model framed within a social conception of it. Its ultimate meaning is intimated through the protection, security and responsibility that the state should afford to its citizens. The development of the idea is largely attached to the world of work: the focus is on the role of regulator that states played during the Fordist labour pact that was widely established in Western societies after World War II. For this reason, in order to understand what kind of state these textbooks conveyed, and the developments of the following years, the vision of the world of work that was intended to be transmitted needs first to be sketched out.

The story that textbooks tell us about labour tends to begin with how it is organised. In other words, with the 'community' that is created when a group of individuals, of working age, participate in an enterprise. As a result, work is the

'*centre of social life*' (Abad Caja *et al*., 1979a, p. 249). The community is a core element in connection with all that is related to the organisation of labour. The 'work community', according to the ideas of the time, is therefore a 'functional organisation that regulates the functions of different people'. Within it, workers perform their activity based on a 'hierarchical structure that is more or less complicated' in line with the 'size of the company and the degree of specialisation and the complexity of the work being carried out' (Abad Caja *et al*., 1979a, p. 249).

However, the work community not only refers to the way in which the company is set up to produce. The relationships that exist between workers and capitalists also occupy a central place in the textbooks. As we can see, there is a pronounced differentiation between 'labour' and 'capital'. In relation to this aspect, the concept of labour during the transition to democracy focused on showing, in a Durkheimian sense, the mutually supportive function of the hierarchy and the social division of labour. In this regard, 'in the work community the workers have a shared relationship … because there is a community of interests among the workers' (Ramos *et al*., 1977a, p. 41). Such division is expressed in its 'normalising' nature without analysing its different forms. However, what is important to emphasise here is that the separation between labour and capital is observed as an unquestionable phenomenon. Although there may be work or objectives that are shared between capital and labour, the social and labour hierarchy is not hidden. It is even openly acknowledged that 'sometimes, in the work community conflicts arise due to a lack of understanding between the group of workers and the company' (Ramos *et al*., 1977a, p. 41). The working class is used as a central concept when it comes to explaining arguments about labour and the inequalities that the state is meant to alleviate. In turn, capital forms another group of differentiated actors with specific interests.

However, the formula for solving these problems is not found within a classical liberal pattern in which workers and employers negotiate solutions to situations of conflict amongst themselves. The main idea posited to remedy the social challenge arises from a functionalist perspective known as 'social consultation' (Mañero Monedo *et al*., 1979a, p. 34). There is open criticism of the excesses of economic liberalism. There is a questioning of how, with the emergence of 'major industry in the nineteenth century, workers lived in inhuman conditions, working 12 or 14 hours, without holidays or days off, without insurance of any kind, without retirement … '. It is accepted that 'the workers' struggles have been directed towards achieving their participation in the surplus value, the profits generated by the effort of the workers' and that 'it is not a question of abolishing logical industrial profits … but of ensuring that capital is not the only side to appropriate the profits'. Therefore, it is necessary that

capital does not 'exploit the workers' (Mañero Monedo *et al*., 1979a, pp. 34 and 35).

The importance of the employment contract, work insurance and life cycles and stable labour statutes are not discussed. It is patently clear that exploitation by employers is an element of constant concern for school textbooks. The debates about inequality and the need to seek out a social order to break with inequality are pivotal. The concerns that were expressed in Marxist theory at the time may be divined to a greater or lesser degree in these textbooks. Explanations about the origin of capital present it as accumulated labour that is extracted from the activity of workers. Profit is not exclusive to the employer. Because of this, industrial profit has to be accepted insofar as the company is owned by a capitalist, but part of it must be delivered to the working class in the form of a salary or through indirect redistribution with the creation of social services. Labour is understood to occur under capitalist relations of production that are determined by differential and arbitrary access that is dependent on class structure. This fact gives rise to another range of concerns and criticisms in these textbooks. The problem that arises from labour under the framework of liberalism is that it leads a large part of workers to 'work on only one link in the production chain, and always the same link'. Hence 'the production chain' may 'provide us with examples of alienated work [and] contribute to this alienation' (Abad Caja *et al*., 1979c, p. 289).[10]

However, as we have already indicated, workers or employers are not independently in charge of solving all the problems related to the redistribution of wealth, the conflict between capital, work and alienation. The state and its intervention in this process is not only understood to be necessary, but also legitimate and essential. This is where the role and the concept of the state that school textbooks used during the transition to democracy is defined. The state is responsible for alleviating situations that the labour market cannot resolve. What school curricula treat as social inequality is considered to be the product of a set of social and political relations derived from the excesses of liberal capitalism. State interventionism, as an agent that regulates and drives the economy, is the main feature that defines the concept contained within these textbooks, which are framed within modernisation theory and the Fordist labour pact. To a certain extent, for the textbooks 'the problems began with the existence or not of a job for every man or woman'. Therefore, depending on 'whether or not they have work, a person can change radically'. This is because the construction of individual identity is fundamentally based on labour. Without this there is no personal realisation, no individual or social progress. For this reason, the textbooks point out that 'the importance of there being work for all and the need for the state to create jobs, where necessary, can therefore be inferred' (Colomer Viadel *et al*., 1979, p. 39).

In addition, the textbooks indicated that for the development of 'modern societies' to take place, it is necessary for 'states to implement a state policy

for the defence and promotion of employment through the creation of jobs' (Abad Caja *et al*., 1979b, p. 263).[11] In this regard, the safety net that supports modern societies in achieving the coveted right to work is none other than the 'social state'. Inequality is not the result of personal weakness, as purported by classical liberalism. Society generates perverse effects that individuals cannot overcome, despite their best efforts. Moreover, there need to be institutions charged with mediating the construction of society. The forging of this modernising process means, therefore, that 'the state' develops 'public services' and becomes 'the biggest employer' (Mañero Monedo *et al*., 1979a, p. 35).

In this way, the 'state … must take responsibility for ensuring that all people obtain decent and sufficient living conditions through their work' and that 'the requirements that guarantee a job and adequate economic and social conditions for workers are met' (Abad Caja *et al*., 1979c, p. 289). This type of explanation in textbooks should not surprise us at all. Although they are framed in the period of the political transition, what we must keep in mind is not the ideology of National Catholicism as a cross-cutting element or a catalyst of these textbooks. The important thing here is that, during the dictatorship, the perception of human progress, social organisation, labour and economic relations was based on the idea that societies are susceptible to change and improvement through the intervention of institutions. They were rooted in the central ideas of the theorists of modernisation and functionalism. This was the aspect around which educational reforms revolved. But it was also a space or conception of the social model that did not contradict the more conservative values of the dictatorship.

For this reason, and in relation to the ideas of the social state, the solutions to the problems of labour did not only stem from state intervention into the economy. The classical proposals of modernisation theory were also present as a way to promote the progress of society. The most important such proposal was the use of the education system to attain that desired social model. The school textbooks indicated that 'equal opportunities must be encouraged, so that everyone may demonstrate their aptitude for work that is agreeable to them and that can contribute to their personal fulfilment' (Abad Caja *et al*., 1979c, p. 289); this is a central aspect of the concept of the state in these books. Within this framework, it is understandable, therefore, that the textbooks claimed that there is a model based on the idea of functionalist meritocracy. In turn, to achieve this process it is necessary to 'create an educational system that continuously improves those who work and adequately prepares those who are going to start work'. This is the only way to avoid 'potential talents being wasted and those who see no encouragement to excel in their work falling into routine' (Abad Caja *et al*., 1979c, p. 289). However, all these concerns underwent modifications in later years.

3. The Evolution Towards a New Neoliberal Economic Model: the Reconstruction of the State as an Economic Fact during the Beginnings of Democracy

As we have already mentioned, textbooks during the transition began by explaining the work community. This community disappeared from school textbooks during the following years. Labour appeared as a formal element and was not represented in its real economic space. Under the constitutional framework, there was an insistence that 'all Spaniards have the duty to work and the right to work and to freely choose their profession'. A salary was understood to be a fundamental statutory premise. However, inequality was focused in a new area not ascribed to class analysis. All that was said was 'in no case can there be discrimination on the grounds of sex' (Abad Caja *et al*., 1984, p. 201). Unlike in previous years, an introduction to labour did not start with an open debate about the productive model. Capitalism had become normalised and references to the USSR and Karl Marx had disappeared. Everything related to the pronounced differentiation between labour and capital, the existing hierarchies between workers and employers and exploitation disappeared from school curricula during democracy.

It is true that the concept of the state appeared to be linked to the model of institution responsible for ensuring the welfare of citizens. Despite this, there is a fundamental change in the social logic under which it is analysed. The opposition of worker versus employer has been blurred by 'the individual'. It is no longer just the state but also a more abstract entity – 'society' – 'that must take responsibility for ensuring that all people obtain decent and sufficient living conditions through their work' (Abad Caja *et al*., 1984, p. 202). For these textbooks, the state is still presented as being in charge of 'adopting measures that promote the creation of new jobs and that allow existing jobs to be maintained. Society and the state must take responsibility for ensuring that all people obtain decent and sufficient living conditions through their work' (Abad Caja *et al*., 1984, p. 203). However, it is not only the appearance of new social subjects, defined by vaguer terms such as 'society' or the 'individual', that define the actions of the state. The question is that, unlike in previous textbooks, society is again an intentional human creation. That is, individuals, through their efforts, can determine their own lives and make them change. To a certain extent, there was a return to a classical vision of liberalism, known from that moment onwards as neoliberalism.

For this reason, there was acknowledgement of the fact that 'first of all, the state and individuals must create jobs to the extent that all members of the community can pursue an occupation and the abilities of all are harnessed'. 'Individuals' now appear to be an object not determined by social conditions. They can be mediated by society, but have an ability such that with 'ingenuity, wonders may be achieved: works on a gigantic and microscopic scale … ' (Martínez Beltrán *et al*., 1987a, p. 99). The texts that we have thus far analysed

would never have pointed this out. They operated within a different rationale. During the transition to democracy, the social state intervention model progressively moved into the background and the case was now made for a classical liberal premise. Individuals 'with perseverance, honesty and application can achieve great goals … For labour to contribute to developing our personality, it must take into account more and more the capacity for initiative of company workers' (Martínez Beltrán *et al*., 1987a, p. 99).[12] Alienation, exploitation, production lines; these are an ever-present reality that is not analysed. Essentially, an understanding is regained according to which society is also mediated by development and the acumen of individual elements of human nature and not the other way around.

Because of this, the textbooks insisted on a new understanding of the state based on two different premises: individual and society. The first of these premises had not been present in the textbooks of the final years of the dictatorship. Thus, on several occasions the new texts indicated that 'it is the obligation of the state and of all citizens to contribute to reducing *unemployment*' (1987b, p. 65). Unemployment was to become one of the growing concerns in school curricula that focused on the world of work and the notion of the state. This is quite logical, given the economic crisis during which these textbooks were authored. Now, and picking up on previous ideas, we are offered two different positions: the first, centred on 'public authorities […] that will introduce special policies designed to promote full employment' (Abad Caja *et al*., 1984, p. 201); and the second position, in which the educational system is increasingly adapted to the needs of the economy to defeat unemployment. The education system is now seen as an entity in charge of 'providing adequate preparation to future workers [and] perfecting the knowledge of workers so that they may always be able to respond to labour demands' (Abad Caja *et al*., 1984, p. 203). In other words, the responsibility for solving the problems that arise from the system of production no longer lies solely with the state. Now individuals are entrusted with finding the solution to what is a problem of the community, through an 'equal opportunities' policy linked to the capacity-building provided by the education system.

In line with this idea, school textbooks no longer turned their gaze towards a diagnosis of labour problems in terms of social mechanism. They turned to individual components amidst a wider acceptance that we occupied a framework or space that was deficient from the point of view of social protection. It was pointed out that 'labour represents a source of satisfaction and a stimulus for self-improvement. However, since labour is a scarce commodity, many people have to perform unrewarding tasks that bear little relation to their qualifications' (Abad Caja *et al*., 1993, p. 188). The question of whether or not these tasks should be undertaken by the state is not even raised. Unlike the view of the role of the state from previous years, the root of the problems now ceases to be found in the imperfections of capitalist societies. Labour problems began to be

accepted as a necessary evil. Examples of other contexts for redeeming the national situation began to appear. This is what occurred, for example, when it was stated that:

unemployment affects a large number of workers, many young people seeking their first job and those who cannot exercise a newly acquired profession. In developed countries there are unemployment benefits, but the amount is insufficient, they are of limited duration and not all the unemployed have the right to receive them. In underdeveloped countries, the problem is even more serious, because there is less work, and unemployment insurance is often lacking (Abad Caja *et al*., 1993, p. 189).

However, it now becomes necessary to ask why textbooks changed their theoretical stance from an organicist conception of the state to a model that is once again supported by the basic premises of classical liberalism. The answer to this question is not simple. School textbooks are a manifestation of curriculum policies that are subject to many social, cultural, political and conceptual processes that imprint a highly complex character on them. Such complexity often exceeds the intentions of authors (Authors reference), the editorial lines of publishers (Darr, 2012), and even the pressures of professional fields in certain historical periods (Foster and Burgess, 2013). This compels us to investigate, for each specific case, the causes that may have influenced the configuration of said school materials at the time they were written. We shall dedicate the following section of this article to this question.

