Digital Educational Resources: the Case of Manual Digital II

Elisabete Barros[*1], António José Osório[2], Altina Ramos[3], Carlos Moreira[4], Lara Gonçalves[5]

[1]Institute of Education, University of Minho, Campus de Gualtar 4710-057 Braga, Portugal

[2,3] Department of Curriculum Studies and Educational Technology, University of Minho, Campus de Gualtar 4710-057 Braga, Portugal

[4,5]Lusoinfo Multimedia, Rua António Gomes Soares Pereira n.º 188 B 4470-139 Maia, Portugal

[*1]barros.viana@gmail.com; [2]ajosorio@ie.uminho.pt; [3]altina.ramos@ie.uminho.pt; [4]cnm.lusoinfo@gmail.com; [5]larag.lusoinfo@gmail.com

Abstract

The textbook has been a privileged element for teachers, students and parents to support acquisition and construction of knowledge. However, in the information and knowledge society, we are witnessing the introduction, increasingly intense, of technology in the classroom, starting from the early years of schooling. Still worthy of being studied, the supply of digital educational content for primary education, is little known, especially with regard to the quality of existing resources and the intensity of their use.

In this context we present the Manual Digital II (MDII) project, which aims at producing digital pedagogic contents based on innovative design, production and application processes, for children, educators, teachers and parents. Especially for primary education it developed the multimedia application Manual Digital®, in accordance with the curricular guidelines from the Portuguese Ministry of Education, offering children creative learning adjusted to their own learning pace. Establishing itself as a complement to the textbook, this proposal was geared to help children acquire basic skills of thinking and develop other levels of higher cognitive demand. The proposal was also designed to be easily and naturally integrated into teachers' regular lessons.

In order to study the impact of this digital resource, three case studies, two in formal learning contexts and one in a non-formal learning context, were developed. The findings suggest different impacts on learning, depending on how they are operationalized. Simultaneously, during 2012/2013, several training initiatives were held, resulting in pedagogical materials to assist the integration of the Manual Digital resources in teachers' daily lesson plans.

In this paper, we present: a) the concept and the product; b) the findings obtained in the various field activities; and c) the future prospects of this project, including the development of its potential and its possible adaptation to Portuguese speaking countries contexts.

Keywords

Digital Educational Resources; Primary Education; Educational Innovation; Educational Software

Introduction

The integration of information and communication technology (ICT) and digital educational resources in the Portuguese classroom was potentiated by the Education Technological Plan that had the ambition of putting Portugal, until 2010, among the five European countries with technologically modernized schools. In this context, in the last decade, intensive efforts were made to requalify the school system from primary education through various programs, involving, according to data from the Portuguese Ministry of Education, 282560 children and 12289 classrooms. This requalification included, in addition to physical spaces, significant investments in school furniture, teaching materials and computer equipment.

These programs have created conditions for a change in educational practices by providing educators and teachers with new resources for their teaching and new learning opportunities for students through activities oriented for the development of essential skills and competencies for citizens of the information society. "The equipping of spaces, the requalification of the buildings as well as the availability of computers for students helped to improve the conditions of and for teaching and learning but were

not *sine qua non* term for educational success." [Barros, Osório, Silvestre, and Ramos, 2013].

In this scope, many researchers consider digital educational resources and different electronic equipment as good tools to enhance the learning process and the interaction between the teacher and the students, assuming the last one as central in the educational process. However, these resources are presented as a complement to other resources, such as the textbook, a privileged tool for teachers, students and parents to support the acquisition and construction of knowledge [Barros *et al.*, 2011]. As pointed out by Santo (2006), "the 'student handbook' is eminently devoted to the areas of school learning and fills functions traditionally linked to learning and acquisition of knowledge , aiming the development of skills and capabilities and allowing to consolidate and evaluate tasks related with the students' acquisitions".

In a highly technological era, schools need to follow the developments and current practices of access to information and knowledge, in addition to create conditions for children being capable to read the reality, to solve contemporary problems and to make them active and socially critical. According to Schleicher (2012), "it is essential for teachers to understand how young people learn, play and socialize outside the classroom and there are many efforts to provide opportunities for this […]. Digital media have the potential to transform learning environments and empower learners to become active in shaping their own education".

