

12th International Conference on
Textbooks and Educational Media

18 - 20 September, 2013

Ostrava, Czech Republic

The background of the cover features a close-up photograph of an open book. A magnifying glass is placed over the left page, focusing on the text. The text visible through the lens includes the words "ster", "vistg", "gjenn", "orden", and "ny sj". To the right of this text, the number "857" is printed in red. The right page of the book is also visible, showing more text and the binding of the book.

Textbooks and Educational Media in a Digital Age

IARTEM

University of Ostrava - Facultas Paedagogica

Edited by Zuzana Sikorova, Mike Horsley, Tânia Braga Garcia, Jesús Rodríguez Rodríguez

Textbooks and Educational Media in a Digital Age

The Thirteenth International Conference on
Research on Textbooks and Educational Media
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This book presents cutting-edge research and research methodologies from members
of the International Association for Research on Textbooks and Educational Media

(IARTEM)

Edited by: Zuzana Sikorova, Mike Horsley, Tânia Braga Garcia, Jesús Rodríguez Rodríguez

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Introduction

This volume presents papers from the 12th IARTEM conference on textbooks and educational media, held at University of Ostrava in the city of Ostrava, Czech Republic, in September 2013. The theme of the conference was Textbooks and Educational Media in a Digital Age. More than 90 participants attended the conference, coming from five continents and 19 different countries.

The topics discussed in the conference can be easily recognised by looking at the workshop titles: text materials in various subject-based areas, textbooks and teachers in terms of teacher training, textbook selection and use, learning from text materials for different purposes. However, the title of the last session has proven to be the most important. The key topic of discussions was ‘change’: changes in society and education influencing the perceived and required role of educational texts, and changes in the texts themselves, changing the nature of educational materials and even changing the traditional notion of the textbook.

The issue of particular relevance for most of presentations was the role of digital learning materials in teaching and learning: the various types and their usefulness, quality criteria, and the relation between printed and digital materials. *Eric Bruillard* in his keynote presentation articulated some basic problems connected with the introduction of digital media into schools and the research on the issue: “... Very fast adoption rate, strong expectations and not completely convincing results, constraints with openness of resources and new educational markets etc. ... Many stakeholders simply prefer to believe that it works and only accept an accompanying model of research aiming at improving a technology already considered as wonderful and essential in schools.”

Since its very beginning in 1991, IARTEM’s biennial international conferences have provided a great opportunity for scholars from around the world to share their experiences in research on textbooks in different countries and from the perspectives of different disciplines, such as education, psychology, cultural studies, linguistics, political sciences and philosophy, etc. This introduction gives an overview of the volume content.

Keynote presentation

The keynote paper provided in this conference volume is an excellent contribution to above-mentioned discussions about changes. *Arno Reints* considers the changes in school education which strongly influence teachers, educational publishers and educational scientists in relation to textbooks and other learning materials, especially digital. He aptly describes consequences of social developments, economisation of education and technological changes in the nature of learning materials and their publishing. Reints’s argumentation is really worth reading. He grounds his ideas in the concepts of ‘learning’ and ‘quality’. The main task of educational publishers should be to make textbooks that support the learning process of children, and quality textbooks are those that scaffold learning. One of main questions posed in the paper is how educational science and educational research can help publishers and teachers when developing, selecting and using quality textbooks. The author argues that the vital question is not ‘what works’, but *why* it works, and we can understand the ‘why’ only when it is based on a reliable theory and/or model, especially a theory of learning. In the second half of the paper the concept of textbook quality, developed by the author, is

presented, which may be used as a sound basis for the development and evaluation of textbooks, particularly digital ones.

Workshop 1: Text materials in mathematics and science

The papers in this session focused on different aspects of textbooks and other media in mathematics and science teaching and learning. In the first paper included in the volume, *Hana Moraová* highlights that mathematics textbooks are far from being only a repository of mathematical tasks. They contribute to social discourse and the narratives in them play a significant role in cultural reproduction. The author suggests a possible methodological approach borrowed from literary theory enabling analysis of these narrative texts. The second paper presents a study based on the investigation of textbook selection and use in three schools with different sociocultural profiles in Brazil. In their study, *Edna de Souza* and *Nilson Garcia* sought to verify how aspects of local cultures might interfere in the teaching practice of science teachers, and how they lead to the choice and the use of textbooks.

Workshop 2: Text materials in social science and humanities

In the first article from this session, *Stig T. Gissel* considers a methodological issue concerning the use of learning materials for interventions in design-based research. The author describes a research project focused on the use and creation of digital learning materials for developing literacy in the early grades. Two theories of word reading, dual-mechanism and connectionist, are introduced, compared, and their practical consequences for scaffolding students' reading and literacy acquisition are analysed along with the consequences for choosing instructional texts. The two following articles from this session deal with textbook analysis. The research study reported in the paper by *Gabriel Kapfidsze* sought to find out if social studies textbooks used in Zimbabwean primary schools meet prescribed national curriculum standards. An emphasis was placed on relevance and adequacy of the content. An analytical instrument was employed using both qualitative and quantitative criteria revealing elements of bias, prejudice and bigotry in the textbooks. In the paper by *Vânia Ferreira* and *Carmen Ricoy* the analysis of music education textbooks is presented based on the instrument developed by the authors.