4. Why This Type of Representation? Some Pointers to Understanding the Concept of the State in the School Textbooks Analysed

As we have pointed out, there is no simple answer to this question. The explanation that will be expounded over the following pages is based on a perspective that needs to be expanded further. Delving into the reasons as to why the thematic contents of textbooks are developed in a certain way is a particularly broad undertaking that often eludes researchers who try to unravel their mysteries. However, in some cases there are coherent explanations that may help us understand this process. John Issit (2004) argued that school textbooks symbolise a 'very fuzzy category as they reflect a multiplicity of meanings and uses' (Issit, 2004, p. 685). School books are, in essence, mediated by a mixture of elements that may be drawn from 'the configuration of dominant ideas and social values, the commercial impulses of the publishing industry, particular academic disciplines and conventions of authorship, and from the progressive technologies of media production' (Issit, 2004, p. 685). School textbooks have to adopt a position or synthesise these elements if they are to gain a temporary status of legitimacy and social credibility. And it may be precisely this factor that underlies a significant reason for the representations of the state found in the

textbooks from the last years of the dictatorship and the advent of democracy. However, this does not mean that the other reasons should be overlooked.

Part of the answer to this way of observing the concept of the state lies in the political framework in which the textbooks were developed during the transition. The subjects taught in school were strongly influenced by the curriculum policy that was laid down by the Ministry of Education and Science (MEC) and the Directorate General for Basic Education. The curriculum was not decentralised.[13] The different textbook authors had to faithfully reproduce the basic reference levels of the social science curriculum as defined in ministerial documents. It should be noted that the general outline of the concept of the state was defined by the MEC through the Ministerial Orders of 29 November 1976 and 30 June 1977,[14] which were respected by the textbooks written during the final years of the dictatorship. The approval of these textbooks was subject to the 'Documents' that were drawn up to this end. To take a case in point, in a support document for preparing social science materials, the MEC encouraged teachers to teach students to 'understand the meaning' of terms such as 'trade union, nation, cooperative, social classes, citizenship, common good' and to know or understand the world 'of labour, of a decent job and a fair wage' (Crespo Alonso *et al*., 1979, pp. 165 and 172)

What these documents tell us is that during the Spanish transition the economic model of state that was described in the curriculum was clearly linked to the world of work and the need to shore it up as a central tenet underlying the construction of citizenship. Luis Enrique Alonso (2007) has brought this aspect to light. It was an era marked by a vision or construction of citizenship linked to the 'Fordist working life model' (Alonso, 2007, p. 69). Citizen status was linked and developed mainly through a professional career (work) that was stable, continuous, full-time and of indefinite duration. Labour was the driver behind the construction of social regulation that brought widespread forms of property and social resources (unemployment, health and education services) that at the same time had redistributive effects. This life cycle, despite the fact that it began to enter into a crisis at the end of the 1970s (Castel, 2002), was almost exclusively organised through labour market inclusion. The central point of reference was work, which became the primordial 'factor of identity and social recognition: it was the great integrator' (Alonso, 2007, p. 72). The state therefore had to bolster the construction of citizenship by maintaining labour cycles, an aspect that was directly related to the development of the social state in Spain. For this reason, the state-as-protector was configured as a concept alongside the world of work in the textbooks of the last years of the Franco regime. In other words, the legitimate concept, or predominant discourse, on the construction of citizenship was rooted in the need to control the excesses of the liberal economic model. Employing an array of different arguments, the school textbooks recognised that a capitalism controlled by the state was the essential driver of economic development and social cohesion, and the leveller of social inequalities.

On the other hand, the concept of the state in these textbooks was also reinforced by factors of another nature. We refer here to the influence that state

theory – reformist or social – had on the academic field of social sciences after World War II (Jessop, 2016). These theories focused on demonstrating that state intervention in the economy was necessary to solve the problem of free competition. From this vantage point, the conflicts between capital and labour could only be overcome through a series of measures designed to remedy classical economic individualism that tied in directly with the creation of Fordist labour models, and state intervention that resulted in the growth of unemployment, sickness and pension benefits. It is true that during these years certain theorists advocated models that were less interventionist in the economic sphere (ESping-Andersen, 1996). It was also the case that theorists of a more Marxist persuasion criticised the state intervention model because it generated policies that resulted in the creation of bourgeois state capitalism (Alonso, 2007). However, the important thing to note about these studies is that they all started from the same premise. Classical liberal capitalism created situations of inequality that individuals could not solve by their own means. This was also true of Spain. Indeed, during these years, Marxist debates about the role of the state in the protection of workers and the redistribution of wealth were widely known through the translations of works by, inter alia, Ralph Miliband (1971), Nicos Poulantzas (1973) and Louis Althusser (1974).

However, the concept of the state contained in the textbooks of this study does not only originate in the construction of the rights of social citizenship within the domain of labour. This intervention framework was also promoted in other institutional areas. In 1944, the Franco regime developed the first policy of 'social justice in the field of education' through the creation of the School Protection Law.[15] With this law, the dictatorship sought to construct a positive rights model that compensated for the obstacles that prevented individuals from developing a harmonious social life. It was a law that was not 'merely a charitable gesture, but a duty of the state and a social obligation'.[16] Within this conception, from the 1950s onwards the principle of 'equality of opportunities' continued to grow and was regularly revisited in Francoist educational legislation. In 1958, Feliciano Lorenzo Gelices, one of the leading officials at the School Protection Commission of the Ministry of National Education (MEN), theorised about the new policy of 'equal opportunities for families with low incomes' (Lorenzo Gelices, 1958, p. 63).

This type of policy was, in fact, in keeping with the recommendations made to Spain during those same years by the Organisation for Economic Cooperation and Development (OECD), regarding the need to develop education as a strategic pillar of 'economic and social growth'. These recommendations included the need to set up 'a progressive tax mechanism' to bring about a 'quantitative and qualitative' improvement in education (OECD, 1965, p. 117). Thus, the dictatorship accepted and converged with modernisation theory, which saw the education system as one of the fundamental institutions for economic growth and modernisation of the country.

Within the concept of the state expounded by the textbooks of the Spanish transition, a range of factors therefore appeared that may help us to understand its

configuration. Facts such as the curriculum policy set down by the MEC, the persistence and dominance of the Fordist labour model, a theory of the state that focused on the different models of intervention and control of free competition, and the influence of international organisations and modernisation theory are significant factors or ingredients of the process. However, the main reason behind the use of this concept of the state in textbooks is the very notion or idea of society as interpreted by the dictatorship. It was an approach that, as Miguel Ángel Cabrera (2019) has pointed out, has its origins in the beginnings of the social reforms in Spain in the period comprising the end of the nineteenth century and the beginning of the twentieth. The dictatorship developed a series of values known as National Catholicism. However, this was not the conceptual pillar on which the educational model was built from the 1950s onwards. The education system was underpinned by a school of thought according to which the individual was mediated by social elements. For this reason, National Catholic values were deployed in parallel to a state model framed within the principle that individuals are not entities that develop in the abstract. Both approaches were not incompatible with each other. To understand why school textbooks represented the state in a certain way, we must understand that the Franco regime operated under a rationale or an understanding of the state that was of its time and context.

In fact, just after the end of the dictatorship an important aspect emerged in relation to the conception of the state that Western societies settled on: those policies related to what has become known as the neoliberal offensive or the 'new spirit of capitalism' (Boltanski and Chiapello, 2005). This aspect helps us to understand why school textbooks during the democracy ventured more and more into a space in which the individual began once again to be the master of his or her fate within the social division of labour. It is well known that during the political transition the Spanish Socialist Workers Party (PSOE), at its 28th General Congress, abandoned its Marxist leanings as a way of confronting problems related to social inequality (Tezanos, 1985). When it came to power in 1982, the PSOE had already adopted a neoliberal approach to economic policy. The extent to which the PSOE adopted this new vision of the state is demonstrated to us by the fact that it was studied in the European context as the ideal type of social democratic party that had shifted openly towards these economic policies (Share, 1988).

This conceptual change began therefore to give new meaning to the lack of individual freedom and the de facto equality of social subjects that was curtailed by excessive state intervention. To a certain extent, institutions were seen as generators of processes of unequal socialisation and of social control. Schools were one such institution. This fact helps us to understand, to an extent, how factors of this nature brought about a transformation in the contents of school textbooks that examined the concept of the state during democracy. For this reason, inequalities in these textbooks no longer came from the social division of labour ascribed to class inequality. This reality is not even mentioned in the school curricula. Other social

subjects such as inequality of race, gender or identity began to be the points of reference upon which social sciences in schools were taught (Authors Reference).

5. Conclusions

The concept of the state found in the textbooks of the Spanish transition was subject to a series of unquestioned elements. For these textbooks, the state had to broadly intervene in the economic model. Despite putting forward certain idealistic notions such as the work community or the common good, the fact is that they considered that the excesses of liberal capitalism, born of the nineteenth and twentieth centuries, had to be controlled by the state in some way. For this reason, they gave the utmost importance to social protection, social classes, trade unions and actions aimed at ensuring that it did not have to be individuals alone who faced up to social risks. Karl Marx, the policies of redistribution, social security, alienation, and unemployment constantly appeared in their pages. This was the concept that underpinned them.

However, during the beginnings of democracy this perspective began to change. Labour disappeared as a central point of reference for the contents of school textbooks. It appeared in isolation as a formal fact ascribed to the constitution. The social classes, the social division of labour and everything related to a Fordist workspace began to disappear. The theoretical framework within which the state had been viewed began to fade during the first years of democracy. The individual took up the torch as a lone entity that had to solve his or her own economic problems. The state, rather than protect, had to guarantee the right conditions so that personal initiative would not be curtailed.

It is not easy to explain this type of transformation for several reasons. The first has to do with the way of looking at education during the Franco dictatorship. In many cases, it has been assumed that the ideology of National Catholicism was the substantial and unifying element of educational policy during this era. However, a closer look at the education of the Franco regime leads to a far more complex reading of this reality. Equal opportunity policies were first developed during the early years of the Franco regime. The state was entrusted with curbing the inequalities that the liberal social model had produced. Moreover, in the 1950s the dictatorship subscribed to modernisation theories and the recommendations of international organisations. Certainly, all these factors are important to understand why the school textbooks propounded a protectionist vision of the state. However, the ultimate reason as to why these textbooks expounded such ideas is found in the underlying view of social inequality and the position occupied by individuals in the social sphere. In essence, the economic model of state that underpinned the Franco regime operated under the same logic as other state models of its time.

Altogether, this helps us to appreciate how textbooks are cultural, political, economic and even conceptual manifestations. Ultimately, if they want to reach their target audience, they have to take up and develop the same ideas that have

been expressed with far greater force and legitimacy in other fields. For this reason, they are complex artefacts shaped by the wide-ranging social and conceptual context in which they are written.

6. Disclosure Statement

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8. Notes

1 See, for example, the works of Bromley and Lerch (2018) and Roldán Vera and Fuchs (2018).

2 The literature on Franco era textbook analysis is very broad. We will only give a few examples of the most recent works, such as García Fernández (2017) or Mahamud Angulo (2016).

3 There are some publications that present exceptions. See Mahamud Angulo *et al*. (2016) or González-Delgado and Ferraz Lorenzo (2018).

4 This same process can be seen in other dictatorships in southern Europe, such as Portugal or Greece. See for example Foukas (2018), Estrela (2019) or Alves and Lima (2018).

5 Modernisation theory was a scientific and ideological tool used by the US to channel the processes of development and decolonisation that began to take place after the Second World War. This theory was based on a range of concepts that dominated much of American social sciences and impregnated its foreign policy. A broader development of this paradigm can be seen in Gilman (2007) and Martín García (2015).

6 In the *General Education Act* of 1970 primary education was called Basic General Education (EGB). This was organised in eight grades with three stages: first stage: 1st and 2nd grades; second stage: 3rd, 4th and 5th grades; third stage: 6th, 7th and 8th grades. The concept of state and its role in the economic context began to appear in the sixth grade, when the third stage began. For this reason, this research focuses on the 6th, 7th and 8th grades of EGB. This primary education structure would last in Spain until 1990, when a new educational law was introduced: The *Organic Law on the General Organisation of the Education System* (LOGSE). See Groves (2014, pp. 20–53).

7 See Valls (2007), Evans (2011) and Woyshner and Bohan (2012).

8 See Steedman (2001), and McCulloch (2004).

9 See González Clouté *et al*. (2016), Mahamud Angulo *et al*. (2016) and Badanelli (2012).

10 The concept of alienation is explored in Abad Caja *et al*. (1979b), Cases Méndez *et al*. (1978), Pavón Espiga *et al*. (1978) and Ramos *et al*. (1977b).

11 Similar arguments may also be seen in Colomer Viadel *et al*. (1979) and Pavón Espiga *et al*. (1978).

12 Other textbooks use similar arguments: Equipo Aula 3 (1983), Ramos *et al*. (1983) and Ramos *et al*. (1984b).

[13] During the dictatorship and the transition in Spain, the educational system was centralised: the MEC made decisions regarding the syllabus. In 1981 a process of educational decentralisation began with the *Programas Renovados de EGB* (Renewed Programmes of EGB) (1981). The *Comunidades Autónomas* (Regions) could introduce local content to the curriculum. With the 1990 LOGSE Act, educational decentralisation expanded to its present extent, and a new governance began to develop. See Verger and Pagès (2018).

[14] Ministerial Order extending the Ministerial Order of 29 November 1976, which established new contents in the teaching guidelines for the social sciences in the second stage of Basic General Education, BOE (Official State Gazette) of 3 December 1976, No. 290 and BOE of 29 July 1977, No.180 .

[15] Law of 19 July 1944 (BOE 21/07/1944).

[16] Ibid., p. 5555.