It is not enough to teach through the textbook, it is essential to prepare citizens with critical thinking and responsibility for their own learning.

Bearing in mind the educational issues associated with the creation and use of textbooks and digital educational resources for primary education, we present in this paper: i) a conjectural analysis about textbooks, followed by the presentation of MDII, the concept and products associated; ii) the presentation of findings from the field work, and; iii) conclusions and future prospects, including the potential of the adaptation of these digital resources to other educational contexts.

Theoretical Background

The textbook has a long history, having been mass-produced in Portugal during the Estado Novo period and after the legendary date of 1974, April, the 25th [Magalhães, 2006]. Currently there is a wide range of textbooks for all school years and all disciplines of the *curricula*. Publishers have the freedom in its design, since they follow the guidelines of the Ministry of Education regarding the *curriculum*. Teachers must be able to analyse and choose the textbook that will be chosen for their schools. Similar process occurs in most European countries [Carvalho and Fadigas, 2007].

This is an issue that involves various educational and social agents, especially: the Ministry of Education and the institutes of his tutelage, which provide guidelines for their design and subsequent selection by schools; publishers, authors and distributors/booksellers, who are expected to offer quality teaching materials; teachers, responsable for a reflected analysis and a choice of teaching material, to be used in their teaching, and finally; the students, who will use this material to develop abilities and skills and, consequently, foster the personal and cognitive growth, involving in this framework their parents that defray the educational material.

In Portugal, it was in 2006 that a law sets the rules of assessment, certification and adoption applied to textbooks and other teaching resources in primary and secondary education, defining them as follows: b) " 'Textbook' the relevant didactic-pedagogic resource, though not exclusive, of the teaching and learning process, designed for a year or cycle, to support the independent work of the student who seeks to contribute to the development of skills and learning defined in the national curriculum (…); c) 'Other teaching resources' resources to support the action of the teacher and achievement of student learning, independent of the form they take, the support they are available and the purposes for which they were created, so clearly autonomous in relation to textbooks" [Law 47/2006, August 28].

The study of Carvalho and Fadigas (2007) states that our country is the only one, of the nine observed, where there is a state regulation concerning physical aspects of textbooks. According to the authors, a "member of the Government, responsible for Education, may establish or make recommendations regarding the material characteristics of the textbooks. The material quality, namely robustness and weigh is included in the evaluation criteria of the certification process". Taking into consideration, the current development in relation to the use of ICT in pedagogical pratices, these authors draw attention to the lateness of this measure in the context of the emergence of digital educational resources. Despite

the importance of the previous executive of the Ministry of Education attributed to the introduction of ICT in learning and the investments made in technological infrastructure, there was no analogous procedure for certification of digital resources. Incidentally, it is currently being called into questioning some use of ICT in the classroom.

However, the last years have seen a proliferation of digital resources and repositories, many designed by teachers themselves, who share them on the web; others, resulting from educational projects in several organizations; and still others, from publishers, who have advanced rapidly in the design and creation of this type of teaching materials, varying and upgrading its educational provision. In turn, the integration of ICT in the classroom has been a gradual process, which brought changes in the level of infrastructure and equipment available in schools, as mentioned above, as well as some teaching and learning methodologies. ICT at school is increasingly a reality that requires work of teachers who will necessarily be aware of and interested in constantly updating their knowledge in this field. As mentioned by Schleider (2012), "teachers need to acquire strong skills in technology and the use of technology as an effective teaching tool, to both optimize the use of digital resources in their teaching and use information-management systems to track student learning".

Currently, the use of digital resources by teachers is made to complement the textbook. However, we believe that the textbook on paper tends to become completely digital. Reducing the weight in the backpacks of students and the costs associated with purchasing multiple volumes is advantages to consider, but it is necessary to prepare schools, teachers, students, parents and the market for this change.

