

Interactive Textbooks and Student's Learning

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In the last decade, crucial advances in computers, in digital memory, in internet resources, in audio and visual transmission, in virtual imaging, and in wireless communication have created new possibilities for the use of technology in the teaching of English. Web publishing, digital archives, digital video, electronic conferencing, blogging, wikis, podcasting, virtual reality worlds are easy-to-explore/accessible-to-all potential new tools for teaching and learning English (Webb). The use of information and communication technologies (ICTs) transformed traditional teaching and learning models and practices in the past decade. This evolution has resulted from the emergence of the information society and has greatly impacted on the global economic and socio-cultural development (Vieira; and Kahiigi et al.).

According to the European Union's aims for 2010 (Treaty of Lisbon):

- We should experience a shift from PC centeredness to ambient intelligence. The ICT environment should become personalised for all users. There should be full multimedia, with an almost 100% online community.
- Innovations in learning should be focused on personalised and adaptive learning, dynamic mentoring systems and integrating experienced based learning into the classroom.
- Learning resources should be digital and adaptable to individual needs and preferences. E-learning platforms should support collaborative learning. There should be a shift from courseware to performanceware focused on professional learning for work.

- ICTs should be an integrated part of the learning process. Access to mobile learning should be enhanced through mobile interfaces.

The use of these new technologies requires, however, new literacies that enable to exploit their potentials effectively. According to Leu et al., the new literacies of the ICTs include the skills, strategies, and dispositions necessary to successfully use and adapt to rapidly changing information contexts that continuously emerge in our world and influence all areas of our personal and professional lives. In the same way, recent trends in education focus on the need to shift from a teaching paradigm to a learning paradigm (Ponte; and Brown). Such a shift changes the emphasis not only from teaching to learning, but also from teacher-directed to selfdirected learning and from passive to interactive learning. In other words, teachers become instructional designers creating learning experiences and environments, and students work without the teacher being present for every structured learning activity (Kim et al.). According to Brown, contemporary educational paradigms focus not only on the production of knowledge, but are beginning to focus more and more on the effective application/integration/manipulation/etc. of existing information and knowledge.

Therefore, school syllabus are unanimous about the need to design and implement strategies that lead the learner to search, to enquire, to build his knowledge, to develop competences, to use new technologies, and above all to become autonomous. As a result, the use of interactive resources in teaching and learning processes turns out to be essential, so that learners can lead a successful path in this new information society.

Bearing in mind the above assumptions, this research will explore the advantages and disadvantages of electronic interactive textbooks versus traditional textbooks in student's learning.

1. Conceptualizing the learning process

As Kahiigi et al. stated, many approaches to learning over the years tend to agree that learning is a process through which learners achieve their learning goals by carrying out a number of learning activities and participating in interactions to reflect their understanding (Sun et al.). Thus,

learning seems to result from a change in students' perception of reality related to the problem area under study (Rekkedal, and Dye). Learning is then concerned with the way people acquire new knowledge and skills and the way in which existing knowledge and skills are modified to solve problems (Shuell). It consists of the active role played by the learner to process the information for use (Barnard).

Moreover, Chi, Glaser, and Rees argue the amount of knowledge students possess has a substantial impact on their learning processes and learning styles as students learn in different ways. They pay attention to different aspects of their environment, they solve problems in a different manner, they relate to others in distinctive partners and they process information in unique ways. Thus, the manner in which information is presented to them affects their ability to learn (Kahiigi et al.). Consequently, the learning style must be differentiated, although according to Dunn and Griggs, teachers tend to teach in the style in which they prefer to learn or were taught and prefer to work with students who exhibit the same learning style preferences they do.

Sun, Lubega, and Williams identify three learning styles to support students in their learning process:

Visual learners	Students who learn best through images, demonstrations, facial expressions, and body language of the instructor to fully understand the content of the lesson.
Auditory learners	Students who learn best by hearing verbal lectures, discussions, talking things through and listening to what others have to say.
Tactile/Kinaesthetic learners	Students who learn best through experiencing, reflecting, interacting, and doing things. These learners prefer to actively explore the physical world around them and would benefit from manipulating real objects and/or acting on them in a simulated environment.

Table 1 – Three learning styles (adapted from Kahiigi et al.)

According to the same authors, however, students need to make use of the different learning styles interchangeably during the learning process so that they can have an effective learning experience.

1.1 Learning theories

Literature reviews suggest that learning theories can be related to three widespread models: cognitivist, constructivist, and socially situated model of learning.

