Collaborative Digital Textbooks: Theoretical Framework and Development Tools

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Abstract: *A Collaborative Digital Textbook (CDTb) is a complex digital learning resource and an intrinsic component of an e-learning environment. Developing collaborative digital textbooks performs a fresh approach to the e-textbooks field, putting the emphasis on personalised textbooks for learners. A collaborative digital textbook integrates different technologies, tools, and architecture, as well as the practice of various learning scenarios based on the authors' creativity and visions. It is a shared process of developing a digital textbook that includes the potential to expand e-books' usefulness in teaching.*

This study presents insights into the theoretical framework and the development tools of collaborative digital textbooks by reviewing scientific studies and cases, and analyses the authors' views on this topic. The work also examines different factors that influence the development of these types of e-textbooks in the frame of proper applications. Further, the research will require in-depth future studies on exploring the pedagogical design of collaborative digital textbooks.

Keywords: Collaborative Digital Textbook, Framework of Collaborative Digital Textbook, Development of Collaborative Digital Textbooks.

1. Introduction

As information technology and learning tools advance, we talk more and more often about the chances of using digital possibilities to improve educational processes and services. We think digital textbooks represent a particular segment of this field.

There are approximately two decades of the evolution and expanded implementation of digital textbooks in developed countries, which began during the promotion of multimedia interactive learning resources and the integration of information and communication technologies into teaching [MEC RM, 2015]. So far, there is not either a rate of a constant process of the application of digital textbooks in education or standards regarding digital textbook types described in

https://doi.org/10.58503/icvl-v17y202216

specialised publications. Besides, we did not identify free tools for developing interactive personalised e-textbooks.

It is obvious the digital textbook is more advanced than a traditional printed textbook, as it could incorporate and use multimedia, collaboration and interactive learning features [Roberts et al., 2021]. We highlight particularly the usefulness of digital textbooks in classrooms through their interactive features that form a vital component of digital textbooks. The interactive content keeps students engaged and motivated, making learning more comprehensible. Besides, they make it possible to personalise student learning and select the most appropriate subject for each topic as often as needed. Also, we should draw the attention of both students and teachers to the following attractive experiences, like interactive activities, 3D images, diagrams, notes, incorporated educational applications, tutorials, appropriate references, and others. Another distinctive feature is that e-textbooks are more flexible, and we can constantly develop educational content. Using a good eBook builder, teachers can prepare customised educational content and, thus, provide a student-centred method in classrooms.

Contemporary didactic practices that combine blended learning, problem-based learning, or another type of student-centred approach, as well as 21st-century learning skills, contribute to informed training, well-prepared students and future competitive citizens in the modern workplace. The following statements could sum up the pedagogical characteristics of e-textbooks (Chiriac, 2016):

- e-textbooks involve instruction in meaningful environments that guide students to discover, collaborate, and share content;
- e-textbooks offer a lively and active learning approach, which leads to effective communication between the cognitive contents and the students, challenging them to learn;
- e-textbooks encourage know-how, comprehension, and critical analysis, and adapt to the student's learning rhythm.

In these conditions, we investigate tools that offer innovative and relevant features in creating interactive content necessary to ensure the development of students' skills and abilities.

1.1. Meanings of Collaborative Digital Textbooks

Seeking a broad and meaningful explanation of what a Collaborative Digital Textbook is, we will first introduce what a digital textbook is. We discover that the investigations regarding collaborative digital textbooks are preliminary and few to introduce some definitions of them or more precise meanings, though there is a substantial quantity of research on digital textbooks optimised with interactive features.

Chen et al. (2012) mentioned "eTextbook was a special kind of eBook developed according to curriculum standards, which meets the students' reading habits, facilitates organising learning activities, and presents its contents in accordance with paper book styles".

As stated by Embong et al. (2012) referring to some practical functions, e-books as textbooks in the classroom "allow students and teachers of the school to search for word definitions, bookmark pages, highlight text, and type notes", and […] "should offer various presentations of information and activities […], automate some feedbacks for students, provide scaffolds or flexible supports suitable for students' learning process, and ensure sustainable resources of knowledge".

In similar terms, by digital textbook/e-textbook we signify a structured interpretation of a subject/module/unit in digital format elaborated under the curriculum, whose content could combine various media like text, graphics, audio sequences, video, hyperlinks, interactive exercises, and other proper information.