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Correspondence
Mariano González-Delgado
Department, of History and Philosophy of Science, Education, and Language
Universidad de La Laguna
Avda. La Trinidad s/n, Módulo B, La Laguna
Santa Cruz de Tenerife 38204 Spain
Email: mgondel@ull.edu.es

9.3. Article 3

Information and Communication Technologies in the Curriculum Policies, a Critical Analysis

Cristian Machado-Trujillo and
Mariano González-Delgado
Department of History and Philosophy of Science, Education, and Language, Universidad de La Laguna, La Laguna, Spain

Introduction

This entry focuses on developing a brief critical exploration of the introduction and development of the use of information and communication technologies (ICT) within the educational curriculum. In recent years, the use of ICT as a tool to produce processes of innovation, improvement, and modernization of school systems has become one of the most powerful discourses when creating new educational policies throughout the world. Both locally and supranationally, ICT have occupied a prominent place in the educational agendas of different nations and international organizations: OECD, UNESCO, World Bank, or the EU. With the aim of improving students' learning processes or linking education systems more directly with economic growth, ICT have been modifying teaching-learning methodologies and knowledge in curriculum policies worldwide. To a certain extent, the use of ICT has increasingly linked curriculum models with the new neoliberal governance in state education. In this entry, we will analyze the nature and development of ICT in education. We will begin by indicating its historical background. Then, we will continue with an analysis of the most current trends. From here, we will present the main criticisms that the use of ICT have raised in classrooms and observe to what extent these technologies have led to an improvement in education. The entry concludes with the exposition of some of the main weaknesses of the use of this type of methodologies in education and what effects they really seem to produce.

Historical Background

Since the use of ICT began to become popular in the early 1960s, their use in educational systems as a methodological tool for school improvement has become one of the most powerful and least contested educational theories. This is because their origin lies within two arguments that, today, are configured as central to collective imaginations: ICT can produce improvement and innovation in schools and help to strengthen the links between education and job creation. To a certain extent, the success of the introduction of ICT in schools is related to the theories of human capital and their union with the modernization theory. On many occasions, it has been pointed out that one of the ways in which developing countries can

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achieve better levels of wealth is through investment in education, but not any type of investment. To produce this growth in a more effective and efficient way, it is necessary to use tools that promote the acquisition of knowledge in an attractive and fast way for students. ICT have become these tools. However, the development of ICT programs has not been immune to criticism. First of all, one could question the explanation that ICT use in schools is related to economic growth. On many occasions, it has been pointed out whether or not it is desirable for schools to make efforts to try to achieve economic objectives. In addition, it has been questioned whether ICT use effectively generates an improvement in the acquisition of knowledge.

The modern roots of the use of ICT in schools are usually located on three parallel fronts: the popularization of Daniel Lerner's thesis (1958) on the modernization theory and the use of mass media as a key factor in achieving economic development; the work of Wilburn Schramm (1964) on the central role that mass media has in the development of countries through their implementation in education systems; and the credence and political direction that UNESCO gave to these ideas as key factors for social transformation and the generalization of Western values within the context of the Cold War. We must not lose sight of the fact that it was in the USA that Educational Television programs first began to be developed just after World War II. The purpose was to improve teaching and learning processes and modernize the country to win the race for global geopolitical control against the USSR.

Essentially, UNESCO, under the leadership of the works of Schramm and Lerner, began to popularize a series of arguments about development and education. The most effective way to get developing countries to create a modern economy was through the use of mass media within the education system. This was due to two fundamental issues. On the one hand, the acquisition of skills of the population for the world of work was an essential element in the search for development. The fastest way to acquire these skills was with the introduction of ICT in the classroom. It was assumed that mass media had the ability to make knowledge be acquired more quickly and efficiently. Therefore, the use of ICT in schools would create more qualified workers. In short, better human capital that, in turn, would produce greater economic development. On the other hand, the popularization of ICT in schools was also related to infrastructural problems. In order to get countries to acquire greater economic modernization, it was necessary to educate millions of children. Thousands of schools had to be created all over the world and, more importantly, hundreds of thousands of teachers needed to be trained in the transmission of knowledge, and ICT could pave that way. Television, radio, or teaching machines could help reduce the costs of such an endeavor, as well as accelerate students' learning processes.

In this way, in the different meetings that UNESCO organized in Bangkok, Thailand, Santiago de Chile, and Paris between 1960 and 1962, it urged developing countries to create this type of program (McAnany 2012). Such educational policy proposals soon began to be put into practice. Countries such as Italy, Spain, El Salvador, Mexico, Colombia, Niger, Japan, or American Samoa created curriculum policies in which the use of TV or educational radio occupied an important part of their educational systems (Schramm et al. 1967). However, problems concerning their use began to appear soon. Did ICT work to increase the wealth of countries and improve the acquisition of knowledge in students? The academics themselves who managed the implementation of these curricular reforms with UNESCO soon observed the complexity of producing processes of development and change within education systems (Mayo et al. 1976). These authors observed that economic development could depend on other completely different variables (economic investment, structure of labor markets, or redistribution of wealth) to the introduction of changes in education systems. This fact would be endorsed later by Robert Arnove (1975). This author analyzed such programs and indicated that "school dropout," "disadvantaged population," or "urban unemployed" (p. 145) were still realities in these countries. The key, therefore, was not in the use of ICT per se. They did not have the capacity to

modify the educational and economic reality of a country. The success or failure of these curricular models had to do with their previous political objectives. Unless countries systematically pursue models of educational and social equality with their public policies, injustice will continue (Carnoy 1975).

Moreover, the development of this type of curriculum policies did not take into account the complexity of the school organizations themselves. To a certain extent, UNESCO treated schools as if they were black boxes. In different studies on the use of ICT in schools, Larry Cuban (1986) indicated that these programs had barely been implemented in the USA or in other countries. The problem was that school organizations were rife with different educational ideologies, there were conflicts, teachers had different goals, or communities could put pressure to start or not certain programs. In short, the "grammar of schooling" had not been taken into account when analyzing the implementation of these programs. Despite this, the use of ICT continued to proliferate as one of the major educational policies to be developed by international organizations and national states. This was an aspect that would increase with the arrival of personal computers (PCs) in the late 1970s. At first, they were called microcomputers due to the significant reduction they underwent in size and cost. This evolution of the tool opened the possibility that for the first time their educational applications were seriously considered, and that there really was space in classrooms and they were affordable both for schools and for families to acquire one for their homes. This point was not lost on the large companies that saw in them an infinite niche market.

As a result of this, the decade of the 1980s was a technological boom in education systems, there were many state programs throughout the world (including in developing countries) that promoted the provision of computers, the training of teachers, and the creation of educational software (often sponsored by large computer companies that initially made large donations to promote these programs). We can place some of the first initiatives in the UK, USA, Canada, or Sweden. However, it was in the 1980s and 1990s that Educational Technology policymaking as a global trend would be conformed, and as a fundamental part of the agendas of the state educational policies of many countries. To name a few of them, in the UK we can highlight "Micros in Schools" (1981) as the first initiative that was transformed into the "Microelectronics in Education Program" and "New Technology for Better Schools Program." In the USA, we can find several initiatives from the beginning of the 1980s, but it was with the "US National Information Infrastructure" developed in the 1990s when state commitment to ICT was firmly established. Also noteworthy is the case of Japan, which from the 1950s had been developing aspects related to computer literacy in different subjects until the "90s Japanese Information Infrastructure" was established in the 1990s. In Latin America, we can highlight the case of Chile with the development of the "Enlaces" program in the same decade, and many other initiatives that took place all over the world. Programs that have developed differently depending on the innovations and technological transformations that have taken place in computer science since then.

Information and Communication Technologies and the Current Debate

If we look at the history of the introduction of ICT in the education system from its beginnings to the present, we can observe that it has developed in the form of "cycles of hype, hope, and disappointment" (Selwyn et al. 2018, p. 8). That is, each innovation, software, and/or new application has been attributed, in an optimistic way, the ability to transform educational models, improve standards, or, in short, has been granted the status of being the panacea that can solve all educational problems. Quickly, however, that hope is frustrated by the scarce impact that this innovation produces when encountering educational reality or because another technology or application has appeared that once again generates unconfirmed expectations. These cycles have been uninterruptedly linked up to the present day, depending on the

appearance of this or that technological innovation. In the same way, we find that from different sectors, there has been a clear interest to legitimize ICT practices, one of the fundamental arguments being the optimization that they produce in the teaching and learning processes, and, especially, their incidence in the improvement of student performance. The latter also attends to the institutional desire to obtain better results in the large international comparative evaluations that organizations such as the OECD carry out, and to which the quality of state of education has been attributed. Moreover, we can find in the literature today huge numbers of studies, reports, and endless concrete experiences of the application of ICT in specific curricular programs, trying to demonstrate the benefits of its use. This is well explained by Selwyn, Nemorin, Bulfin, and Johnson, who indicate that: "industry-based companies have diligently produced reports and evaluations to convince us that everything is indeed awesome" (2018, p. 8).

Specifically, if we look at one of the last major evaluations of the penetration of ICT in education, prepared by the OECD in 2015, the results on the impact of ICT on students' marks are quite diffuse. There is no significant evidence to show the positive incidence of ICT, but the report does show that abusive use has a negative impact. It also emphasizes that ICT do not lead to a greater democratization of the educational systems, and they are not serving to reduce the gaps between students (an aspect that was also part of the technological promise). Therefore, the report concludes that it is difficult to isolate the role of ICT in improving performance in the complex world of education, but what is clear is that "we have not yet become good enough at the kind of pedagogies that make the most of technology; that adding 21st-century technologies to 20th-century teaching practices will just dilute the effectiveness of teaching" (2015, p. 3). These results do not have to be interpreted from a pessimistic perspective, but they bring to light that the technological promise is far from being fulfilled in the daily life of schools. There is still a long way to go to take advantage of the potential offered by these tools, both in terms of optimizing teaching and learning processes, and in the field of democratization of educational systems, highlighting that though there has been no pedagogical rethinking about using ICT in education, other criteria of a technical and/or economic nature have prevailed.

Given this scenario, the fundamental issue we observe about the debate on ICT is that technological innovations are not the result of an isolated process, but have to do with a certain state of knowledge, and with the industrial and economic, institutional, and political environment. As pointed out earlier, ICT tools have little power to transform the curriculum or teaching and learning processes if we do not ask the right questions of educational policy and if we are not promoting a pedagogy that promotes greater equity. Therefore, following some of the reflections that M. Apple was already making in 1991 about ICT in education, we should begin to ask ourselves some questions about all this technological progress (or progressivity depending on how you look at it): "Whose idea of progress? Progress for what? And fundamentally, who benefits?" (p. 59). These questions can broaden our view of other types of interests involved, and, in this sense, ICT fit well with neoliberal and market dynamics. Apple continues to affirm we cannot understand ICT as a mere network of machines, but rather they "involve ways of thinking that under current educational conditions are primarily technical" (p. 75). Therefore, it would be a mistake to try merely to provide technological solutions to educational problems, which are so complex, in addition to subordinating the debates on policies and interests to the application of an agenda of adaptation to technological change.

We cannot deny the benefits, and the need to move forward according to a reality increasingly focused on ICT. However, this should not mean taking a naive approach that does not contemplate the different agents and interests involved in this phenomenon, and that transcend education. It is important to understand that the processes of school change in general and curricular construction in particular, require a broader perspective than just technical. Reducing the responses to this spectrum also means encouraging the rise of uncritical dynamics, so "the poor quality of debate

surrounding schools and digital technology (characterized by hyperbole, misinformation, and unfounded optimism) must be challenged" (Selwyn et al. 2018, p. 186). This would mean avoiding processes of instrumentalization and subordination of education to the interests of large technological industries and transnational organizations, which are governed more by criteria of economic efficiency and where the pedagogical is often relegated to the background.

Cross-References

- Educational Innovation as Ideology
- Mirages of Educational Innovation on the School Transformation
- Pedagogical Innovations, Roots and Flowers

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9.4. Article 4

El boom tecnológico en las escuelas de los años 80: una aproximación al programa ATENEA español[1]

The Technological Boom in Schools in the 80s: an Approximation to the Spanish ATENEA Programme

Cristian Machado Trujillo
email: cmachado@ull.edu.es
Universidad de La Laguna. España

Resumen: Objetivos: Este trabajo pretende hacer un análisis de los debates en relación con la integración de las Tecnologías de la Información y la Comunicación (TIC) en el Sistema Educativo Español, en concreto de los antecedentes y el desarrollo del primer programa experimental de carácter estatal, el proyecto Atenea (1985-1992). Metodología y fuentes: Para ello se ha hecho una revisión documental del programa y sus evaluaciones, atendiendo también a los debates que generó. Documentos que hemos complementado con informes y evaluaciones sobre programas afines, y cuyas conclusiones hemos analizado comparativamente con algunos de los informes contemporáneos, como el realizado por la OCDE (2015). Conclusiones: algunos de los debates fundamentales que se originaron a raíz de estos programas que fomentaban el uso de ordenadores, y, en concreto, con el análisis realizado del programa Atenea, son de llamativa vigencia y siguen sin tener una respuesta clara. En el caso del fomento de las TIC como herramientas educativas, debemos reconocer la relevancia de intereses corporativos y empresariales que vieron en el Sistema Educativo un gran mercado, por lo que fomentaron este tipo de programas, favoreciendo una aplicación centrada más en el plano instrumental que en el pedagógico.

Palabras clave: Historia de la educación; política educativa; currículum; innovación educativa; tecnología educativa.

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Abstract: Aims: This paper aims to analyse the debate concerning the incorporation of Information and Communication Technologies (ICT) by the Spanish Educational System, specifically the background and development of the first state-sponsored experimental programme, the Atenea project (1985-1992). Methodology and sources: To this end, we performed a review of documents pertaining to the programme and its evaluation, also taking into account the debates it generated. These documents were supplemented by reports and evaluations on related programmes, the conclusions of which we analyse in comparison with some of the contemporary reports, such as the one published by the OECD in 2015. Conclusions: Some of the fundamental debates that arose as a result of these programmes promoting the use of computers, in particular the Atenea, are strikingly valid but still lack a clear response. In the case of the promotion of ICT as an educational tool, we must recognize the relevance of corporate and business interests that saw the Education System as a large market, and therefore encouraged this type of programme, favouring an application focused more on the instrumental level than on the pedagogical one.