The **cognitive learning theory** emphasizes the learner's schema as an organized knowledge structure (Bruner; Gagne, Yekovich, and Yekovisch). Unlike behaviorism, cognitivism recognizes that the human mind is not simply a passive recipient of knowledge. Rather, the learner interprets knowledge and gives meaning to it (Hadjerroit). They demonstrate how a student perceives, processes, interprets, stores, and retrieves information and are mainly concerned with the changes in a student's understanding that results from learning. The student is involved in the learning process, so the teachers have to present organized information in a way the student can relate to. Shuell emphasizes that a cognitive approach stresses learning as an active, constructive, and goal oriented process that is dependent upon the mental activities of the learner.

The constructivist learning theory views knowledge as a constructed entity made by each and every learner through a learning process. Constructivism frames learning less as the product of active construction whereby the learners construct their own knowledge based upon prior knowledge (Duffy, Lowyck, and Jonassen; Piaget; Steffe, and Gale). Constructivist learning requires learners to demonstrate their skills by constructing their own knowledge when solving real-world problems. The constructivist model calls for learner-centered instruction, because learners are assumed to learn better when they are forced to explore and discover things. That is, the learner is led to actively construct or build new ideas using previous knowledge and experience attained (Hadjerroit). During the learning process, the teacher takes on a facilitator role focusing on making corrections, fostering new understandings, and creating social disclosure. The learners, in turn, take on the responsibility of learning by actively participating in the learning activities placed at the centre of the learning process.

The socially situated learning theory can be seen as a correction to constructivism, in which learning is disconnected from the social context (Hadjerrouit). Whereas in the constructivist paradigm learning is assumed to occur as an individual learner interacts with study

material, this perspective regards learning as socially situated and knowledge as socially distributed (Vygotsky; Wengler). Learning occurs as learners exercise, test, and improve their knowledge through discussion, dialogue, communication, collaboration, information sharing, and interaction with others. Vygotsky argued that the way learners construct knowledge, think and reason is shaped by their relationships with others. He defended that the guidance given by more capable people allows the learner to engage in levels of activity that could not be managed alone.

Thus, learning theories explain the learning process through which learners are able to acquire knowledge, although there is no single learning theory that can fully explain all types of learning. Consequently, several theories coexist and complement each other during a learning process. Along the same line of argument, the attainment of the learning concepts varies from one learner to another and the learning methods dictate the level of knowledge to be attained (Kahiigi et al.). Although the literature on learning theories points to the fundamental philosophical differences between them (Lin, and Hsieh), in practice, a blend of learning theories is being used, as educators tend to believe that what works in a learning situation is a subtle combination of learning theories (Karagiorgi, and Symeou).

As Hadjerroit quoted, Mayes and Fowler proposed a three-stage model or learning cycle, in which they identified three types of learning – conceptualization, construction, and dialogue. According to the authors the essential characteristic of the learning cycle is that it describes a continuous cycle of gradual understanding. Thus, learning develops in three phases, beginning with conceptualization, progressing through construction to dialogue.

Conceptualization is characterized by the process of interaction between the learners' preexisting framework and teacher's knowledge. The construction phase refers to the process of building and combining concepts through their use in the performance of meaningful tasks. The dialogue phase refers to the testing of conceptualizations and the creation of new concepts during conversation with both learners and teachers. It is believed dialogue emerges from collaborative learning.

The three stages of the learning cycle include components which are related to learning theories. In other words, conceptualization is associated with the cognitive learning theory as it

focuses on concepts and their relationships. The construction phase is related to the constructivist learning theory as it aims at the construction of new knowledge and its use in the performance of taskbased activities. The dialogue phase is based on the socially situated learning theory as it is concerned with dialogue, group collaboration, and discussion.

1.2 Learning methods

Learning methods are frequently referred to as ways through which instructors deliver instructions and learners access these instructions. Literature describes several learning methods, such as **traditional learning, e-Learning, blended learning, mobile learning, and personalized learning**, which have been accompanying the advancements in technology and the paradigm shift from traditional learning to personalized learning methods.

Traditional learning refers to face-to-face teacher centered sessions, where the teacher provides the learning information to the students and assessments depend on study notes given to students by the teacher. According to Chickering and Gamson, students must do more than just listen to what is said in class, such as read, write, discuss, or be engaged in solving problems constructively.