These challenges are responsible for public schools, which should aim to prepare all individuals with skills for the information society. It is up to publishers to create and provide quality educational resources which are not limited to digital versions of the paper, but original resources that involve students in the complex thinking process [Jonassen, 1996] and develop skills for solving problems. In turn, teachers need to prepare lessons that motivate students and meet their needs, leading them to the construction of meaningful learning [Ausubel, 1963; Ausubel, 2003]. Students should become active citizens and responsible for their growth and learning process.

Finally, the local authorities, have to ensure the maintenance and updating of investments in ICT (interactive whiteboards, computers, networks, internet acsess and access to digital educational resources).

The Manual Digital II Project: Concept and Products

The project MDII is a consortium between Lusoinfo Multimedia and the Institute of Education of the University of Minho, a pioneer in Portugal in the creation of connections between Companies and Universities in the Education field. The project is funded by the National Strategic Reference Framework. Based on constructivism theories, its intention is to promote the integration of ICT into the education and learning process by providing a set of proposals of digital activities for preschools and primary education, involving children, educators, teachers and parents.

In the scope of the project four multimedia products were created: i) Manual Digital®, with educational content for primary education including the three curriculum areas – Portuguese Language, Mathematics and Environmental Studies – and two enrichment curriculum areas – English Language and ICT Citizenship; ii) the Classroom Website, an online space where students, teachers and parents can communicate and share information and ideas in a personalized and safe way; iii) The Giant's Library, a preschool resource that guides discoveries for the area of Expression and communication, mastering language and approaching writing and artistic expression, and; iv) the collection Bia and Kiko, also directed to the preschool, which presents a set of suggestions for work in several areas: expression and communication, English Language, Maths and Expressions.

Manual Digital®

This multimedia product presents a set of digital educational resources, following guidelines of the Ministry of Education, for exploration of learning content. It is defended in the official document about curriculum and programs organization, "varying the materials, techniques and processes to develop a content is conditions that are associated with the same need to diversity the methods of school work and the ways of communication and exchange of knowledge acquired" [Ministério da Educação, 2004]. Thus, this multimedia product allows the integration of its

resources in the daily plan of teachers, encouraging and motivating a variety of dynamics of work, potentiating the development of cognitive skills, critical attitudes and investigative action by its users.

This product is available on DVD and does not require internet access during the operation of the activities menu, where all educational resources are available. It can be installed on any Windows computer, which facilitates its use in any contexts of formal and non-formal learning. It can also be explored individually or in group, using Magalhães computers (distributed to children in 2007) or computers in a computer lab. Methodologies and learning strategies can be various and appropriate to the contexts and needs of students.

During the design of this multimedia product, the project team took into consideration some concerns about the graphic aspect. The choice of a variety of strong colors makes them pleasant and connected with childhood. Characters and scenarios were developed using the color gradient - this strategy was allowed to model the graphics giving them a three-dimensional aspect and introducing a sense of depth in space. By adding these elements, we potentiated a more realistic and appealing effect for children.

All characters were created in order to stimulate children's imagination and carefully animated in different situations to become more captivating and fun, potentiating a possible relationship between the end user, as shown in Fig. 1.

FIG. 1 – CHARACTERS OF "MANUAL DIGITAL®"

The animation was designed in order to assist informative and entertaining functions, existing a specially care not to behave like an element of distraction to the main objective: learning. Special effects transitions as a way to emphasize certain situations were also incorporated, contributing to reinforce the learning, such as the existence of positive and negative feedback. The animation also served to describe difficult concepts.

The structure and navigation feature were designed for an intuitive and independent use by children. Thus, the proposed exercises on multimedia are controlled by the students, according to the pace and level of difficulty, mobilizing knowledge and stimulating the development of a critical and reflective attitude. The student is not only a receiver of information, he/she mobilizes his/her knowledge in solving problems, determining and building strategies. In turn, the teacher has at his disposal dynamic and interactive activities, raising an active and reflective participation by students, enabling reviewing and consolidating learning.

The creation of a product based on a reflective and investigative model that potentiate an "integrative proposal between the learning content and capacity building" [Alonso, 1996] was intentional. As such, activities related to the projects appeared interconnected and were "oriented towards problem solving with meaning and intentionality, and set in experiential contexts of children, in order to allow the significance and functionality" [Alonso, 1996].