Keywords: Educational history; educational policy; curriculum; educational innovation; educational technology.

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1. Introducción

En este trabajo hemos planteado como objetivo principal hacer un análisis de los discursos políticos, la legislación educativa y cómo fue el proceso de introducción de Tecnologías de la Información y la Comunicación (TIC) en el Sistema Educativo Español, centrando el debate en la década de los ochenta, puesto que en ella aparecen programas como Atenea, que suponen la primera apuesta fuerte por el uso de ordenadores en las aulas en nuestro país. En la mencionada década, desde el Ministerio de Educación y Ciencia (MEC), y de diferentes Consejerías Autonómicas, empiezan a desarrollarse proyectos pioneros en nuestro país para dotar de equipos informáticos a los centros e integrar en el currículum medios audiovisuales. Estas políticas son el germen de la introducción de las TIC como herramientas educativas y vienen auspiciadas por el auge de políticas afines en diferentes países, así como por la promoción del uso de las TIC por parte de organismos como la Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura (UNESCO), y por los intereses de grandes multinacionales del mundo informático.

Países como Estados Unidos, Japón, Francia, Reino Unido, Alemania y otros, comienzan a desarrollar programas de dotación de equipos informáticos y medios audiovisuales a las escuelas desde la década de los setenta. En España, es a partir de la segunda mitad de los ochenta cuando surgen los programas experimentales Atenea (cuyo objetivo fundamental era la dotación de equipos informáticos), y Mercurio, referido a la incursión de medios audiovisuales en el currículum. Estos programas se desarrollaron en las once Comunidades dependientes del MEC bajo el eslogan «España no puede perder el tren de la revolución educativa» (Bustillo, 2000, p. 472). A la par, las seis Comunidades Autónomas restantes (que gozaban de responsabilidades educativas) implantaron proyectos propios que siguieron la línea de Atenea. En concreto, el Plan Zahara en Andalucía, el Proyecto Ábaco en Canarias, el Programa de Informática Educativa en Cataluña, los proyectos Abrente y Estrella en Galicia, el Plan Vasco de Informática Educativa, y en Valencia el Programa Informática a l´Ensenyament (Area, 2006).

Toda esta tendencia, y los diferentes programas creados, hicieron también necesaria una remodelación de la estructura administrativa para tutelar y coordinar los proyectos existentes, así como impulsar otros nuevos. Se entiende que el uso de las TIC es un factor fundamental que puede mejorar la calidad de la enseñanza, abriendo nuevas posibilidades para la innovación y para desarrollar nuevas estrategias de enseñanza y aprendizaje. Aunque ya existía una Comisión de Medios Audiovisuales creada a través de la Orden de 28 de abril de 1980, desde 1987 comenzó a gestarse una nueva comisión, que tomó forma en 1989 (Orden de 7 de noviembre de 1989), denominándose Programa de Nuevas Tecnologías de la Información y la Comunicación Aplicadas a la Educación (PNTIC) y dependiente de la Secretaría de Estado de Educación. El objeto fundamental del PNTIC era «proponer la creación de infraestructuras estables, que garanticen la continuidad y el avance de los procesos de formación, junto con el desarrollo de materiales que permitan su correcta extensión en íntima conexión con la proyectada Reforma del Sistema Educativo» (Orden de 7 de noviembre, 1989, p. 36223), refiriéndose esto último a la Ley General de Ordenación del Sistema Educativo (LOGSE) de 1990. Asume entonces tanto Atenea como Mercurio, y empieza a trabajar en propuestas que se desarrollarían entrada la década de los años 90, ramificándose el PNTIC en dos vertientes: medios informáticos y medios audiovisuales.

Antes de entrar de lleno en el análisis de cómo se implementaron estos programas y mostrar algunos de los debates fundamentales que generaron (y que siguen siendo de actualidad), es interesante mencionar los antecedentes a estas políticas de integración de las TIC en nuestro país, así como las estrategias por las cuales estos nuevos programas que aparecieron en los ochenta se desmarcaron de anteriores intentos de incluir el mundo informático en las aulas.

2. La llegada del ordenador a la escuela: debates y primeras propuestas entre los años 50 y 70

En la década de los 50 y 60 fue bastante popular la Enseñanza Programada (EP), la Enseñanza Asistida por Ordenador (EAO) y demás propuestas en esta línea a nivel internacional. Estos modelos partían del soporte teórico conductista y las aportaciones de B.F. Skinner (1970), especialmente tenían que ver con programas que respondían al esquema de estímulo y respuesta del Condicionamiento Clásico, que fueron la base de las actividades de *drill and practice* que fomentaron las máquinas de enseñar y posteriormente los primeros ordenadores. Se entendía, por tanto, que estas fórmulas de enseñanza eran más eficientes, puesto que permitían personalizar la educación en mayor grado, así como reducir costes y suplir la función del profesorado en muchos casos. J. Delval cuestionaba lo que muchos expertos comenzaron a anunciar en los sesenta, acerca de que en poco tiempo la figura del docente sería reemplazada pues «la máquina sería más barata con el tiempo, no se enfada con el niño, reacciona inmediatamente a una respuesta correcta u errónea, proporciona una enseñanza adaptada a cada alumno y a su ritmo de progresión, etc.» (1985, p. 30).

Por otro lado, grandes organismos como la UNESCO fueron los promotores de estos programas, que prometían la mejora de la eficiencia de los procesos de enseñanza y aprendizaje, y la optimización de los recursos económicos. Especialmente estaban dedicados a la alfabetización, e incluso se desarrollaron en multitud de países en vías de desarrollo. La UNESCO se propuso también la alfabetización digital, justificando la utilización de las llamadas «máquinas de enseñar», y ofertando la enseñanza programada como instrumento eficaz para la resolución de los grandes problemas educativos y sociales, como el analfabetismo y la mejora de la productividad del alumnado para elevar el desarrollo económico (González y Groves, 2017).

Este soporte conductista, que auspició todo tipo de programas de EAO, fue bastante discutido, siendo numerosas las críticas y las dificultades estructurales que se encontraron en la aplicación de estos programas, por lo que estas propuestas de corte desarrollista fueron menguando con cierta celeridad hasta desaparecer en la década de los 70 (véase Ferster, 2014 para mayor detalle). Por tanto, se repetía con los ordenadores el esquema conductista que sustentaba las máquinas de enseñar que aparecieron desde los años cincuenta y que nunca llegaron a consolidarse. El nobel de Economía Herbert A. Simon, en un congreso celebrado en Pittsburg en noviembre de 1982, llegó a declarar que, «gran parte de las CAI (computer aided-instruction, correspondiendo a las siglas EAO en castellano) encaja con la descripción del carro sin caballos. Nos hemos limitado a coger toda suerte de cosas que hacíamos con los niños y a meterlas en el ordenador» (1985, p. 15-16). Mostraba cierto escepticismo ante esta instrucción conductista, resaltando que con ello no se habían conseguido grandes innovaciones, sino que se seguía haciendo lo mismo, pero con otro instrumento, generando así elevadas cotas de desgaste en los docentes (que además no habían tenido las motivaciones y reconocimientos adecuados), e incluso pecando de no usar todo el potencial de los ordenadores.

En la propia Psicología, el Conductismo fue relevado por la nueva Psicología Cognitiva, que ahondaba más en los procesos que en la fórmula observable de estímulo y respuesta, y que fomentaban una enseñanza *paidocéntrica*, por lo que quedaban deslegitimados los programas de enseñanza por ordenador que se basaban en cánones conductistas. Por tanto, al fracaso en los resultados de los programas de EAO, al escepticismo ante estas propuestas de enseñanza, a las críticas acerca de su desconexión con la realidad del currículum, a la escasez de hardware en los centros y de software educativo, se sumó este desarrollo en la Psicología que daba un salto desde el modelo conductista, y que demandaba ahora otro tipo de actuaciones más centradas en el proceso.

El nuevo soporte teórico y la aparición de los microordenadores durante los años setenta, mucho más asequibles en coste y dimensiones (de ahí que en un inicio se les añadiese el prefijo «micro») frente a los aparatosos y costosos ordenadores que hasta ahora se venían usando en las escuelas, supuso un nuevo repunte exponencial de programas educativos a finales de los setenta y, especialmente, en la década de los ochenta. Los centros fueron adquiriendo microordenadores incluso antes de tener una estructura y soporte que les permitiese integrarlos en el currículum, esto es, software educativo suficiente y relacionado con los contenidos curriculares, y un cuerpo docente formado no solo instrumental sino pedagógicamente.

En Estados Unidos, uno de los países pioneros en este sentido, y, además, uno de los principales productores informáticos, en 1981 había 33.000 microordenadores en las escuelas públicas y en el año 84 la cifra había ascendido a 630.000, estando presentes en casi el 60% de las escuelas (Delval, 1985). En 1985, el Center for Social Organization for Schools de la Universidad John Hopkins presentó los resultados de la primera encuesta nacional (realizada en 1983) sobre el uso de los ordenadores en las escuelas. El estudio reflejó en detalle cómo las escuelas primarias y secundarias dotaron sobremanera de ordenadores sus centros, pero acudiendo al detalle, el tiempo que se usaban era bastante escaso y el para qué se usaban también era bastante cuestionable. El estudio reveló como, en el mejor de los casos, se usaron en los centros de dos a tres horas al día, un máximo de 13 horas a la semana, y que el alumnado estaba poco en contacto con ellos (una media de 23 minutos a la semana para el alumnado de primaria, y de 45 minutos para los de secundaria). También es interesante cómo destacaron que los usos más frecuentes no se referían a grandes innovaciones curriculares, sino fundamentalmente a actividades de alfabetización digital básica, realización de algunas simulaciones, y como herramientas para generar otro tipo de espacios de carácter lúdico (Becker, 1985). Esto es, el uso instrumental de la herramienta, un énfasis de lo técnico frente a lo pedagógico y la innovación educativa (Ballesta, 1993). Una lectura del estado de la cuestión interesante es la que nos aporta el profesor ya emérito de la Universidad de Standford L. Cuban (2001) en su texto *Oversold and Underused*, en el que debate acerca del auge por el reformismo y en la que se cuestiona si la inversión realizada en las escuelas en materia de adquirir y desarrollar tecnologías educativas en torno a los ordenadores ha valido la pena viendo los resultados y los usos que se hacían en lo cotidiano de las aulas.

Es importante observar no solo los resultados educativos de estas primeras intervenciones, sino cómo su desarrollo y expansión estuvieron fuertemente mediados por la industria informática. Empresas como Apple se dedicaron a hacer grandes donaciones a escuelas en Estados Unidos para que hicieran programas experimentales e ir contagiando a otros centros a subirse al carro de estas nuevas experiencias, prometiendo mejoras en los resultados y que dotaban de buena prensa a los centros en los que se iban realizando. Dentro de esta estrategia mercantil, Apple usó las escuelas para llevar sus productos a los hogares, haciendo ver a las familias que los ordenadores serían indispensables en el futuro próximo de sus hijas e hijas, creando un cierto temor a través de diferentes estrategias publicitarias para que padres y madres compraran para sus casas los mismos ordenadores que se usaban en las escuelas (Delval, 1985). Para ello, tanto Apple, como Commodore e IBM empezaron a generar publicidad específica en la que aparecían niños y niñas en sus hogares alrededor de los ordenadores utilizando algún software educativo entre otras estrategias (o la famosa campaña de Apple de los años 80 elaborada por M. Groening en la que aparece un estudiante con la mesa llena de trabajo y la pregunta: *Who needs a computer anyway?*). Ya desde 1978 el informe elaborado por S. Nora y A. Minc titulado *La informatización de la sociedad,* vaticinaba con rotundidad que tras el debate sobre los ordenadores había muchos intereses y abriría nuevos espacios, exponiendo los autores que «la telemática está en el punto

neurálgico de los juegos de poder. Desplaza los equilibrios sobre los mercados competitivos y entre las colectividades públicas» (1980, p. 20).

Por tanto, una de las claves fundamentales que espoleó este tipo de programas fue la oportunidad de negocio que generaban. En Estados Unidos en 1984 se realizó un cálculo de mercado, en el que simplemente teniendo en cuenta que si los mayores 50 distritos escolares del país (unas 9.000 escuelas) compraban por término medio un ordenador para cada 170 estudiantes, cada uno con un coste medio de 500$, la demanda resultante ascendería a los 15.000 millones de dólares (Sotelo en Pfeiffer y Galván, 1985). Cifras astronómicas a pesar de que los cálculos se realizaron con una ratio que se alejaba bastante del ideal planteado de un ordenador cada 3 o 4 estudiantes.

En España, voces como la de A. Galino, ya desde mediados de la década de los sesenta miraban con recelo estos primeros modelos de Enseñanza Programada, y, aunque reconocían las posibilidades todavía no exploradas que ofrecía este nuevo aparataje tecnológico en la educación, afirmaba que «la enseñanza no es un producto elaborado por el trabajo de una máquina» (1965, p. 21). Estos programas respondían más bien a una forma de instrucción y no a una educación que permitiese una visión profunda y concreta de la realidad, no suponían una educación global sino parcial y limitada a lo que determinado software (que en el plano educativo era muy escaso) en una interfaz de preguntas y respuestas (estímulo-respuesta conductista) se relacionaba en mayor o menor medida con contenidos específicos del currículum.