E-Learning, in turn, refers to the use of ICTs to transform and support the learning process ubiquitously. Meyen, Tangen and Lian define e-Learning as the acquisition and use of knowledge which is distributed and facilitated by electronic means, such as internet, intranet, extranet, CD-ROM, video tape, DVD, TV, and personal organizers. Thus, it seems e-Learning can be carried out in several ways which include computer based, asynchronous, and synchronous learning (AEN), which facilitates an environment where the students take ownership of their learning.

Blended learning encompasses a combination of various learning methods that include face-to-face classroom activities, live e-Learning, and self-paced learning (Valiathan), in order to maximize the learner's learning potential (Dean et al.; Lubega, and Williams).

Mobile learning comprehends learning or delivery of content that is facilitated by the use of portable technologies such as mobile phone, PDAs, or iPods (Wagner). The global penetration and the use of mobile technologies have created new avenues in teaching

(Armatas, Holt, and Rice). It is believed mobile learning presents vast benefits that facilitate e-Learning. However, mobile learning methods are still in their infancy and have not been fully adopted as a learning method (Kinshuk, Sutinen, and Goh).

Personalized learning is a learning approach that facilitates and supports individualized learning. Each learner has a learning path that caters for learners learning needs and interests in a productive and meaningful way (Graven, and MacKinnon).

2. ICT and foreign language learning

The changing conceptions of learning and the rapid technological advances have been accompanied by changes in language teaching and learning. According to ODLAC surveys (2008), Language classrooms are increasingly turning into blended learning environments that focus on active learning. In other words, teachers tend to use multiple teaching and guiding methods by combining face-to-face sessions with online activities and using a mix of technology-based materials.

The growing use of ICT in language learning environments has changed language teaching and learning in a beneficial way. According to Jonassen, who defines technology-enhanced meaningful learning as active, authentic and cooperative, the main benefits of ICT to language learning are mainly three:

First, **ICT** provide language learners with the opportunity to use the language that they are learning in meaningful ways and in **authentic contexts**. The Internet, in particular, provides an easy and fast access to the use of authentic materials (such as online newspapers, webcasts, podcasts, newsroom video clips or even video sharing websites), which is motivating for the language learner. The author also demonstrates that chat rooms and virtual environments such as Second Life are other sources of learning making use of ICT, where the language learner can practice not only the written use of the language, but also speaking and pronunciation, without the fear of making mistakes.

A second important benefit of ICT use in a language classroom is related to the opportunities it facilitates for **cooperation and collaboration** with one's peers. Language teachers all over the world are introducing ICT-enhanced language learning projects, including

simulations, between their students and groups in other countries, thus widening the language learning perspective into that of learning about the cultural context of the language being used today (ODLAC). For instance, using ICT they can 'skype' or chat online, where learners and teachers can not only write to each other in real-time, but also see each other and speak to each other online. Students are thus able to write, read, speak, listen, and react to a conversation using ICT as part of the language learning process. These beneficial ICT-enhanced language learning activities call for the teacher to organize and monitor them, although in a blended language learning class the overall role of the teacher has changed from the traditional authoritative role to that of a facilitator.

A **third** benefit is the opportunity that ICT-based tools give to language teachers so that they can **tutor their learners** more effectively. With the help of ICT-based tools and the constantly growing number of available educational resources language teachers are able to give individual and personalized guidance to the learners. The use of several media-audio, video, authentic contexts and real-world experiences help language learners with different learning styles to assimilate the content according to their needs.

According to the author, in a blended learning environment that uses ICT tools, it is easier for the language teacher to use different approaches with students and to accommodate different learning styles and the different needs of fast, slow, or handicapped language learners (Jonassen).

2.1. Teachers' perceptions and beliefs about ICT for language learning

Cuban defends that teachers will use technology only if they perceive it to facilitate instruction. Recent Studies have concluded that if teachers perceive technology as adding value to curriculum goals, motivating learners, or augmenting learning they are more willing to teach with technology (Doering, Hughes, and Huffman; Ertmer et al.; Russell et al.).

Likewise, in the ODLAC institutional surveys (2008), it is stated that teachers' attitudes as well as perceptions of the benefits of ICT for language learning, teachers' beliefs about teaching methods, electronic communication with students, perceptions of their role as a

teacher, and their confidence with using technology can influence the ways in which they use technology in their teaching.

2.2. Learners' perceptions of ICT use for language learning

It is believed the use of ICT in language learning not only involves pedagogical changes for teachers but also involves environmental and pedagogical changes for learners who are traditionally used to face-to-face teaching in classrooms.