Classroom Website

The Classroom Website was created to answer the needs of sharing and collaborative work of the various elements of the educational community of primary education, a safe space and customized access, as we can see in Fig. 2.
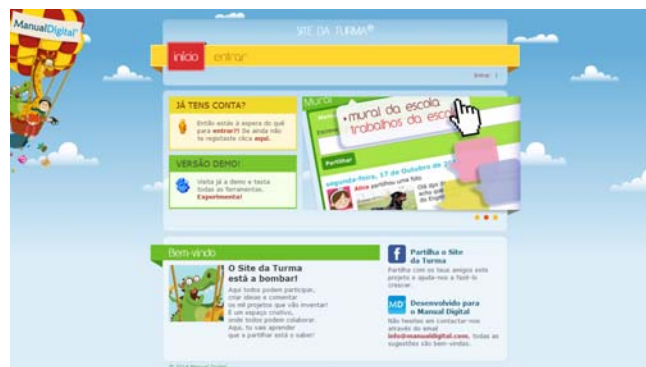

FIG. 2 - GRAPHIC ENVIRONMENT OF THE "CLASSROOM WEBSITE"

It is an extension of the products of the project aiming to involve students, teachers and parents in a gated community accessible "anywhere, anytime", promoting fast communication and information among all those concerned with the teaching and learning process. In this space, everyone can safely create, share, collaborate and comment information.

Students can develop ideas and projects with the collaborative editor, using text, drawings, images or files. All documents developed are stored in each

user's personal area where they can be edited or deleted at any time. The publications on the Website of the Group depend on the approval of the teacher who can choose to share the work of his/her students, making them available for the entire educational community.

The Giant's Library

The Giant's Library, product intended for children aged between 4 and 6 years, offers a rich learning environment that involves the whole family, with games, interactive stories, songs and other activities. According to the proposed curriculum designed guidelines for preschool education (Ministry of Education, 1997), allows the continuous development of skills, the assimilation of knowledge and promotes the creation of an informal learning environment, where the family will be able to support the child throughout the process.

The feature is composed of nineteen stories accompanied by interactive multimedia activities, six games, six songs, a creative workshop and a schedule of activities, on paper (Fig. 3).

FIG. 3 - GRAPHIC ENVIRONMENT OF THE RESOURCE "THE GIANT'S LIBRARY".

The Collection Bia and Kiko

FIG. 4 - GRAPHIC ENVIRONMENT OF THE RESOURCE "BIA AND KIKO".

Directed to the same audience of the resource above,

this multimedia product contains intuitive and attractive activities, which stimulate the development and learning of children, nurturing mathematical and linguistic notions. The activities respect an interdisciplinary approach and encompass the content areas of preschool education. In this feature, children have the opportunity to take advantage of a variety of educational experiences, wishing to develop new skills, creativity, discovery and pleasure in learning (Fig. 4).

The Manual Digital in the Teaching Practice: Findings of implementation Studies

During three years of work it was possible to mature ideas and concepts, improve processes and strategies, analyze and reflect on teaching practices, know school contexts and realities and thus deepen and improve the quality of the digital educational resources resulting from this project.

The research in this project is addressed specifically on the Manual Digital® resources since the remaining products have subsequently been produced. The findings are related to the educational use of digital educational resources available in this product, in formal and non- formal learning contexts.

Different studies with different methodological approaches were developed: i) two case studies involving two classroom in primary education: 21 children in the 1st grade and the teacher; and 24 children on the 4th grade and the teacher; ii) one case study with 11 primary education children from a leisure activities center, and iii) a quantitative study, based on a questionnaire for educators and teachers, which involved 86 respondents. We also carried out two teacher training courses for 47 educators and teachers, aiming to explore the project resources and its integration into daily lesson plans.

In this way, during two years, we have collected qualitative and quantitative data in pre and primary schools, in the north of Portugal. In the three case studies, data were collected from participant observation supported by field notes and audio and video records and photos, then analysed with QSR NVivo®. For the quantitative study, we prepared two questionnaires, on paper and online, subsequently disseminated to the school community. All these responses were analysed with SPSS. In the training courses we used active methodologies to involve educators and teachers in the use of digital

educational resources, performing data collection with the support of specific forms.