Based on our findings, we can say that the term "collaborative" is practised in "the collaborative digital textbooks" syntagma when developing digital textbooks in collaboration, and/or digital textbooks include collaborative tools.

Thus, Weiskott (2017) experimented with a new pedagogical tool called "Collaborative Digital Textbooks" by building an intellectual resource (website) and inviting students to contribute through research, writing, design, and publishing new pages on the site. We determined that the website collaboration model in textbook elaboration was introduced in 2008 when the Flexbook authoring platform appeared on the IT market (https://www.ck12.org/fbbrowse/). Hill (2010) mentioned that the model of digital textbooks that uses a web-based collaborative model, called flexbook, includes open educational resources, and enables teachers to customise and produce their textbooks.

A newer interpretation of collaborative digital textbooks was proposed by Grönlund et al. (2017) in their article, in which they stated that collaborative digital textbooks "are developing from being books in pdf format to becoming collaborative digital environments where teachers and students can communicate, engage in feedback and discussions, share and manipulate materials, test knowledge, and monitor results".

In the following, we identify that Kempe & Grönlund (2019) introduce Collaborative Digital Text Books as "emerging artefacts in Swedish schools, combining the quality assured content of the traditional paper and digital textbooks with affordances for multimodal representation of knowledge, differentiated instruction, communication, collaboration, documentation and with varying learning activities". These new artifacts, as described by the authors, contain exercises, navigation mechanisms, marking and text annotation, explication of notions, tools for communication like chat rooms, wikis, tools for documentation and teacher feedback from exercises, can also include serious games, and tools that support the administrative concern for the teacher (ibid.). We can conclude that Kempe and Grönlund present the "collaborative" meaning of digital textbooks in case of digital material covering the entire curriculum in a digital book includes collaborative tools.

In figure 1, we recapitulate and graphically present connections between the collaborative e-textbooks' meanings and interpretations based on collaboration elements and how these could help us understand the use of CDTb in education.

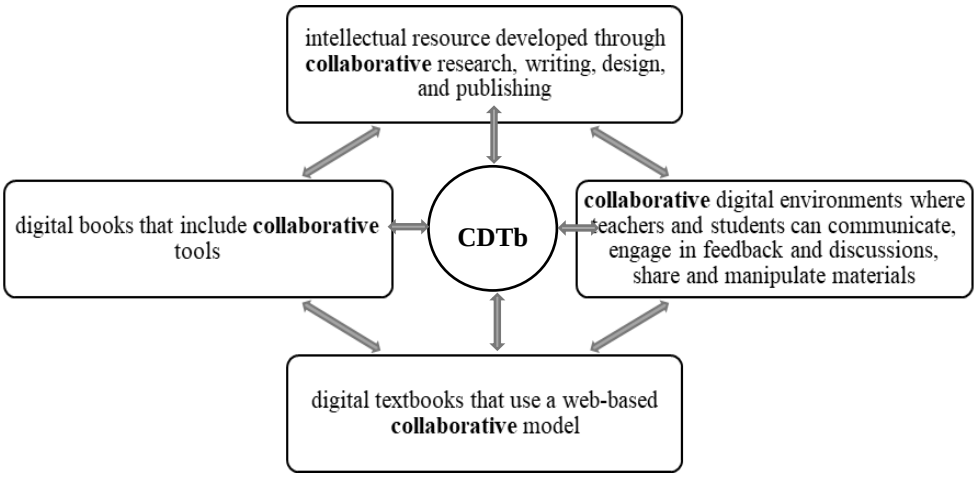

Figure 1. Collaborative Digital Textbooks: meanings and interpretations

2. Collaborative Digital Textbook Framework

The above differentiations, illustrated in figure 1, having in common a 'collaborative' topic, are made to centre the reader's attention on the usefulness of collaborative digital textbooks and how they could be developed and implemented in education. Each statement handles an aspect of the collaborative work and shows the conditions of the collaborative digital textbooks' involvement in the entire curriculum content. Also, these statements could suggest us the dimensions of Collaborative Digital Textbook Framework that should be considered when plan, produce and implement a CDTb, which are described below:

- *Key Features*. The key characteristics commonly realised for collaborative e-textbooks include the function to build interactive exercises and multimedia, navigate and search through the text, take notes or make annotations, insert hyperlinks, and also allow teachers and students to print information, and download the book to their computer or mobile devices. Considering pedagogical principles by applying interactive strategies (collaborative project creation, learning by doing, problem-based learning) we could complement the use of CDTb learning resources in a classroom, thus contributing to collaborative education.
- *CDTb types and formats*. E-textbooks differ in type and Lee et al. (2012) proposed three categories of e-textbooks: web-based systems, reading software, and dedicated devices. In this case, the accessibility

and usability of e-textbooks are specified. We read the content of digital textbooks in various format including *pdf*, *epub*, *html* or *exe* files;

- *The structure of the working team to develop a CDTb*. A successful e-textbook implementation relies on the mutual interconnection between members of a well-organised working team in developing learning resources for digital textbooks. The contributions of the expert team engaged in developing various components of the digital textbook are vital to get qualitative learning resources. As a whole, the team must include subject authors, researchers, programmers, designers, teaching staff, and other specialists involved with the development, distribution and use of e-textbooks and learning resources. This process is a collaborative one;
- *CDTb Builders*. Building upon our experience of developing e-textbooks, we recommend taking into consideration the following aspects to design and develop customised collaborative learning resources for an e-textbook, namely: the importing of various types of data, creating navigation, links, comments, developing/editing of learning objects, the assessment, intuitive access, interactivity, and other relevant characteristics. According to Grönlund et al. (2017), tools serving various purposes in developing e-textbooks could be structured as presentation aids, tools for working with texts, tools for communication, and teacher tools.

Any design of a CDTb for teaching and learning activities specifies the perspective of how to teach knowledge. We notice many software applications help us create and present information or phenomenon using different formats, thus contributing to understanding that information (text, images, simulations, etc.). Also, users' professional skills are constantly increasing as soon as new tools appear, which determines the development of new alternative content for modern learning resources. The fundamental role and diversity of tools for building e-textbooks for all levels of learning bring us to a newer standard of digital textbooks, which is rectified within the context of improvements in education. Many software packages offer adequate facilities to build e-textbooks, which could contain various types and tools of information representations mentioned above. However, using those tools combined in an application differs from using them separately in multiple digital environments. That's why a specialised cooperative team in developing e-textbooks is better than separated developers. From this point of view, the development of digital textbooks becomes cooperative, positive, and innovative, which supports both a collaborative digital textbooks framework and establishes a partnership between the curriculum and new tools in developing digital textbooks.

3. CDTb and collaborative tools

In what follows, we discuss the abilities of some e-textbook builders to ensure the expectations of the teachers and students regarding the collaborative features of e-textbooks.

The study investigates some examples of e-textbooks builders that offer tools to produce 'collaboration' through web technologies or enriched tools for learning context.

One of the powerful tools focused on a web-based collaborative model is *FlexBook* open authoring platform developed by the CK-12 Foundation (screen capture, figure 2).

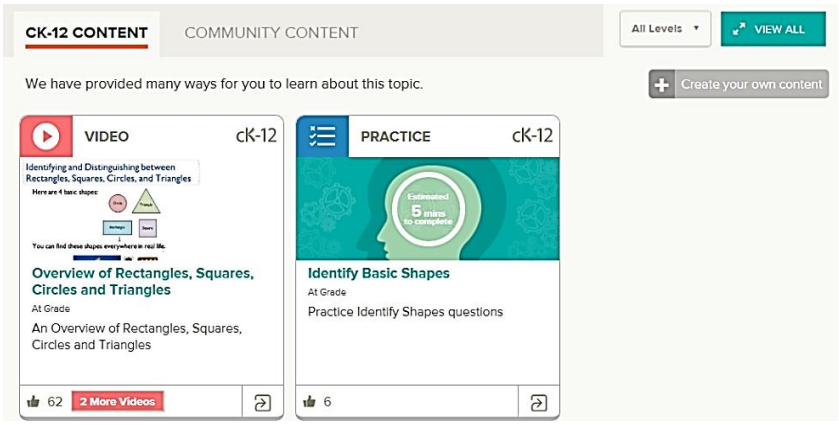

Figure 2. Example of flexbook: Math, Grade 1-5, Geometry, Identify basic shapes (source: https://www.ck12.org/c/elementary-math-grade-2/identify-basic-shapes/)