Although an increasing number of learners have access to online technologies and use ICT for personal interactions, they find it challenging to use ICT in an educational context. In the same way, even though many online language courses include spoken elements and oral interactions with the teacher, learners are often unsure how such elements would work and whether they could actually learn using ICT resources in the physical absence of the teacher. Often students are more willing to listen to audio materials, watch video materials, and take self tests online as a supplement to face-to-face interaction and communication in a language course (ODLAC).

Learners' prior experiences with language learning and with learning making use of ICT, their technical skills, and their personal learning preferences play an important role in their perceptions of teaching and learning in general and with ICT in particular. On the one hand, it is common for learners to feel isolated from their tutor and peers while using ICT, while on the other hand, learners who hesitate to speak in front of peers are more comfortable writing their opinions online (Kumar). In order to help language learners to deal with learning supported by ICT, there should be study tutor systems which include guidance about self-study and rules when using ICT to learn a language from a distance, to access to library resources, and to accomplish activities for collaboration and communication with peers.

Lynch and Roecker identify three delivery trends in formal education and corporate education. The first trend is the freedom to learn at a time that is convenient for the learner and at his own rhythm. The second trend is the emphasis on personal choice. Learners want to make choices as all topics in a course may not be interesting or needed at that particular time in their life. Finally, the third trend focuses on peer support in learning. Most learners seem to

want contact with their peers, which increases the need to provide opportunities for such communicative moments.

Kershaw underlines people who use the new technologies must be provided with training, technology access, and encouragement to use the technology in their day-to-day work. He stresses that “there must be a clear focus on the people who use the technology, not on the technology itself” (Kershaw 14). Moreover, he emphasizes the need of a sustained commitment, as the transformational process can be expected to take between five and ten years, and that it is easy to slip back into old ways if an institution begins to lose its focus on change (48).

3. Textbook and learning

Textbooks in one form or another have been a part of education since the written tradition began, as textbooks are an integral part of most education systems serving as bridges between teachers and students (Bliss 422). Zevin stated that teachers depend on the textbook as their main source of ideas without much enrichment or supplementation from other sources. The author also stated that textbooks are used as part of a nearly closed system of assignments, reading, questions, homework and tests that provide security but little imagination.

3.1. The role of textbooks in language classroom

Textbook plays an important role in English Language Teaching (ELT), particularly in the English as a Foreign Language (EFL) classroom where it provides the primary form of linguistic input (Kim, and Hall).

In fact, English language instruction has many important components but the essential constituents of many ESL/EFL classrooms and programs are still the textbooks and instruction materials that are often used by language instructors (Litz). As Hutchinson and Torres suggest:

The textbook is an almost universal element of [English language] teaching. Millions of copies are sold every year, and numerous aid projects have been set up to produce them in [various] countries . . . No teaching-learning situation, it seems, is complete until it has its relevant textbook. (315)

According to Richards, textbooks are regarded as a key component. In some situations they serve as the basis for much of the language inputs learners receive and the language practice that occurs in the classroom since they may provide the basis for the content of the lessons, the balance of skills taught and the kinds of language practice the students take part in. For learners, in turn, textbook may provide the major source of contact they have with the language apart from the input they have from the teachers.

Other theorists such as Sheldon agree with this observation and suggest that textbooks not only “represent the visible heart of any ELT program” (237) but also offer considerable advantages – for both the student and the teacher – when they are being used in the ESL/EFL classroom (Litz).

Haycroft suggests textbooks are psychologically essential for students since their progress and achievement can be measured concretely when they use them. Second, as Sheldon has pointed out, students often anchor expectations about using a textbook in their particular language classroom and program. Third, textbooks involve low lesson preparation time, whereas teacher-generated materials can be time, cost and quality defective. Thus, textbooks can reduce occupational overload and give teachers the opportunity to spend their time undertaking more worthwhile tasks (O'Neill; Sheldon). Fourth, textbooks serve several additional roles in the ELT curriculum (Cunningsworth). The author argues that they are an effective resource for selfdirected learning, an effective resource for presentation material, a source of ideas and activities, a reference source for students, a syllabus where they reflect pre-determined learning objectives. Furthermore, textbooks give support for less experienced teachers who have yet to gain in confidence. Finally, Hutchinson and Torres argue textbooks play a relevant role in innovation, since textbooks can support teachers through potentially disturbing and threatening change processes, demonstrate new or untried methodologies, introduce change gradually, and create scaffolding upon which teachers can build a more creative methodology of their own.