We have confirmed that in every classroom there was a computer for the teacher. The remaining equipment varied, existing well equipped classrooms with whiteboard, interactive whiteboard, printer, multimedia projector and internet access; classrooms where all students had Magalhães computers in good condition; others, without interactive whiteboard but with whiteboard or blackboard where multimedia projector was replaced by an LCD and the internet access had constant failures. In some cases, the malfunction of equipment prevented the planned and effective use of ICT in the classroom. With regard to the type of classes there were also differences: the number of students per class varied, there were mixed groups with children in the four levels of education and children with special educational needs.

After the characterization of contexts we will reflect about the five categories in which we synthesize the data collected: i) learner-content and teacher-content interaction; ii) autonomy; iii) need for monitoring and guidance; iv) learning perception, and; v) social interaction.

Learner-Content and Teacher-Content Interaction

For the development of this, multimedia product was extremely important in this first category that allowed us to observe how students interacted with the digital resources of Manual Digital® and identify strategies related to their integration in the pedagogical practices of teachers.

We concluded that this type of digital content aroused curiosity and interest in the students and motivated for learning. It was possible to observe the feeling of motivation geared by the graphical environment and the interaction with the characters of the product and the solution of the challenges and proposed problems. Among the various proposals for work and games, the preferences were evident: children explored games that test their knowledge and allowed the competition with their peers and shunned games where repetition was constant and exercises with an easy or extreme difficulty solution, causing discouragement and disinterest.

With regard to the interaction teachers-content we found that the methodologies adopted were very similar, through reading and exploration of texts, exploration of vocabulary, resolution of group exercises and, when possible, individually with the support of Magalhães computer. Most often, the Manual Digital® was used to review content and consolidation knowledge [Barros, Osório, Silvestre, and Ramos , 2013].

Most teachers we contacted had common practice of the inclusion of activities involving the use of technology in their lesson plans. Most data also showed us that, as a rule, the teacher guided the student in the Manual Digital® activity, providing directions where to go and where to click. The introduction of active methodologies, of a constructivist nature, was only observed in contexts where students had Magalhães computer, allowing them an individual exploitation, to the pace of each one.

Autonomy

The observations made under the various studies confirmed that much of the proposed work or activities of the Manual Digital® presented a logical and intuitive structure that allowed students to easily navigate between different menus, as well as solve the challenges. The immediate reinforcement of games was presented as an asset for learning and motivation to learn more. However, there are proposals of work that need to be improved for several reasons: difficulty in understanding instructions and complex or too easy exercises for the cognitive level of the students. Both constraints limit the autonomy of the students in the use of Manual Digital®.

We could also confirm the existence of an intuitive menu that allows students to freely browse through the contents while learning and solving problems according to their knowledge and capabilities. We could also see differences in the choice of objects of study by students, when allowed free exploration of Manual Digital®, having identified different levels and rates of learning.

Need for Monitoring and Guidance

While there has been considerable autonomy by students in navigation and exploration of the Manual Digital®, in some activities, they needed monitoring and guidance from the teacher. The difficulties experienced by the students were subject of discussion and test of different strategies between peers for their resolution when in formal learning context. Only when they could not overcome the obstacle, they would request the support of the teacher. Otherwise, in informal learning contexts, it was observed that,

when children reached a certain exercice and did not know what to do or how to solve it easily, they would exit and search a new game.

Perception Learning

The use of Manual Digital® in the classroom allowed a different approach to curriculum content and in some cases, a more concrete explanation of reality. Students were aware of the learning that went with this type of resource, since they claimed to have succeeded in retaining new information, revising or consolidating knowledge, learnt in a creative and playful way. In turn, teachers considered that the use of Manual Digital® in their practices allowed them to develop more interesting and motivating lessons for students, evaluating the product as a good tool to consolidate knowledge.