Ante esto, y a la luz de los datos, J. Delval planteó tajantemente sobre el caso español y los inicios de Atenea: «¿Por qué hay tanto interés en introducir los ordenadores en las escuelas si los usos que se están haciendo son tan poco interesantes y muchas veces ni siquiera se usan?» (1985, p. 31). El propio autor respondió aludiendo a dos cuestiones. En primer término, este fenómeno tiene que ver con una nueva realidad social en la que los ordenadores se abren camino a pasos agigantados, introduciéndose en el mundo laboral y en el académico; y, en segunda instancia, porque suponen un grandísimo negocio, prácticamente inagotable.

De hecho, el propio Ministerio de Educación y Ciencia organizó unas Jornadas de Informática y Educación en las Enseñanzas Básicas y Medias celebradas en 1984 como actividad para la discusión del proyecto, en las que se expuso abiertamente que España adolecía de actividad industrial en este campo, y que Atenea podría fomentar desarrollos autóctonos que se beneficiaran de una demanda de mercado que ya existía, incitando a un desarrollo industrial que de otra forma probablemente no sucedería (Pfeiffer y Galván, 1985).

Estos antecedentes llevaron a que en España se materializara Atenea (además de los programas afines que articularon las Comunidades con competencias educativas ya mencionados), que vino a ser el primer intento serio de la mano del MEC, y cuyo mayor fruto fue dotar de herramientas tecnológicas los centros. Anteriormente, habían sido escasas las iniciativas que se habían articulado de modo voluntarista de la mano de profesorado y centros sensibles e interesados con la causa. En concreto, a inicios de los ochenta en nuestro sistema educativo se posibilitaba en bachillerato programar asignaturas de carácter optativo de Enseñanza y Actividades Técnico-profesionales, así como en la Formación Profesional de

segundo grado se incidió en la necesidad de mejorar los medios técnicos en las especialidades de Administración e introducir la especialidad de informática. También para la Enseñanza General Básica el MEC estableció concursos que, previo proyecto innovador elaborado por docentes, destinaban fondos para adquirir materiales innovadores como ordenadores (OCDE, 1991). Por tanto, hasta la aparición del programa Atenea en 1985 no encontramos una apuesta seria por los ordenadores en las escuelas, así que en adelante aportaremos detalles acerca de cómo se implementó y cuáles fueron los debates fundamentales que se generaron en torno al programa.

3. Una aproximación al Proyecto Atenea

Atenea es la primera iniciativa seria dependiente del MEC para incorporar el ordenador a la escuela, propiciando con el proyecto coetáneo Mercurio, la creación del PNTIC en 1989. Desde sus planteamientos iniciales, se planteó introducir las nuevas tecnologías en las diferentes áreas curriculares, incentivando el desarrollo de programas de innovación, dotando de equipos informáticos a los centros y generando y motivando la producción de software educativo como ejes fundamentales del mismo (MEC, 1988). La perspectiva con la que se elaboró el programa detallaba que «la introducción de nuevas tecnologías carecía de sentido si no se convertía en un aliciente para la renovación de las prácticas educativas en los centros escolares» (García, 2011, p. 154). Esto desmarcaba Atenea de programas homónimos que se estaban realizando en otros países, que se centraron más bien en crear la estructura tecnológica en los centros surtiendo de productos informáticos y enseñando a usarlos en vez de optar por un modelo de integración curricular. Elena Veiguela, secretaria técnica de Atenea y directora del PNTIC en su posterior creación, afirmó que la pretensión era introducir las Nuevas Tecnologías como medio didáctico dentro de todas las asignaturas curriculares y no de forma atomizada en el marco de una asignatura de informática (1991). Desde un inicio se entendió que su uso debía trascender al mero aprendizaje instrumental de uso de los ordenadores y estar al servicio de los procesos de enseñanza y aprendizaje de forma transversal. A pesar de que las intenciones principales eran bastante ambiciosas en comparativa con programas similares de otros países europeos, el mayor hito de Atenea fue la dotación de equipos informáticos a los centros y no lo referido a las innovaciones educativas o que se hayan introducido transversalmente en el currículum como herramientas didácticas.

Atenea se dirigió a centros de Enseñanza General Básica, Bachillerato y Formación Profesional, que debían solicitar su participación en el proyecto elaborando un proyecto pedagógico y definiendo un equipo de trabajo encargado de coordinar la experiencia en el centro. Una vez aprobado, se procedía a equipar el centro (en primera instancia de cinco microordenadores, una impresora y seis unidades de disco flexibles) y a formar al profesorado que iba a tutelar la experiencia (Orden de 19 abril, 1985). Uno de los factores fundamentales que marcaron el desarrollo del programa, como veremos en adelante, fue su carácter experimental y voluntario, por lo que solo fueron participando centros con profesorado interesado en las TIC o habituados a dinámicas de innovación educativa, siendo, además,

criterio preferente haber participado de forma previa en algún proyecto de innovación (Bustillo, 2002). El desarrollo de Atenea sucedió en dos fases, una primera que duró hasta el curso 1988-89 destinada a la difusión e incorporación al proyecto y una segunda de generalización o extensión a partir del curso 1989-90.

Para entender las dimensiones de Atenea, el proyecto supuso una inversión total de 6.663,308 millones de pesetas, de los cuales 2.684,450 fueron destinados a la compra de equipos y un total de 1.525,182 destinados a la formación del profesorado (gastos referidos tanto a cursos, materiales, viajes…). En su desarrollo hasta el año 1991, estas cifras correspondían a la dotación de 8.013 ordenadores a 1.004 centros implicados, así como a la formación de alrededor de 12.500 profesores (OCDE, 1991).

El trabajo en la práctica se articuló en torno a la figura del *monitor/a*, docentes adscritos a los recién creados Centros de Profesorado (CEPs) a tiempo completo, pero que también mantenían vinculación con los Servicios Centrales del Programa. Esta dualidad, dio como resultado que en muchas ocasiones se dieran conflictos y contradicciones en las líneas de trabajo propuestas por una y otra entidad. Estos monitores en la fase inicial del proyecto recibieron una formación más extensa tanto en informática (incluso en lo referente al mantenimiento y reparación de equipos), como acerca de las aplicaciones didácticas de los ordenadores. El objetivo de esta formación extensiva era que se convirtiesen en formadores de los equipos pedagógicos de los centros que participaban en Atenea, supervisando a su vez las actividades que se desarrollaban en los centros educativos y creando espacios para la coordinación, por lo que los monitores y monitoras se convertían en los agentes de innovación fundamentales (García, 2011).

En líneas generales, lo presentado muestra someramente la línea de trabajo y las aportaciones a nivel macro de Atenea, pero para conocer el impacto real en la dinámica de los centros y en los procesos de enseñanza y aprendizaje, es necesario ahondar en los datos de las evaluaciones que del mismo se realizaron. En primer término, se programaron dos evaluaciones internas que se encargaron a un equipo de investigadores de la Universidad de Murcia encabezado por J.M. Escudero, publicando un primer informe de progreso en 1989, y, realizando un informe final, que estaba previsto publicarse en 1991 pero que nunca vio la luz puesto que entre los Servicios Centrales y el equipo evaluador hubo fuerte divergencias. Desde el MEC no se concebía la visión tan desfavorable que aportaban los datos, y pidieron a los evaluadores matices en ellos puesto que debían entender que Atenea tenía un carácter experimental. Los argumentos expuestos desde el Ministerio aludían a que en el informe no se habían tenido en cuenta las dificultades contextuales, lo costoso que resultó movilizar a los diferentes agentes implicado, y que no se habían valorado lo suficiente los logros conseguidos (García, 2011). Estas divergencias tuvieron como resultado que las autoridades españolas encargaron un informe de resultados a la OCDE, que designó un grupo de cuatro expertos para tales fines. El equipo estuvo presidido por Henri Dieuzeide, inspector general del Ministerio de Educación Francés, acompañado por Linda Roberts, perteneciente a la Oficina de Asesoramiento Tecnológico del Congreso de los Estados Unidos; Martyn Roebuck, inspector del Departamento de Educación de Escocia; y Christine Brusselmans-Dehairs, del Laboratorio de Didáctica de la Universidad de Gante. Después de

recibir el informe, visitaron en dos ocasiones España durante el año 90, destinando la primera estancia a recoger documentación y reunirse con el equipo directivo de Atenea, y la segunda en la que visitaron y entrevistaron a coordinadores y docentes de diversas etapas en la que se estaba implementando el proyecto, a empresarios de la industria informática, y tuvieron un debate con los investigadores de Murcia (Retortillo, 1991). Todo este trabajo dio lugar a un informe que fue publicado conjuntamente por la OCDE y el MEC en 1991.

4. Evaluación del Proyecto Atenea

Después del análisis descriptivo que acabamos de realizar, y que define los objetivos y medios que planteó Atenea, es interesante revelar algunas de las conclusiones más significativas de las evaluaciones realizadas, pues aterrizan en la realidad de lo sucedido en los centros, y en el verdadero uso y percepción de las TIC por parte de los agentes que estuvieron implicados.

El Informe de Progreso que se publicó en 1989 y que elaboró el equipo encabezado por J.M. Escudero, ya reflejaba las claves acerca de los éxitos y dificultades de Atenea y que podrían ser extensibles en general a los diferentes programas de integración curricular de las TIC realizados en otros contextos (ver Pelgrum, 1992). Al ser Atenea el primer proyecto firme al efecto en España, desde los Servicios Centrales del MEC se justificaron las limitaciones de este, aludiendo a que el objeto fundamental del programa estribó en crear la estructura necesaria para posteriores intervenciones, creando el equipo humano y la estructura material en los centros (García, 2011). De la misma forma, la posterior evaluación final externa que realizó el equipo de la OCDE gravitó (aunque con determinados matices que comentaremos) sobre las mismas cuestiones que el equipo evaluador de la Universidad de Murcia, por lo que las conclusiones a las que se llegaron fueron bastante similares. La evaluación de progreso publicada por el MEC (1989), expuso claramente la cara y la cruz del proyecto de la siguiente forma:

> La valoración general que se detecta en relación con el Proyecto Atenea tiene dos caras: una, el Proyecto, en sus metas y filosofía, es muy aceptable para los profesores y monitores; otra, existen serias limitaciones en los centros y en la propia capacitación de los profesores para hacer viable la idea de la integración curricular y, en la opinión de los monitores, por lo que al diseño en sí se refiere, éste necesitaría de mayor claridad estratégica, definición práctica y estructuración (p. 25).

Por tanto, se puso de manifiesto lo loable de las intenciones de Atenea, y la buena acogida por parte de los agentes implicados (aunque es cierto que como la participación era voluntaria, los docentes que se implicaron estaban interesados en estas cuestiones y tenían una actitud favorable ante la integración de las TIC), entendiendo la dificultad de los procesos de cambio educativo y de innovación pedagógica. Sin embargo, a pesar de estas limitaciones evidentes, y las diferentes dificultades estructurales de partida del proyecto, las evaluaciones revelaron

algunas problemáticas que fueron comunes a proyectos coetáneos en otros países, e incluso a iniciativas posteriores que llegan hasta nuestros días.

En primer lugar, uno de los aspectos destacados tanto por el propio profesorado participante como por los evaluadores, fue el carácter de la formación impartida en Atenea. Las encuestas realizadas a los monitores y profesorado implicado en el proyecto reflejaron que la formación estuvo centrada más bien en la parte técnica e instrumental del trabajo con ordenadores. La parte pedagógica, referida a dotar de estrategias de integración curricular de los mismos y promover innovaciones educativas fue más bien residual (MEC, 1989). Esto supuso una barrera clara para conseguir el uso curricular de las TIC, y se debió en buena medida no solo a la necesidad prioritaria de alfabetizar digitalmente al profesorado para poder trabajar con estas herramientas, sino a que muchos monitores vieron el proyecto más como un espacio para aprender informática que como una posibilidad para la innovación pedagógica en su praxis docente (García, 2011). De igual forma F.J. Ballesta destacó que hubo «un excesivo énfasis por la preparación técnica del profesorado y una falta de sugerencias sobre las posibilidades y estrategias de integración de estas tecnologías de la información en las diferentes áreas de contenido» (1993, p. 131). Datos de las encuestas realizadas en las evaluaciones describen que, en el plano informático, aproximadamente el 50% de los participantes indicó que la formación fue adecuada, pero en el plano pedagógico casi el 65% señaló que fue escasa (MEC, 1989). Esto, en definitiva, llevó a que los actores del proyecto tuvieran un rol más técnico que de agentes de innovación educativa, por lo que cercenó en buena medida las pretensiones de Atenea de convertir las TIC en un eje transversal del currículum (pretensiones que se formularon además de forma muy elevada a la realidad educativa existente y los medios propuestos).

Otra queja destacada, y que fue un lastre para el desarrollo del proyecto, fue el escaso reconocimiento y estímulos hacia el profesorado participante. Desde el inicio, la vinculación a Atenea se planteó de forma voluntaria, pero al profesorado participante no se le facilitó la labor, ya que no se le hizo un reconocimiento de su participación en el mismo y todo el tiempo que destinaban a Atenea se realizaban en horario no lectivo (incluso las sesiones de formación a las que debían asistir). Como resultante, fue decayendo el entusiasmo de los participantes y se fueron generalizando las quejas, reclamando en los cuestionarios y entrevistas que se les realizaron en el Informe de Progreso la necesidad de que se les liberasen horas lectivas para asistir a la formación, tener un mayor reconocimiento, y la asignación de incentivos, refiriéndose con esto último a tener un mayor apoyo personal más que a cuestiones económicas (MEC, 1989). Otro factor asociado que destacó el profesorado en esta línea fue la inestabilidad de los equipos pedagógicos en los centros, pues muchas veces las actividades quedaban paralizadas por las rotaciones de profesorado, ya que no se tomó en consideración mantener en el centro a los participantes del proyecto durante el período de vigencia de Atenea para facilitar el desarrollo del programa.