According to Litz, while many of the aforementioned theorists point out the benefits of using ESL/EFL textbooks, there are many other researchers who maintain some well-founded reservations on the subject. Allwright suggests that textbooks are too inflexible and reflect the

pedagogic, psychological, and linguistic preferences of their authors. Consequently, the educational methodology that a textbook promotes will influence the classroom setting by indirectly imposing external language objectives and learning constituents on students as well as potentially incongruent instructional paradigms on the teachers who use them. Moreover, the pedagogic principles that are often displayed in many textbooks may also be conflicting, contradictory or even out-dated depending on the interests and exploitations of the sponsoring agent.

Litz quotes some recent authors such as:

- Porreca; Florent, and Walter; Clarke, and Clarke; Carrell, and Korwitz; and Renner who have criticized EFL/ESL textbooks for their inherent social and cultural biases.
- Prodromou and Alptekin, who have focused on the need to use the target language culture as a vehicle for teaching the language in textbooks, suggest that it is not really possible to teach a language without embedding it in its cultural base. They argue that such a process inevitably forces learners to express themselves within a culture of which they have scarcely any experience. Frequently, controversial topics are avoided and instead an idealized middle-class view of the target culture is portrayed, which may result in stereotyping, or even reluctance or resistance to learning.

On the contrary there are authors as Gray, who defends textbooks socio-cultural components, arguing that English language textbooks are ambassadorial cultural artifacts and that students should not only critically engage in their textbooks but also view them as more than mere linguistic objects. He suggests, learners will improve their language skills by using their textbooks as useful instruments for provoking discussion, cultural debate, and a two-way flow of information.

Furthermore, some proponents of authentic classroom language models do not criticize the fact that textbooks are culturally or socially biased. They, in turn, have demonstrated that many scripted textbook language models and dialogues are unnatural and inappropriate for communicative or cooperative language teaching because they do not adequately prepare students for the types of pronunciation (Brazil, Coulthard, and, Johns; Levis), language structures, grammar, idioms, vocabulary and conversational rules, routines and strategies that

they will have to use in the real-world (Cathcart; Yule, Matthis, and Hopkins). Consequently, they argue that textbooks are actually too artificial in their presentation of the target language, defending it is crucial to introduce learners to the fundamental characteristics of authentic real-life examples of both spoken and written discourse.

Richards summarises both advantages and disadvantages of the use of textbooks in teaching, depending on how they are used and the contexts of their use:

Textbook advantages	Textbook limitations
<ol style="list-style-type: none"> 1. They provide structure and a syllabus for the program. 2. They help to standardize instruction. 3. They maintain quality. 4. They provide a variety of learning resources. 5. They are efficient. 6. They provide effective language models and input. 7. They are visually appealing. 	<ol style="list-style-type: none"> 1. They may contain inauthentic language. 2. They may distort content. 3. They may not reflect students' needs. 4. They are expensive. 5. They may be confining, i.e., they inhibit teachers' creativity.

Table 2 – Textbook advantages and limitations

Collins, in turn, states other limitations to the textbook pedagogy:

First, the standard textbook pedagogy places severe limitations on the classroom instructor, making him or her beholden to a particular approach and interpretation and organization of content. Instructors often find themselves compelled to fit their lecture to the textbook in order to make a clear connection for students between what is being read and what is stated in class. Thus, teacher's role is easily reduced to that of a technician whose main function is to present materials prepared by textbooks authors. When exposed to this methodology, students are forced to learn the same thing in the same way.

Second, the traditional textbook methodology is becoming increasingly superfluous to the courses and to the students using them, as social and technological changes have transformed the way students access and process information.

3.2. Traditional textbook versus electronic textbooks

Collins states textbooks have changed drastically over the years in response to technology and changing needs. The author believes textbooks will continue to change as society uses new technology to better achieve its needs, since the Internet now offers the potential of remaking textbooks completely. First, it will replace the scarcity model on which publishing had been traditionally based with a model in which the value of information increases as it becomes more accessible. Second, technology will result in the creation and validation of multiple forms of discourse that will enrich the educational experience. Third, because of the variety of skills and expertise needed to build interactive textbooks, the notion of authorship will change and more collaborative development models will become the norm.