Social Interaction

Collaborative learning was allowed to achieve common goals as successfully completing a game or activity. In some games, two or more students interacted to create new knowledge, communicating its perspectives and coordinating activities in order to solve problems. For students, some of the Manual Digital® games seemed proposing something that was recognized increasingly important in the learning process: the peer collaboration, sharing ideas and strategies with a common goal. Social interaction observed showed the importance of the relationship between students and the surrounding environment in the construction of their own learning. This work environment can generate new perspectives for analyzing problems and generate the ability to new solutions.

Conclusions

According to Alonso (1996) and on the line of thought of Ausubel (1963), the construction of knowledge supposes an active and productive interaction between the meanings that the individual already owns and the various information arriving from the outside, not limited to the subject to receive them but draw up their own meanings. Such prerogative requires an investigative and reflective methodology, creating integrative activities that encourage the investigation of problems that stimulate observation, curiosity and research and also to encourage the sharing of knowledge, the development, the mobilization and integration of competencies in problem solving. It is in this sense that we have

developed our work, focusing on development, adaptation and updating of content and multimedia contexts presented, reflecting on the kind of tools that may be created to encourage the active and reflective student interaction structuring and streamlining activities that enable the construction of knowledge of each child.

The legal regulatory framework continues to give importance to ICT in primary education, although the Governmental practice seems contradictory since hesitations occur in the continuity of the investments made under the Education Technological Plan. Demotivation of the educational agents; the stagnation of the measures of the Education Technological Plan; the disparate conditions of schools, some classrooms equipped with technologies where the student is at the center of learning and other schools where traditional practices are followed, are some of the current scenarios.

In such context, the traditional textbooks may well keep their function, provided that digital educational resources as helpful tools, are allowed to complement books, allowing different and original learning activities.

In our findings there is clear evidence of the motivation and interest of students when using this type of educational content, allowing us to conclude that they provide moments of exploration and creative and critical learning. However, teachers are faced with various difficulties that affect this kind of pedagogical practice.

Research is also our workspace in line with the production of teaching materials for use in the digital world. As suggestions for future research, we can include: the study of Manual Digital® being explored in a school year, a curricular area or a specific theme; the curriculum integration of the Manual Digital®, privileging constructivist nature methodologies; the socio-cognitive implications resulting from the use of this type of resource; teacher training directed to the curricular integration of the Manual Digital® educational resources. The comparative analysis at European level concerning digital contents in primary education and the exploitation of these contents for their adaptation to Portuguese-speaking school contexts are very interesting lines of investigation.

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Barros Elisabete completed the master of Science in Education, Specialization in Educational Computing, in 2010, at the Portuguese Catholic University. Element of the investigation team of the consortium I&DT Manual Digital II, promoted in copromotion by Lusoinfo Multimédia and the Institute of Education of University of Minho, Portugal. Participated in several research projects and organizing cientific events related to Children, Technology and Education. She is trainer in the same area. Her research interests include education and technology, education and training; digital educational resources and educational innovation.

Osório António José assistant professor with aggregation and member of the Department of Curriculum Studies and Educational Technology in the Institute of Education of University of Minho, Portugal. He is researcher at the Centre of Research in Education. Coordinates various research projects, national and

international, within ICT in Education. He is also director of master courses and supervisor of several PhD and MSc projects.

Ramos Altina professor and researcher at the Department of Curriculum Studies and Educational Technology in the Institute of Education of University of Minho, Portugal. She is researcher at the Centre of Research in Education. With several publications in the research areas: technology and learning; technology and teachers training; research methodologies – software of analysis of qualitative data.

Gonçalves Lara completed her degree in Basic Education, in 2008, at University of Minho. She is currently production coordinator of digital educational resources in the company

Lusoinfo Multimedia, intervening in creative production resources, monitoring and evaluation of multimedia development. Cooperated in the consortium I&DT Manual Digital II, promoted in copromotion by Lusoinfo Multimédia and the Institute of Education of University of Minho, Portugal. Develops training sessions for primary teachers, in the use of educational software.

Moreira Carlos Partner and Managing Director, Master Degree in Information Management from Universidade do Minho. Guest Assistant Lecturer in Information Systems / Information Techonologies disciplines at ISMAI – Instituto Superior da Maia, Portugal. Coordinator on several national and international I&DT projects, within the Information and Communication Technologies.