According to the mission of flexbooks and CK-12 concepts (https://www.ck12.org/) they are made to be flexible, engaging and educational, and can customise online textbooks to fit learners' learning styles, regions, languages, or levels of skill. Every teacher can create a flexbook from scratch (could contain reading, videos, images, simulations, flashcards, study guides, assessments etc.), and to begin he/she needs to have a CK-12 account. A user could form a group (teachers, community) to develop learning material in collaboration, thus multiple flexbook editors can work under a single account, as stated by CK-12 Foundation Blog. Also, the collaboration could occur over multiple CK-12 accounts. Each team member can work on a separate piece of a flexbook. Then, the group leader will organise a collection of customised content developed by the team members.

French e-textbooks, *manuels numeriques*, are another example of CDTb (https://www.lelivrescolaire.fr/) (figure 3). The process of creating textbooks is opened up and expanded to all teachers who have the opportunity to participate, interacting with hundreds of other colleagues, which makes it possible to create content tailored for classrooms.

Figure 3. Manuel numeriques. Sciences numériques et technologie (source: https://www.lelivrescolaire.fr/page/36959000)

3.1. Case description and research

For several years our research is focused on e-textbook builder *MDIRConstructor 2.0* (Balmuș, 2020) (within the national research project "Development and implementation of interactive digital textbooks in pre-university education"), which has incorporated tools to develop personalised digital textbooks, namely:

- hypertext (semantic links between content sequences);
- multimedia integration: simulations, didactic films, interactive animation, audio clips;
- integrating complex learning activities and educational games;
- online access (downloading, completing some tasks in cooperation, sending the solution to some work tasks, etc.).

Developing any educational application by MDIRConstructor 2.0 is a process of a collaborative working of a team that includes at least a course teacher, a programmer, and a tester (teacher, student). The developed e-textbooks through MDIRConstructor 2.0 require a particular educational pdf file (scanned traditional book, auxiliary educational materials, and others).

The next screen capture, figure 4, represents an example of adding a link from YouTube resources (menu PersonalResources/ResursePersonale, SelectTypeOfResource/Alege tipul de resursa, InternetLinks).

As it could be seen in figure 5, there are numerous tools available to help teachers to add various types of learning resources (audio, video, PowerPoint presentations, images, documents, vocabulary and grammar exercises, choose the correct option, complete the gaps, sentence formation, word transformation,

matching, true/false, crosswords, executable applications elaborated in integrated development environments, and many others).

The advantages of this builder stand in the possibility of personalising digital textbooks. Any teacher can develop didactic materials from personal experience and point of view, aiming for an innovative style of getting new knowledge.

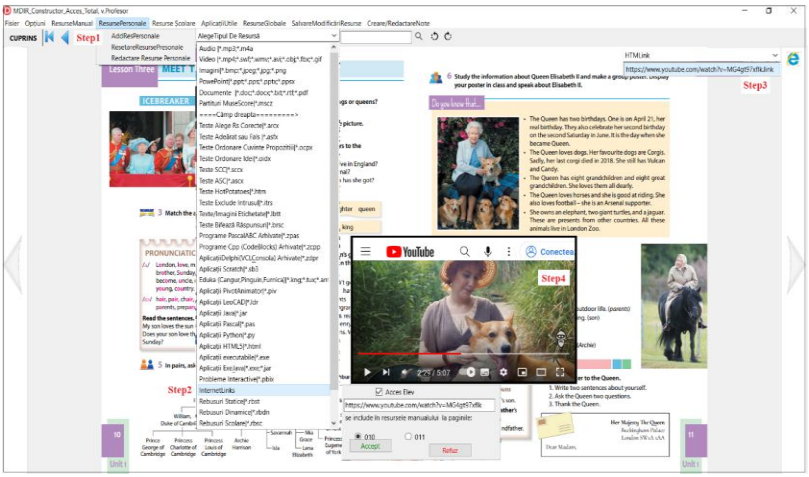

Figure 4. Adding a video link

In the figure 5 we present a screen capture of the *MDIRConstructor* e-textbook: 4 steps of the elaboration of the "Select the Correct Answer" application. At the first three steps we access and open the menu (/ResourceCreation/Creare resurse, Text/Immages/Labels-Texte/Imagini Etichetate) and create the educational application (TexteEtichetateCreator). In the last step, the teacher integrates the elaborated application in the e-textbook. Accessing and finding the solutions could be a collaborative activity as well.