In fact, the advance in the area of the information technology has opened up new possibilities for the use of the interactive media such as CD-ROM, in the learning and teaching situation. Textbooks are now available via computers (Kim et al.). According to Brusilovsky, Schwarz, and Weber, a very big part of developed “electronic textbooks” are no more than “electronic copies” of printed textbooks: they offer the learner nothing more than access to the textbook content, sometimes with use of simple hypertext technology. Frequently, printed textbooks exist on the market with electronic supplements. However, according to the same authors, a new concept has emerged. Technically, current electronic textbooks (ET) are much better than their grandparents: first ETs used expensive mainframes and represented only text (302). Multimedia technology, however, added the possibility to present sound, video, and animation, and, now, Internet and World Wide Web bring the possibility of distance access (Kim et al.). One of the new features is a multimedia approach, which combines sound, text, stills and video with interactive learning (Plasschaert; Carvalho). These new electronic or multimedia textbooks appear similar to the conventional books, but differ in function. In addition to text and images, they contain the video and audio clips, which allow the learners to interact with the content and to be exposed to the target language and the culture. Learners explore the simulated environment with audio and visual input, which facilitates comprehension in listening and reading (Chun, and Plass; Verdugo, and Belmonte). Teachers, in turn, are able to easily

retrieve the most recent and pertinent information for their students (Moore, Morales, and Carel).

The purposes of developing multimedia textbooks are to enhance student enthusiasm, by using more materials of multimedia and creating opportunities for interactive learning (Davis et al.), thus creating a stimulus-rich environment in which the users can enjoy a variety of interactive experiences that will facilitate the learning process (Calhoun).

Kim et al. quote several studies which compare the effectiveness and efficiency of multimedia textbook (MMTB) and traditional methods. According to the authors even though the multimedia textbook fails to prove its effectiveness in the beginning stage, it became evident that computer-based instruction can be more fruitful as the technology develops. According to a research conducted during 1993, the instructional effectiveness of the multimedia textbook and the lecture are equal. In a 1995 study, the instructional effectiveness of the MMTB is greater than that of the lecture ($P < .05$), and this measurement is the same as that of the printed textbook.

The instructional efficiency of the MMTB is equal to that of the lecture and of the printed textbook. The authors concluded that the MMTBs constitute an educationally alternative instructional method and have a promising future in education. In Lilienfield and Broering's study, the effectiveness of an interactive multimedia computer program in improving the knowledge of users was determined, as the users who had used the computer program achieved a significantly higher grade.

Moreover, multimedia textbooks can be quickly and inexpensively updated and repurposed for the lectures and the handouts, and are available on-line via computer networks for the distance learning. The networked multimedia textbook approach, for the global distribution of multimedia information, brings the benefits of multimedia publishing on the Internet.

According to the subcommittee of the Computer Network Study Project Advisory Committee established under Senate Bill 294, 75th Texas Legislature (1999), there are major differences between a printed textbook and an electronic textbook. Electronic textbooks are made up of the same formatting and design elements as printed textbooks, text formatting,

symbolic text, graphics, and a navigation system. However, these formatting and design elements are enhanced because the information is presented making use of multimedia.

	Printed textbook	Electronic textbook
Text	Words and punctuation that make up the document.	Text may be resized, or the font may be changed to meet the reader's needs.
Text formatting	All of the attributes of characters and words, such as bold, italics, underline, coloured lettering, or size. The words are structured into meaningful units, such as sentences, paragraphs, pages, sections, and chapters, as well as tables and lists.	In addition to all of the attributes of printed textbooks, text formatting in electronic textbooks may include hyperlinks which can move the reader to other parts of the page or book (see <i>Navigation System</i> below).
Symbolic Text	All subject-specific, semantically rich symbol sets, related text, and positioning which provide information and meaning.	Symbolic text in electronic textbooks may be resized or reformatted to meet the reader's needs. The student may be able to move symbols or edit text to solve problems. The resulting solution could be dynamically graphed or displayed for additional student interaction.
Graphics	Photographs, maps, charts, graphs, illustrations, and diagrams. These may have text associated with them, as with captions, or contain text embedded within the graphic itself.	The electronic versions of graphics may allow the image to be expanded to fill the entire screen, or sections of the image could be expanded to show detail. Graphs and charts may dynamically change to reflect student interaction or manipulation of associated data.
Navigation System	Formatting and design elements include colour sidebars, a table of contents, different levels of headings (chapter, section, subsection), indices, and page numbers. These navigation systems help the student find specific information (text or graphic) in a printed textbook.	Electronic textbooks use techniques for finding specific information within them, such as navigational maps, tables of contents with hyperlinks, heading levels, indices, and page numbers. They may also include hyperlinks, expand and collapse features, search functions, and interactive controls for navigating and controlling the information presentation.