Además de estos problemas que se ocasionaron en torno a la gestión de los recursos humanos del proyecto, las evaluaciones también mostraron que las innovaciones que se desarrollaron en las aulas tuvieron escaso impacto y relación con el desarrollo de contenidos curriculares, en la línea de los análisis mencionados

de L. Cuban, H. Simon y J. Delval. Las encuestas realizadas indican que se usaron los ordenadores fundamentalmente para motivar al alumnado (41%) y para desarrollar actividades prácticas (25%) fundamentalmente. Actividades de evaluación, usar los ordenadores para presentar la información o para resolver problemas no supusieron cada una ni el 5% (MEC, 1989). En la evaluación se detalla claramente que «suele darse predominio de los contenidos informáticos sobre los curriculares, de modo que los contenidos curriculares se utilizan como soporte para enseñar informática y no al revés» (MEC, 1989, p. 81). Incluso solo un 27% afirma que usar las TIC ha modificado su práctica docente, cuestión que también remarcaron los evaluadores de la OCDE, y que relacionaron también con la dependencia del proyecto al voluntarismo docente (OCDE, 1991). El propio Escudero, presentando algunos de los resultados de la evaluación final no publicada en un encuentro nacional sobre TIC en Educación celebrado en el Instituto de Ciencias de la Educación de Santander en 1992, expuso en líneas generales que el proyecto se caracterizó más por la cantidad que por la calidad, y por la aplicación de los ordenadores en áreas y niveles curriculares muy particulares más que por una práctica extensiva, siendo mayores las dificultades pedagógicas que las técnicas a la hora de adaptar el uso de estas herramientas a las necesidades de la enseñanza. Además, la evaluación externa remarcó que «los indicios sobre el desarrollo cognitivo y el progreso en el aprendizaje han sido escasos o poco concluyentes» (OCDE, 1991, p. 49), por lo que el uso de las TIC tampoco supuso mejoras en el aprendizaje del alumnado (cuestión por otra parte previsible viendo cómo fueron las prácticas en las aulas). De hecho, autores como M. Area (2006) concluyeron sobre Atenea que:

> Ni se demostró, o al menos, existió consenso sobre el hecho de que los alumnos aprendían más y mejor por el hecho de utilizar ordenadores en el aula, ni el profesorado en su conjunto, a excepción del más entusiasta, innovó sus prácticas adoptando los ordenadores como recurso habitual en su enseñanza, así como tampoco se produjo la tan esperada revolución pedagógica (p. 203).

Otro factor que las diferentes evaluaciones destacaron con relación a los usos de los ordenadores, y que es la causa en cierta medida de los datos que acabamos de presentar, fue la escasez de software educativo, y, en concreto, de programas específicos que atendieran a contenidos curriculares. Aunque se promovieron concursos para estimular a los docentes a que desarrollaran software y programas para su adaptación curricular, los esfuerzos no fueron suficientes y, en buena medida, las innovaciones curriculares se vieron estancadas por estas causas.

Con ello hemos presentado algunas de las evidencias fundamentales que marcaron el desarrollo de Atenea y que se pusieron de manifiesto en las evaluaciones realizadas al programa. Sus aportaciones fueron destacables en lo referido a dotar de recursos materiales a los centros, formar docentes e ir generando sensibilidad ante las TIC, pero su propia estructura, así como la realidad compleja con la que se topó limitaron fuertemente sus aspiraciones. Es por tanto que las prácticas con ordenadores en los centros distaron bastante del ideal planteado de ser elementos de innovación pedagógica, en gran medida porque se basó en el voluntarismo y la iniciativa particular.

5. Conclusiones: debates todavía vigentes

Desde la mitad del siglo pasado vienen sucediéndose diferentes iniciativas que intentaban integrar los ordenadores en las aulas, condicionadas por multitud de factores no solo de índole pedagógica, sino también por intereses políticos, económicos y empresariales subyacentes (Area, 2006). Muchas voces han destacado que ese ímpetu de introducir ordenadores en las escuelas ha estado más legitimado desde el plano económico que desde el pedagógico.

En España, la primera apuesta fuerte al respecto comienza con el proyecto Atenea, que tuvo su mayor efervescencia en la segunda mitad de la década de los 80. Aunque los resultados de este fueron más tangibles en lo referido a dotación de recursos materiales a los centros que en el plano de la innovación educativa y en la mejora de los procesos de enseñanza y aprendizaje, se sentaron los precedentes para iniciativas posteriores. En concreto, Ballesta (1993) recogió las siguientes impresiones de los evaluadores:

> Los logros propiamente educativos podrían haber sido mayores de haber cuidado más la idea de las nuevas tecnologías como innovaciones educativas, la formación pedagógica del profesorado, además de la más apropiadamente centrada en los medios, la mejor definición y cualificación de los asesores y coordinadores, la disponibilidad de materiales adaptadas y específicos, y, por terminar, una inserción más significativa en las coordenadas organizativas de los centros escolares (p. 128).

Obviamente las limitaciones de Atenea fueron muchas y muy diversas, más aún si comprendemos que la llegada de los ordenadores a los centros sucedió en un momento en el cual eran una tecnología que no se había extendido socialmente, que era escasa la población que tenía un ordenador en sus hogares o que lo usaba en sus labores profesionales. Los resultados sobre el impacto en los aprendizajes del alumnado y en la transformación de prácticas docentes son poco significativos, por lo que es más interesante hacernos preguntas acerca de la urgencia con la que desarrolló el programa si no existía un contexto que permitiese aprovechar tal inversión económica. Aunque en su fase exploratoria se concluyó acertadamente que los ordenadores eran la herramienta del futuro que iba a transformar todas las esferas, existía cierta sensación de que España podía quedarse atrás en una carrera tecnológica a la que se estaban sumando ya países de todo el mundo. Como indicamos anteriormente, intereses de mercado mediaron fuertemente el debate por las posibilidades de negocio que generaba la informática y por la oferta cautiva que suponía la escuela. Es tal que en marzo de 1985 se realizaron unas Jornadas Internacionales sobre Nuevas Tecnologías que fomentaban el desarrollo de una industria informática española. El MEC empezó a trabajar de forma conjunta con el Ministerio de Industria y Energía y el Consejo Superior de Informática, y promueven el desarrollo de un microprocesador pensando en la escuela por parte de la Empresa Nacional de Informática y Comunicaciones (SECOINSA). Pedro Maestre, uno de los redactores de Atenea, expone en un reportaje para el periódico ABC en 1984, que, si España lograse desarrollar un software educativo propio en castellano, se

obtendría una ventaja para la industria española en el mercado iberoamericano (González, 1984). Por tanto, he aquí una de las claves fundamentales que explican cómo el acento gravitó en torno al fomentar una industria informática nacional, aprovechando la inversión educativa, y los intereses de mercado relacionados. De ahí también las discrepancias en la evaluación final realizada del proyecto, pues mostraba que los resultados educativos habían sido bastante pobres.

Es reseñable que tales conclusiones siguen siendo actuales, e históricamente las dificultades y las críticas hacia la integración curricular de las TIC en términos generales y en diferentes contextos han girado en torno a estos ejes. Hoy día se sigue debatiendo acerca de cómo las discrepancias en las ambiciones y enfoques tanto desde la política educativa como desde la práctica escolar generan un escenario complejo. Autores como M. Hammond (2014), en un estudio similar sobre el caso británico, expone que este tipo de programas deben ponerse en marcha únicamente si existen una serie de «solo si», esto es, «solo si» hay una estructura adecuada, «solo si» existe una política educativa coherente, «solo si» hay una línea definida de trabajo y disposición ante ella… Ya en 1982, en un primer seminario de coordinadores nacionales de educación organizado por la UNESCO para abordar estas cuestiones, argumentaron que decisiones políticas equivocadas podían acabar fácilmente con la promesa tecnológica y convertir a los ordenadores y las nuevas redes en algo no tan distinto de los canales y medios existentes.

Este dilema se ve amplificado en la medida en la que a la par que se desarrollan grandes programas e inversiones en materia de tecnología educativa, se suceden informes que concluyen que, cuanto menos, los resultados no están ni de lejos a la altura de las expectativas depositadas (Haugsbakk, 2011). En concreto, en uno de los más recientes macro estudios sobre el uso de las TIC en la educación (realizado por la OCDE y publicado en 2015), independientemente del salto tecnológico y la extensión masiva que ha habido de las TIC a todos los niveles, A. Schleicher afirma que los resultados son dispares, destacando que no ha existido una planteamiento pedagógico que dé soporte, y que se ha seguido una política educativa bastante ingenua al respecto, mencionando que a día de hoy seguimos intentando introducir en la educación tecnologías del siglo XXI en un sistema educativo anclado en estructuras y prácticas del s. XX (OCDE, 2015).

A pesar de todo ello, no podemos olvidar que la educación, inherentemente lleva asociada la tecnología, puesto que, desde las fórmulas más básicas, siempre se ha servido de herramientas (Ferster, 2014). La gran innovación pendiente, en la línea que expone J. Cobo (2016), y en la que coincide N. Selwyn (2017), radica en usar las tecnologías para hacer cosas diferentes, tal y como expusimos con palabras de H. Simon con anterioridad, y siendo esta una de las grandes problemáticas que tuvo el programa Atenea y que siguen dándose con frecuencia. En definitiva, a la luz del debate de las TIC y la educación, nos gustaría centrar la atención en que «es importante reconocer que muchas de las preguntas fundamentales que rodean a la educación y la tecnología no son preguntas técnicas *per se*. Más bien están relacionadas con preguntas más amplias acerca de lo que la educación es y lo que pretende ser» (Selwyn, 2017, p. 35), cuestión que ya Apple apuntaba a inicios de los noventa ante la abrumadora ola tecnológica que empezó a sacudir las escuelas, y apuntando desde cierta distancia crítica que «con demasiada frecuencia, los debates

educativos se limitan cada vez más a cuestiones técnicas. Las preguntas sobre el cómo sustituyen a las preguntas sobre el por qué» (1991, p. 60). Por tanto, la integración curricular de las TIC, y que aprovechemos el potencial que nos ofrecen, requiere el planteamiento de preguntas que vayan más allá de lo instrumental, y que se cuestionen acerca de qué entendemos que debe ser la educación en este entorno digital, establecer pilares fundamentales desde la política educativa, y reconocer los intereses corporativos y económicos que también han auspiciado el uso de TICs en las aulas (Selwyn, 2016).

Si queremos evitar que nuestra relación con la tecnología en el plano educativo siga sumida en una espiral infinita de ciclos de «hype, hope and dissapointment» –en los que a cada nueva innovación tecnológica le otorgamos el status de la nueva panacea que va a resolver todos los problemas educativos, pero que en breve se demuestra su ineficacia al efecto y pasa rápidamente al olvido porque aparece otro nueva – (Selwyn, Nemorin, Bulfin & Johnson, 2018, p. 8), debemos remitirnos a algunas de las cuestiones anteriores. Preguntas que problematizan la educación desde una perspectiva que entiende lo complejo del asunto, que lo educativo no es un mero objeto técnico, sino que se construye a través de un fuerte entramado de interdependencias en las que juegan factores sociales, económicos y políticos entre otros; y, que, por *ende*, las respuestas y las decisiones van más allá de los actores estrictamente educativos. Con el análisis del caso Atenea español como ejemplo, hemos explicado algunas claves que describen y apuntan los condicionantes del boom tecnológico que fruto de una innovación tecnológica como fueron los primeros ordenadores personales (y del mercado incipiente que produjeron) sucedió en las escuelas en España, teniendo en cuenta que lo acontecido en este contexto fue muy similar en esencia y concreción a otros países.

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9.5. Translation of Article 4

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The technological boom in schools in the 80s: an approximation of the Spanish ATENEA programme

Abstract: Aims: This paper aims to analyse the debate concerning the incorporation of Information and Communication Technologies (ICT) by the Spanish Educational System, specifically the background and development of the first state-sponsored experimental programme, the Atenea project (1985-1992). Methodology and sources: To this end, we performed a review of documents pertaining to the programme and its evaluation, also taking into account the debates it generated. These documents were supplemented by reports and evaluations on related programmes, the conclusions of which we analyse in comparison with some of the contemporary reports, such as the one published by the OECD in 2015. Conclusions: Some of the fundamental debates that arose as a result of these programmes promoting the use of computers, in particular the Atenea, are strikingly valid but still lack a clear response. In the case of the promotion of ICT as an educational tool, we must recognize the relevance of corporate and business interests that saw the Education System as a large market, and therefore encouraged this type of programme, favouring an application focused more on the instrumental level than on the pedagogical one.

Keywords: Educational history; educational policy; curriculum; educational innovation; educational technology.

1. Introduction

The main objective of this work is to complete an analysis of political discourses, educational legislation and the process that was carried out to introduce information and communication technologies (ICTs) into the Spanish educational system. The paper focuses on a debate in the 1980s, when programmes such as Atenea were created, which

represents the first strong commitment to the use of computers in the classroom in Spain. During this decade, the Ministry of Education and Science (MEC) and various regional offices began to develop pioneering projects in the country to provide computer equipment to schools and integrate audiovisual media into the curriculum. These policies commenced the introduction of ICTs as educational tools and were supported by the rise of related policies in different countries, the promotion of the use of ICT by organisations such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the interests of large multinationals in the computer industry.