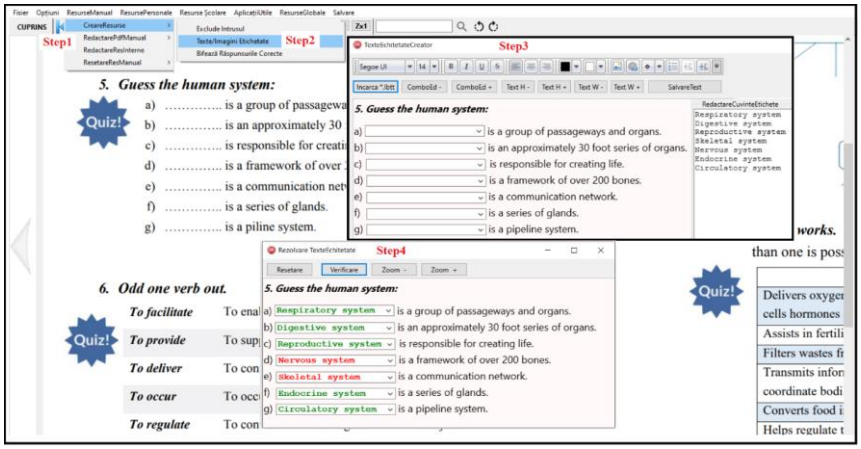

Figure 5. Creating the "Select the Correct Answer" application

Barriers

Despite the advantages of any categories of e-textbooks, including collaborative, immersive, and interactive features, several barriers prevail regarding the implementation of digital textbooks in education in the Republic of Moldova. In our opinion, they are:

- lack of a national policy regarding e-textbooks;
- lack of an e-textbook market, which success depends on the government's support and stakeholders (content publishers, teachers, and students);
- the necessity to endorse the e-Textbook implementation at the governmental level;
- the necessity to adopt e-textbook standards for authors, publishers, schools, teachers, students, and the community;
- lack of free builders to develop complex learning resources and e-textbooks.

Discussions

This work displayed some findings about collaborative digital textbooks, which have elaborated from pdf format books in interactive, dynamic and collective digital learning environments. The important point is the possibilities for interactivity and collaboration within CDTb. The result of the collaboration is proved by the possibility to interact with teachers through some tools, built/shared learning resources and documents.

The lack of digital e-textbooks in the national schools may awaken the involvement of the Moldavian government. Implementing e-textbooks in Moldavian education could start by reassembling traditional textbooks and providing educational content with digital tools. Establishing a national project in a coordinated group of university and pre-university teachers, stakeholders, and target groups centring entirely on the elaboration and adoption of digital textbooks is necessary to experience the highest impact in this field. Furthermore, we need to spread out teachers' professional growth in developing digital resources and promote the utilisation of innovative pedagogical strategies. At the university level, a web-based textbook is more practical than a traditional printed book. Here, it is relevant to encourage a university platform that offers valuable teaching-learning experiences.

4. Conclusions

As stated, there are several interpretations and meanings of collaborative digital textbooks. We can say in conclusion that a CDTb represents a collaborative digital educational resource developed through the joint involvement of a group of teachers and IT staff, where teachers and students can cooperate, engage in feedback and discussions, and share materials. Modern e-textbook web-based

builders use a cooperative working model that includes the possibilities of connection between members of a collaborative team.

The tools of the MDIRConstructor software, introduced as a case study, allow the development and insertion of various types of learning resources and share educational resources. The most common functionalities of collaboration are the links of connection with web pages, completing tasks in group, and using teachers' tools to elaborate learning activities within e-textbook. At present, the transition to a digital representation of educational resources is analysed as an educational change regarding innovative learning strategies.

Acknowledgement

Referring to international and national experiences, the authors present a theoretical research about the practices and importance of Collaborative Digital Textbooks in education and tools that could help developers create Collaborative Digital Textbooks. We carry out this investigation within the national research project "Development and implementation of interactive digital textbooks in pre-university education" (The State Program 2020-2023, Republic of Moldova, nr. 20.80009.0807.25)(https://ancd.gov.md/sites/default/files/document/attachments/Rezumate%20proiecte%20site.pdf).

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