Table 3 – Printed textbooks versus electronic textbooks

According to the aforementioned study, electronic textbooks, however, may also include the following elements, which are not typical of printed textbooks:

- **Hyperlink.** A hyperlink is a segment of text (word or phrase), or an inline image (an image displayed as part of a document) which refers to a location within the current document, or another document (i.e., text, sound, image or movie) elsewhere on the Web. The electronic textbook may also include a “search” feature to find a specific word or phrase anywhere in the book. These navigation systems help the student to find specific information (text, graphic, movie, or activity) in the electronic textbook.
- **Expand and Collapse Features.** Electronic textbooks also have the ability to expand or collapse their structure. For example, it is possible to produce a document which would collapse down to its major titles and subtitles. This makes it much easier to see the overall structure and to navigate to a particular level in the structure. Once that point is reached, it is possible to expand the structure exposing all of the paragraphs at that point.
- **Search Features.** Electronic textbooks generally contain search features that provide users with the ability to search documents and to jump immediately to any occurrence of a particular word or phrase which is used.
- **Sound.** Electronic textbooks often include examples of this auditory information, such as prompts or warning sounds, music, spoken words, and natural sounds.
- **Fixed Sequence Animation and Movies.** Electronic textbooks may contain moving graphics.
- **Interactive Elements.** Electronic textbooks may contain visual graphic animation or symbolic interaction that can be controlled and manipulated by the student.
- **Live Information.** Electronic textbooks may contain hyperlinks to the Web that may provide students access to live information.
- **Collaborative Environments.** An electronic textbook could be designed giving students the ability to collaborate, through the use of chat rooms, wikis, e-mail, discussion forums, videoconferences, among others. Students would be able to study

with peers or a team to write reports, share research data, or share an area of the screen where they can draw, write, calculate, or otherwise work together on the same piece of paper.

- **Three-Dimensional or Immersive Environments.** An electronic textbook may include a three-dimensional environment or experience (virtual reality). These environments can be viewed, heard, felt and/or manipulated using various stereoscopic displays, three dimensional sound systems, interfaces and/or three dimensional controllers. Ideally these environments should simulate real world experiences without real world constraints.

3.3. Interactivity and the emergence of intelligent electronic textbooks

According to Brusilovsky, Schwarz, and Weber, interactivity is the element which turns an electronic textbook from a passive into an active learning medium. In interactive materials it is provided access to a programming environment with a program editor, an interpreter or compiler, and even a graphic program design tool. In such systems, all examples and problems are active teaching operations (303). Thus, the student can not only look at the example but also use the tools to investigate it: to execute it, to change something, to execute it again, and so forth. The same tools replace paper and pencil for developing and testing problem solutions interactively.

The authors quote another example of adding interactivity to textbooks by program testing and grading systems (Benford et al). This kind of programmes not only provides on-line access to the text of lectures and programming problems, but also can process student programmes (i.e., problem solutions) and provide the student with important feedback. It can test the correctness of a student's problem solution, measure its quality with several metrics, and report the results to the student. Such interactive feedback gets the students much more involved in the learning process.

According to Sims, interactivity is intrinsic to successful, effective instructional practice as well as individual discovery. Thus, the author argues the implementation of interactivity can be perceived as an art because it requires a comprehensive range of skills, including an

understanding of the learner, an appreciation of software engineering capabilities, the importance of rigorous instructional design and the application of appropriate graphical interfaces.

Therefore, when developing multimedia applications, significant emphasis must be placed on the ways in which users can access, manipulate and navigate through the content material. Sims identifies a range of interactive concepts based on 11 grades of interactivity which may be used as a guide to different modes of communication between computer and person. By applying these interactive concepts to multimedia courseware design, the various media elements can be integrated based on instructional decisions allowing more effective communication and consequently more educational effectiveness. An important aspect of the following classification of interactive concepts is that they are not mutually exclusive events, but elements which can be integrated to provide comprehensive and engaging instructional transactions.