Countries such as the United States, Japan, France, the United Kingdom and Germany have been developing programmes to provide schools with computer equipment and audiovisual media since the 1970s. In Spain, from the second half of the 1980s onwards, two experimental programmes emerged: Atenea, whose main objective was to provide computer equipment; and Mercurio, which referred to the introduction of audiovisual media into the curriculum. These programmes were developed in the 11 communities that were dependent on the MEC and under the slogan 'Spain cannot miss the train of the educational revolution' (Bustillo, 2000, p. 472). At the same time, the six remaining autonomous regions which had educational responsibilities implemented their own projects that resembled Atenea—specifically, the Zahara Plan in Andalusia, the Abaco Project in the Canary Islands, the Educational Informatics Programme in Catalonia, the Abrente and Estrella projects in Galicia, the Basque Educational Informatics Plan and, in Valencia, the Programa Informática a l'Ensenyament (Area, 2006).

This trend and the programmes that were created also rendered it necessary to reshape the administrative structure to protect and coordinate the existing projects as well as promote new ones. The use of ICT is a fundamental factor for improving the quality of teaching, accessing new possibilities for innovation and developing novel teaching and learning strategies. Despite the existing Audiovisual Commission that was established by the Order of 28 April 1980, a new commission began to form in 1987 by way of the Order of 7 November 1989. This commission, namely the Programme for New Information and Communication Technologies Applied to Education (PNTIC), was installed under the authority of the State Secretary for Education. The fundamental aim of the PNTIC was 'to propose the creation of stable infrastructures which guarantee the continuity and progress of training processes, together with the development of materials which allow their correct extension in close connection with the projected Reform of the Education

System' (Order of 7 November 1989, p. 36223), the latter of which refers to the General Law on the Organisation of the Education System (LOGSE) of 1990. It then assumed both Atenea and Mercurio and began to work on proposals that would be produced in the 1990s, with the PNTIC extending into two areas: computers and audiovisual media.

Before conducting a more in-depth analysis of how these programmes were implemented and elaborating on some of the fundamental and still-current debates that they generated, it is interesting to review the background of these policies of ICT integration in Spain as well as the strategies that distinguished these programmes in the 1980s from previous attempts to include the computer world within the classroom.

2. The arrival of the computer at schools: debates and initial proposals between the 1950s and 1970s

In the 1950s and 1960s, Programmed Instruction, Computer Aided Education (CAI) and other similar proposals were popular internationally. These models were based on behavioural theory and the contributions of B.F. Skinner (1970), especially programmes that responded to the stimulus and response scheme of classical conditioning, which were the foundation of the 'drill and practice' activities that were promoted by teaching machines and, later, the first computers. These teaching formulas were understood to be more efficient because they allowed for improved personalisation of education as well as cost reductions. In fact, they fulfilled the role of the teacher in many cases. In the 1960s, many experts announced that teachers would soon be replaced since 'the machine would be cheaper over time, it does not get angry with the child, it reacts immediately to a right or wrong answer, it provides teaching adapted to each student and his rate of progression, etc.' (1985, p. 30). However, J. Delval challenged this assertion.

On the other hand, large organisations, including UNESCO, were promoters of these programmes, which promised to improve the efficiency of teaching and learning processes and optimise economic resources. They were especially dedicated to literacy and even advanced in many developing countries. In addition, UNESCO proposed digital literacy to justify the use of the so-called 'teaching machines' and offered programmed instruction as an effective instrument for solving major educational and social problems, such as illiteracy, and improving student productivity to increase economic development (González and Groves, 2017).

This behavioural support, which sponsored an array of CAI programmes, was extensively discussed. Because of numerous criticisms and structural difficulties that were found in the programme implementations, these developmental proposals rapidly decreased until ceasing in the 1970s (see Ferster, 2014 for more details). Therefore, the behaviourist scheme that supported the teaching machines of the 1950s and was never consolidated was repeated with computers. At a conference in Pittsburgh in November 1982, the Nobel Laureate in Economics Herbert A. Simon even stated that 'a large part of the CAI fits the description of the horseless carriage. We just took all sorts of things we did with the children and put them in the computer' (1985, p. 15–16). He conveyed a certain scepticism towards this behavioural instruction, emphasising that it had not led to great innovations but rather to repetition of the same approaches—just with a different instrument. Consequently, teachers experienced high levels of burnout, had not been properly motivated or recognised and even failed to use the full potential of computers.

In the field of psychology, behaviourism was supplanted by cognitive psychology, which focused more heavily on processes than on the observable formula of stimulus and response. Cognitive psychology promoted paidocentric teaching, which delegitimised computer-based teaching programs that were founded on behavioural canons. Therefore, this development in psychology was added to the failure of the CAI programme results, the scepticism towards these teaching proposals, the criticism of their disconnection from the reality of the curriculum and the shortage of both hardware in the centres and educational software. Such addition moved beyond the behavioural model to demand other, more process-focused types of action.

In the 1970s, the new theoretical support and the appearance of microcomputers—which were significantly more affordable in terms of cost and dimensions (hence the 'micro' prefix) compared to the expensive and bulky computers that had previously been used in schools—led to a exponential increase in educational programmes at the end of the decade and in the 1980s especially. Schools acquired microcomputers even before establishing a structure and support that allowed for their integration into the curriculum, which required sufficient educational software related to the curricular contents and a teaching staff who were trained both instrumentally and pedagogically.

In the United States, which was not only a pioneering country in this respect but also a main producer of computers, public schools possessed 33,000 microcomputers by 1981; by 1984, this figure had increased to 630,000, and microcomputers were present in almost 60% of schools (Delval, 1985). In 1985, the Center for Social Organization for

Schools at John Hopkins University released the results of the first national survey on the use of computers in schools. The study, which was conducted in 1983, reflected that primary and secondary schools were highly computerised. However, on a more detailed level, it indicated that the amount of time dedicated to using computers was relatively low, and the purpose for which they were employed was questionable. Specifically, computers were used at most two to three hours a day and a maximum of 13 hours per week. Furthermore, students had scarce contact with them, with an average usage of 23 minutes per week for primary school students and 45 minutes per week for secondary school students. Notably, the results highlighted that the most frequent uses did not support significant curricular innovations. Instead, they fundamentally involved basic digital literacy activities, such as running simulations, and the application of computers as tools for generating other spaces of a recreational nature (Becker, 1985). Such trends reflect the instrumental use of the tool with an emphasis on the technical as opposed to pedagogical or educational innovation (Ballesta, 1993). In his text *Oversold and Underused* (2001), Stanford University Emeritus Professor L. Cuban (2001) provides an interesting reading of these insights by debating the rise of reformism and whether the investment of schools in acquiring and developing educational technologies around computers was worthwhile in view of the results and everyday uses of such technologies in classrooms.

It is important to observe not only the educational outcomes of these early interventions but also how their development and expansion were strongly mediated by the computer industry. Companies such as Apple provided substantial donations to schools in the United States to carry out experimental programmes and encourage other schools to pursue these novel experiences, which supposedly promised improvements in results and positive reputation for the schools in which they were carried out. As part of this marketing strategy, Apple used schools to introduce their products into homes, which demonstrated to families that computers would become indispensable for their children in the near future. The company also utilised various marketing strategies to create a certain fear that parents would buy the same computers that were used in schools for home use (Delval, 1985). To this end, Apple, Commodore and IBM began to design specific advertising which, among other strategies, depicted children in their homes around the computers using educational software. A famous Apple campaign in the 1980s, which was produced by M. Groening, presents a student with a table full of work and the question, ‘Who needs a computer anyway?’. As early as 1978, a report by S. Nora and A.

Minc entitled 'The Computerisation of Society' clearly predicted that the debate over computers would appeal to many interests and open up new spaces. The authors stated that 'telematics is at the heart of power struggle. It shifts the balance on competitive markets and between public communities' (1980, p. 20).

Therefore, a fundamental motivation for this type of programme was the business opportunity that it generated. In 1984, a market calculation in the United States indicated that if the 50 largest school districts in the country (comprising approximately 9,000 schools) bought an average of one computer for every 170 students at an average cost of $500 per computer, the resulting demand would amount to $15 billion (Sotelo in Pfeiffer and Galvan, 1985). This figure was astronomical despite the calculations using a ratio that differed significantly from the ideal of one computer for every three or four students.

From the mid-1960, specialists in Spain, such as A. Galino, examined these first models of programmed teaching with suspicion. Although they recognised the unexplored educational possibilities that were offered by this novel technological apparatus, they affirmed that 'teaching is not a product made by the work of a machine' (1965, p. 21). These programs responded more readily to a form of instruction than to an education that allowed for a deep and concrete vision of reality. Accordingly, they did not support a holistic education but rather a partial one that was limited to which particular software (which was very scarce in the educational field) in an interface of questions and answers (i.e. behavioural stimulus–response) related, to some extent, to the specific contents of the curriculum.

Given this situation, and in view of the data, J. Delval commented categorically on the Spanish case and questioned the inception of Atenea: 'why is there so much interest in introducing computers into schools if the uses being made of them are so uninteresting and often not even used' (1985, p. 31). He subsequently responded to this inquiry by alluding to two aspects. First, this phenomenon involved a new social reality in which computers were rapidly entering the realm of work and academia; second, they represented an expansive and practically inexhaustible business opportunity.

In fact, the MEC organised a Conference on Computing and Education in Basic and Secondary Education in 1984 as an activity for discussing the project. In this conference, it was openly stated that Spain was suffering from industrial activity in this field, and Atenea could promote national developments that would benefit from an already existing market demand, thus encouraging industrial development that was not otherwise likely to occur (Pfeiffer and Galván, 1985).

In Spain, this background led to the materialisation of Atenea in addition to the related programs that were articulated by different regions with the aforementioned educational competences. Atenea represented the first serious attempt by the MEC, and its greatest result was the provision of technological tools to schools. Previously, few initiatives had been voluntarily organised by teachers and schools that were sensitive to and interested in the cause. Specifically, in the Spanish educational system of the early 1980s, it was possible to programme optional subjects of technical-professional education and activities in the baccalaureate as well as in the second degree of vocational training. The need to improve the technical means in the specialities of administration and introduce the speciality of computer literacy was stressed. Moreover, for basic general education, the MEC established competitions which, following an innovative project devised by teachers, allocated funds to acquire innovative materials, such as computers (OECD, 1991). Therefore, it was not until the appearance of the Atenea programme in 1985 that a serious commitment to computers in schools emerged. The next section details the programme implementation and the fundamental debates that were generated around the programme.

3. An approach to Project Atenea

Atenea was the first serious initiative to incorporate computers into schools. The Mercurio project, which was carried out at the same time, led to the creation of the PNTIC in 1989. From the onset, the fundamental pillars of the project were to introduce new technologies into the various curricular areas, thus encouraging the development of innovation programmes, and to provide computer equipment to the schools as well as generate and motivate the production of educational software (MEC, 1988). The perspective from which the programme was designed assumed that 'the introduction of new technologies was meaningless if it did not become an incentive for the renewal of educational practices in schools' (García, 2011, p. 154). This distinguished Atenea from homonymous programmes in other countries, which focused more heavily on developing a technological structure in schools by supplying computer products and instruction about their use rather than opting for a model of curricular integration. Elena Veiguela, the Technical Secretary of Atenea and Director of the PNTIC at the time of its creation, stated that the aim was to introduce new technologies as teaching tools within all curricular

subjects in a non-atomised way within the framework of a computer literacy subject (1991). From the beginning, it was understood that their purpose should transcend the mere instrumental learning of computer use to support teaching and learning processes in a transversal way. Although the main intentions were rather ambitious in comparison to those of similar programmes in other European countries, Atenea's major achievement was the provision of computer equipment to schools as opposed to the educational innovations that were introduced transversally into the curriculum as teaching tools.

Atenea focused on elementary and secondary schools and vocational training programmes, which had to apply for participation by proposing a pedagogical project and defining a work team who would be responsible for coordinating the experience at the school. Once approved, the centre was initially equipped with five microcomputers, a printer and six flexible disk drives, and the teachers who would supervise the experience were trained (Order of 19 April 1985). A fundamental factor which marked the development of the programme, as discussed in the following pages, was its experimental and voluntary nature. Consequently, only schools with teachers who were interested in ICTs or accustomed to educational innovation dynamics participated, and previous participation in an innovation project was also a preferential criterion (Bustillo, 2002). The development of Atenea took place in two phases: the first lasted until the 1988–1989 academic year and targeted the dissemination and incorporation of the project; the second consisted of generalisation or extension in the 1989–1990 academic year.

In terms of its size, the Atenea project involved a total investment of approximately $61 million, of which $2.5 million was allocated to the purchase of equipment, and $1.5 million[1] was designated for teacher training, including expenditures for courses, materials and travel, for instance. In its development until 1991, these figures corresponded to the provision of 8,013 computers to 1,004 centres that were involved as well as the training of approximately 12,500 teachers (OECD, 1991).

In practice, the work was articulated around the figure of 'the monitor'—teachers who were attached to the recently created full-time Teacher Training Centres (CEPs) and who also maintained links with the programme's Central Services. Because of this duality, there were many conflicts and contradictions in the lines of work that were proposed by

[1] These amounts have been converted from pesetas to dollars taking into account the currency conversion value as at 15 January 1990. The data in pesetas are as follows: 6,663.308 million pesetas of total investment, 2,684.450 million pesetas for the purchase of computer equipment and 1,525.182 for teacher training.

both entities. In the initial phase of the project, the monitors received more extensive training in both computer literacy, including equipment maintenance and repair, and the didactic applications of the computers. This extensive training aimed to prepare them to be trainers of the pedagogical teams of the schools that were participating in Atenea. Accordingly, they would supervise the activities that were developed in the educational institutions and define spaces for coordination. Therefore, the monitors became the fundamental agents of innovation (García, 2011).

In general terms, the presented information briefly illustrates the line of work and macro-level contributions of Atenea. However, to determine its real impacts on the dynamics of the schools and the teaching and learning processes, it is necessary to delve deeper into the data that resulted from evaluations that were conducted. First, two internal evaluations were programmed and commissioned to be completed by a team of researchers from the University of Murcia that was headed by J.M. Escudero. This team published an initial progress report in 1989 as well as a final report which was planned for publication in 1991 but prevented from release by strong divergences between the Central Services and the evaluation team. The MEC could not conceive of such an unfavourable view that was defined by the data, and they asked the evaluators for more nuance with consideration to the experimental nature of Atenea. The arguments by the ministry suggested that the report had not accounted for the contextual difficulties, the substantial cost of mobilising the multiple agents who were involved or the fact that the achievements had not been sufficiently valued (García, 2011). These discrepancies resulted in the Spanish authorities commissioning a results report from the OECD, which appointed a group of four experts for this purpose. The team was chaired by Henri Dieuzeide, the Inspector General of the French Ministry of Education, who was accompanied by Linda Roberts from the U.S. Congress Technology Advisory Office, Martyn Roebuck, the Inspector of the Scottish Department of Education, and Christine Brusselmans-Dehairs from the Didactics Laboratory of Ghent University. After receiving the report, the team visited Spain twice in 1990—first to collect documentation and meet with the management team of Atenea and later to visit and interview coordinators and teachers in various stages of the project implementation as well as businessmen of the computer industry and to engage in a debate with the researchers of Murcia (Retortillo, 1991). All of this work informed a report which was published jointly by the OECD and the MEC in 1991.

4. Evaluation of the Atenea Project

After the descriptive analysis above, which has defined the objectives and means proposed by Atenea, it is interesting to reveal some of the most significant conclusions of the evaluations since they are based on the reality of events and outcomes in the schools as well as the real use and perception of ICTs by the agents who were involved.

The progress report that was published in 1989, which was prepared by the team under the leadership of by J.M. Escudero, already reflected the keys to the successes and difficulties of Atenea, which could be extended in general to the different ICT curriculum integration programmes that were employed in other contexts (see Pelgrum, 1992). As Atenea was the first project to be firmly established for this purpose in Spain, the Central Services of the MEC justified its limitations and alluded to the fact that the fundamental aim of the programme was to create the necessary structure—consisting of the human team and the material structure in the centres—for subsequent interventions (García, 2011). Despite certain nuances that are later noted, the final external evaluation by the OECD team focused on the same issues as that of the University of Murcia's evaluation team, and they reached similar conclusions. The evaluation of progress that was published by the MEC (1989) clearly dictates the successes and areas for improvement of the project as follows:

> The general assessment detected in relation to Project Atenea is twofold: firstly, the Project, in its goals and philosophy, is very acceptable to teachers and monitors; secondly, there are serious limitations in the centres and in the teachers' own training to make the idea of curricular integration viable and, in the opinion of the monitors, as far as the design itself is concerned, it would need greater strategic clarity, practical definition and structuring. (p. 25)

Therefore, Atenea's intentions were praiseworthy and well received by the involved agents, who understood the difficulty of the processes of educational change and pedagogical innovation. However, since participation was voluntary, the teachers who were involved were admittedly interested in these issues and had favourable attitudes towards the integration of ICT. Besides these obvious limitations and the various structural difficulties at the start of the project, the evaluations revealed certain problems

that were common to contemporary projects in other countries and even to later initiatives that still exist today.

First, an aspect that was highlighted by both the participating teachers and the assessors was the nature of the training that Atenea provided. Surveys of the monitors and teachers in the project evidenced that the training was more heavily focused on the technical and instrumental elements of working with computers. The pedagogical part, which referred to providing strategies for the integration of computers into the curriculum and promoting educational innovations, was rather residual (MEC, 1989). This aspect was a clear barrier to achieving the curricular use of ICTs and was largely due to not only the prioritised need to provide teachers with the digital literacy to work with these tools but also the perspective of many monitors who viewed the project as more of a space for learning about computers than as a possibility for pedagogical innovation in their teaching practice (García, 2011). Similarly, F.J. Ballesta noted that there was 'an excessive emphasis on the technical preparation of teachers and a lack of suggestions regarding the possibilities and strategies for integrating these information technologies into the different content areas' (1993, p. 131). Survey data from the evaluations describe that, at the computer level, approximately 50% of participants indicated that the training was adequate, but almost 65% found that it was poor at the pedagogical level (MEC, 1989). This discrepancy, in short, led to the actors in the project assuming more of a technical role than one of agents of educational innovation, and it therefore significantly curtailed Atenea's pretensions to situate ICTs as a transversal axis of the curriculum. Such pretension was formulated with close considerations to the existing reality and the proposed means.

Another notable complaint which was a burden for the development of the project was the lack of recognition or encouragement of the participating teachers. From the beginning, engagement with Atenea was voluntary; however, the demands on participating teachers were not mitigated, as no recognition was given to their participation in the project, and all of the time that they spent on Atenea, including in training sessions, was outside of school hours. As a result, the enthusiasm of the participants declined, and complaints became more widespread. In questionnaires and interviews that were conducted for them in the progress report, participants requested to be released from school hours to attend the trainings and desired more recognition as well as the allocation of incentives, the latter of which referred to increased personal support rather than to economic issues (MEC, 1989). Another associated factor that was reported

by the teaching staff was the instability of the teaching teams in the schools. Activities were often paralysed by teacher rotations, as no consideration was given to retaining project participants at the school during the Atenea period to facilitate the development of the programme.

In addition to the problems concerning the management of the project's human resources, the evaluations also suggest that the innovations that were advanced in the classrooms had little impact on or relationship with the development of curricular content, which is consistent with the analyses by L. Cuban, H. Simon and J. Delval. The surveys indicated that computers were used mainly to motivate students (41%) and develop practical activities (25%). Assessment activities and the use of computers to present information or to solve problems did not account for each one nor for 5% (MEC, 1989). The assessment clearly states that 'there is usually a predominance of computer content over curricular content, so that curricular content is used as a support for teaching computers and not the other way around' (MEC, 1989, p. 81). Only 27% reported that the use of ICTs had led to modification of their teaching practice—a matter also noted by the OECD evaluators, who referenced the project's dependence on teacher voluntarism (OECD, 1991). J.M. Escudero presented some results of the unpublished final evaluation at a national meeting on ICT in education that was held at the Instituto de Ciencias de la Educación de Santander in 1992, where he explained in general terms that the project was characterised by quantity more than by quality. Furthermore, it entailed the application of computers in very particular curricular areas and levels rather than extensive practice, and the pedagogical difficulties were more prevalent than technical ones in adapting the use of these tools to the needs of teaching. The external evaluation also revealed that 'the evidence on cognitive development and progress in learning has been scarce or inconclusive' (OECD, 1991, p. 49), which implies that the use of ICTs did not produce improvements in student learning, though this outcome is not surprising given the way in which classroom practices were carried out. In fact, in regard to Atenea, the author M. Area (2006) has concluded,

> There was no evidence, or at least no consensus, that students were learning more and better by using computers in the classroom, nor did the teaching staff as a whole, with the exception of the most enthusiastic, innovate their practices by adopting computers as a regular teaching resource, nor did the long-awaited pedagogical revolution take place. (p. 203)

Another factor that the evaluations emphasised in relation to the use of computers—and which is, to some extent, explanatory of the previously presented data—was the shortage of educational software and, in particular, of specific programmes that cater to the curricular content. Although competitions were promoted to encourage teachers to develop software and programmes for their curricular adaptation, efforts were not sufficient, and curricular innovations were largely stalled by these causes.

This section has elaborated on some of the key evidence, as demonstrated by the evaluations of the programme, that marks the development of Atenea. The programme's contributions were outstanding in terms of providing the schools with material resources, training teachers and generating awareness of ICTs; however, the structure of the schools and the complex reality that they encountered severely limited their aspirations. Therefore, while the programme ideally aimed for the computer practices in the schools to support pedagogical innovation, the bases of voluntarism and individual initiative largely hindered the achievement of that outcome.

5. Conclusions: ongoing discussions

Since the mid-20th century, various initiatives have attempted to integrate computers into classrooms. These initiatives have been conditioned by many factors of a pedagogical nature as well as by underlying political, economic and business interests (Area, 2006). Many voices have stressed that this drive to introduce computers into schools has been legitimised from more of an economic than a pedagogical point of view.

In Spain, the Atenea project represented the first strong commitment in this respect and had its peak effervescence in the second half of the 1980s. Although the results of this project were more tangible in terms of the provision of material resources to educational centres than in the realm of educational innovation and improvements to teaching and learning processes, it set the precedent for later initiatives. Ballesta (1993) has synthesised the impressions of the evaluators as follows:

> The actual educational achievements could have been greater if more attention had been paid to the idea of new technologies as educational innovations, the pedagogical training of teachers, as well as the more appropriate focus on means, the better definition and

> qualification of advisors and coordinators, the availability of adapted and specific materials, and, finally, a more significant insertion into the organizational coordinates of schools. (p. 128)

Atenea's limitations were clearly numerous and diverse, especially considering that the arrival of computers in the centres occurred at a time in which such technology was not socially pervasive—few people had computers in their homes or used them in their professional work. Since the results regarding the impact on student learning and the transformation of teaching practices are not particularly significant, it is more productive to interrogate the urgency with which the programme was developed if no context allowed such an economic investment. In the exploratory phase, it was rightly concluded that the computer was a tool of the future that would transform all spheres; nevertheless, there was a distinct feeling that Spain might lag behind in the technological race that countries around the world had already been joining. As indicated above, market interests heavily mediated the debate around the business possibilities that computers afforded and the captive offer that schools provided. In March 1985, an International Conference on New Technologies was held to promote the development of a Spanish computer industry. The MEC began to work jointly with the Ministry of Industry and Energy and the Higher Council for Information Technology and, with schools in mind, promoted the development of a microprocessor by the National Company for Information Technology and Communications (SECOINSA). Pedro Maestre, a promoter of Atenea, stated in a report for the ABC newspaper in 1984 that if Spain managed to produce its own educational software in Spanish, it would grant an advantage to the Spanish industry in the Latin American market (González, 1984). This pursuit was a primary motive behind the emphasis on promoting a national computer industry as well as taking advantage of educational investment and related market interests. It also accounts for the discrepancies in the final evaluation of the project, which concluded that the educational results were disappointing.

It is noteworthy that such conclusions remain relevant. Historically, the difficulties and criticism of ICT curriculum integration in general terms and varying contexts have revolved on these axes. At present, there is still debate about how the discrepancies in ambitions and approaches from both educational policy and school practice generate a complex scenario. In a similar study on the British case, M. Hammond (2014) has asserted that this type of programme should only be implemented according

to a series of 'only if' narratives—for instance, 'only if' there is an adequate structure, 'only if' there is a coherent educational policy and 'only if' there is a defined line of work and disposition before it. As early as 1982, at the first seminar for national education coordinators that UNESCO organised to address these issues, participants argued that poor policy decisions could easily negate the promise of technology and render computers and new networks barely unique from existing channels and media.

This dilemma has been amplified by another aspect: as large programmes and investments in educational technology have been advanced, successive reports have concluded that, at the very least, the results have fallen significantly short of expectations (Haugsbakk, 2011). In particular, in a recent macro study on the use of ICT in education that was conducted by the OECD and published in 2015, A. Schleicher states that, regardless of the technological leap and massive spread of ICT at all levels, the results are disparate. This observation emphasises the lack of a supportive pedagogical approach and the adherence to a rather naïve educational policy in this respect. The report further mentions that ongoing efforts seek to introduce 21st-century technologies into education even though the education system is anchored in 20th-century structures and practices (OECD, 2015).

In spite of all of these insights, education is inherently associated with technology since, from the most basic formulas, it has always used tools (Ferster, 2014). According to an argument by J. Cobo (2016), with which N. Selwyn (2017) has agreed, the most significant pending innovation lies in using technology to do things differently, as previously explained in the words of H. Simon. This goal was central to the Atenea programme and remains relevant. In short, in light of the debate on ICT and education, 'it is important to recognise that many of the fundamental questions surrounding education and technology are not technical questions *per se*. Rather, they are related to "broader questions about what education is and what it purports to be"' (Selwyn, 2017, p. 35). Apple already highlighted this issue in the early 1990s in view of the overwhelming technological wave that began to sweep through schools, and the company noted—from a critical distance—that 'too often, educational debates are increasingly limited to technical issues. Questions of how replace questions of why' (1991, p. 60). Therefore, in order to achieve the curricular integration of ICTs and take advantage of their potential, it is imperative to move beyond questions of the instrumental to not only interrogate what education is understood to be in this digital environment but also establish fundamental

pillars from educational policy and recognise the corporate and economic interests which have fostered the ICT usage in the classroom (Selwyn, 2016).

In the 'hype, hope and disappointment' cycle, each novel technological innovation is idealised as a new panacea for all educational problems but soon proves to be ineffective in this respect and quickly passes into oblivion once a new one appears (Selwyn, Nemorin, Bulfin and Johnson, 2018, p. 8). To avoid continuously plunging our relationship with technology in the educational sphere into this infinite spiral, we must refer to some of the previous questions that problematise education from a perspective that accounts for the complexity of the matter. Education is not a mere technical object but is constructed through a robust network of interdependencies involving social, economic and political factors, among others; therefore, answers and decisions must extend beyond the strictly educational actors. Through an analysis of the Spanish Atenea case as an example, we have delivered key findings which identify and describe the conditioning factors of the technological boom that occurred in schools in Spain as a result of technological innovation, such as the production of the first personal computers and the incipient market that they produced. The developments in this context are notably similar in essence and concreteness to those in other countries.

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