Interaction grades	Description
Object Interactivity	Refers to an application in which objects (buttons, people, things) are activated by using a mouse or other pointing device.
Linear Interactivity	Refers to applications in which the user is able to move (forwards or backwards) through a predetermined linear sequence of instructional material. Often termed electronic page-turning.
Hierarchical interactivity	The hierarchical (reactive navigation) class of interactivity can provide the learner with a predefined set of options from which a specific course of study may be selected. The most common example of this interaction is the menu, and in its basic format, learners will be directed to a linear interaction after selecting an item and returned to the original menu on completion of the sequence. This interaction is relatively simple in terms of development effort, especially if no conditions are attached to menu selection. However, if prerequisite and mastery conditions are required, the instructional strategies will require more careful specification.
Support Interactivity	Refers to the facility for the user to receive performance support, which may range from simple help messages to complex tutorial systems.

Update Interactivity	It relates to individual application components or events in which a dialogue is initiated between the learner and computer-generated content. The applications present or generate problems to which the learner must respond; the analysis of the response results in computer-generated update or feedback.
Construct Interactivity	Is an extension to update interactivity, and requires the creation of an instructional environment in which the learner is required to manipulate component objects to achieve specific goals.
Reflective Interactivity	Records each response entered by users of the application and allows the current user to compare their response to that of other users as well as recognized "experts". In this way, learners can reflect on their response and make their own judgment as to its accuracy or correctness.
Simulation Interactivity	Extends the role of the learner to that of controller or operator, where individual selections determine the training sequence.
Hyperlinked Interactivity	With hyperlinked interactivity (proactive navigation), the learner has access to a wealth of information, and may "travel" at will through that knowledge base. The provision of linked information can provide a means to present problems which are solved by correctly navigating through the "maze" of information.
Non-Immersive Contextual Interactivity	This concept combines and extends the various interactive levels into a complete virtual training environment (mutual elaboration) in which the trainee is able to work in a meaningful, job-related context. Rather than taking a passive role in which they work through a series of content oriented sequences, they are transported into a micro world which models their existing work environment, and the tasks they undertake reflect those of the work experience.
Immersive Virtual Interactivity	Provides an interactive environment in which the learner is projected into a complete computer-generated world which responds to individual movement and actions.

Table 4 – Range of 11 grades of interactivity (Sims, 1994)

Interactivity as a means to access to significant learning is not only a simple navigation process (Caldas). On the contrary, it involves the drawing of interactive environments. Learning, therefore, depends mainly on the strategies used which should demand an adequate cognitive involvement by the learner. Moreover, the addition of the cognitive capacities to the ability to master learning is positive as far as the development of learning and of interactivity is

concerned. Therefore, it seems that the development of multimedia environments as a means to learning is an important challenge more in terms of design of environments through which the learner not only processes learning but also improves the development of cognitive strategies which enable to master, identify and select concepts and transfer acquired knowledge to new situations (Sims). In the same way this intelligent, integrated, interactive textbooks allow:

- **Self-paced learning:** Students can learn the material at their own pace. Simulations can be rerun multiple times to help students to internalize the principles being demonstrated. Interactive problems can provide hints if required. And, of course, students can “flip” the pages when they want.
- **Multiple learning styles:** Students learn in various ways. Interactive textbooks show animations of concepts while they are being explained verbally. They also challenge kinaesthetic learners with simulations that require a grasp of the concept as well as hand-eye coordination.
- **Self assessment for the student:** Each textbook provides many ways for a student to self assess. Sample problems show the student step-by-step solutions for a problem. Interactive checkpoint problems follow the same steps as sample problems, but supply hints when requested.

Conclusion

Printed textbooks have a long history in education and still retain several important advantages over electronic texts. However, the computer-based textbook is a new educational tool that promises to play a prominent role in the coming years. Classical instructional technologies, such as video, stills, audio files and computer programmes with a textbook orientation, have been merged into one multimedia computer system and have created additional opportunities for learning. In fact, electronic texts also have their unique strengths in meeting the needs of learners: electronic texts can incorporate simulations and other concrete examples, employ a style well suited to a learner’s needs, and work in the opportunity to practice and elaborate upon what students have learned which is very appealing, since interactive media provide teaching tools that appeal do diverse learning styles (Bradshaw).

As Cunningham, Duffy and Knuth state, we believe that the textbook of the future will be a construction of the learner, drawing upon the data base and authoring linking and customizing tools provided. Instructional software will be of a different type: instead of selecting, organizing and presenting content, software will provide tools that enable students to select, construct and organize information from a variety of sources and representational modes, thus reinsuring that the times ahead in education will be exciting and challenging.

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