Workshop 3: Textbooks and teachers: Training, selection, use

The papers in this session made contributions to the study of textbooks in terms of the role of the teacher, concerning such issues as textbooks in teacher training courses, textbook selection by teachers and the use of text materials for teaching. An instrument for analysing and selecting textbooks was introduced by *Dilcelia Trebien* and *Nilson Garcia*, specifically for physics textbooks. The instrument was developed based on the Brazilian normative curriculum documents and the results of research on physics teaching. In another paper, *Álvaro Leite*, *Nilson Garcia* and *Marcos Rocha* presented their investigation aimed at examining how student teachers are being prepared to use textbooks in their future teaching. Like some other studies on the same issue, they concluded that little attention was paid to preparing students for the selection and use of text materials. In the last paper included from this workshop, *Arno Reints* questions whether teacher training institutions prepare pre-service teachers enough in recognising the quality of learning materials. He emphasises the most important role of materials – to support learning – and based on his study, concludes that

student teachers are not taught enough about how learning materials have to be evaluated or applied appropriately in order to support learning. In this paper an interesting research study is described, exploring the ability of pre-service teachers from different countries to assess the appropriateness of illustrations in learning materials in relation to the learning goals.

Workshop 4: Learning from text material for different purposes

This session includes papers addressing the issue of learning from texts, each focussing on different aspects, namely: differentiation, gender and immigrant background. In order to find connections between the use of digital learning materials and the differentiation of teaching, a two-year national intervention study in Danish primary and lower secondary school was launched. In his article, *Stefan T. Graf* presents two pillars of this study: a theory-based intervention design and the measuring of the pupils' competencies, performances and learning context. The intervention consists of a highly self-instructive 'learning material' for the professionals in the schools. The central design aspects and research methodologies are discussed in the paper. The second paper, written by *Hendrienne Wilkens*, examines the effect of learning-style characteristics of digital learning materials on learning from a gender perspective. An important conclusion she reaches is that there were less "boyish" assignments in the digital material examined. The author points out that future research should take this into account and proceed in investigating learning-style characteristics in digital learning materials with respect to differences between "boyish" and "girlish" assignments. *Aurélié Beauné* in the last paper of the section deals with the resources for low-skilled adult immigrants' language training. In her study she sought to highlight some of the difficulties in designing and using educational resources to meet the different needs of adult learners who are not experienced in reading and writing.

Workshop 5: Texts and changes, changes in texts

Following the widespread use of computers and web technologies in schools, this workshop invited contributors to discuss the issue of digital teaching and learning materials. The first paper addresses the possibilities of designing learning resources within synchronous learning environments. *Rene B. Christiansen* highlights that computer-mediated communication (CMC) offers new solutions for teachers and students, making it possible not only to teach computer-mediated, but also to design and create new, learning resources. A set of design examples is drawn to show how the design fulfils the dual purpose of functioning as a remote, synchronous learning environment and developing a repository of online asynchronous learning resources. *Nerea Rodríguez Regueria* and *Jesus Rodríguez Rodríguez* used the well-designed and elaborated instrument for digital textbooks evaluation (Reints & Wilkens 2012) which was developed based on the concept of quality conceived as capacity to enable students to learn. They adapted the tool for analysis of a Galician language textbook for primary education. The authors also point out that the very notion of digital textbook is still vague and discuss different approaches to defining it. The next paper in this session reminds us of an idea shared by many current researchers in the field: it is the way textbooks or other text materials are used that matters, not the texts themselves. During implementation and enactment, materials are interpreted, modified and adapted in different ways. *Susan Davis* emphasises that processes that involve co-construction and creation are required to ensure learning is relevant and meaningful. Her paper explores the creation of digital pre-texts as 'open' texts, which may be used as the framework for co-constructing learning experiences and locally-relevant resources. The last paper of the volume addresses the issue

of motivating the students by including problem-based tasks in textbooks. Based on the conclusions of research on Portuguese science textbooks, *José Duarte* argues that textbooks generally do not introduce problem-based activities and thus prevent children from being interested in science. He suggests that it is necessary to awaken curiosity in students to support successful learning.

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KEYNOTE PRESENTATION

What works and why? Educational publishing between the market and educational science

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Abstract

This keynote address focussed on the difficulties that today's teachers and educational publishers are confronted with in assessing the effectiveness of digital learning resources, and thus in choosing the policies they should follow in the digitisation of teaching resources. Teachers face uncertainties in terms of what can be done with digital learning resources, how they can best be used, their effects on student learning, and how digital technology such as iPads and cell phones can best be implemented. Educational publishers, in turn, are faced with their own uncertainties with respect to the development and production of digital educational resources: what teaching materials do teachers really want? What is actually known about the effectiveness of digitisation? Which business models are most suitable? All the while, the market is becoming more and more competitive.

In spite of the many hundreds of studies carried out comparing the effects of digital versus paper methods of learning, there is no conclusive data about the differences between the two. To discover the actual differences, we need theories that can explain them. We need to find out what works, and most importantly, why it works. Current research theories and models on how learning takes place are presented, and the features of digital materials that contribute to the learnability of (digital) textbooks are discussed, the two strongest being multimodality and adaptability – which are, at present, underutilised and/or not used effectively.

Finally, we make a case for publishers to put their focus on 'learnability' in the development of educational resources, and to take the help of educational scientists in designing quality materials and training teachers to use them. This would be a way to compete effectively in the market and at the same time meet the needs of teachers and learners.

Keywords: digital learning materials, educational publishers, learning theory, learning model, multimodality

Introduction

This article is about uncertainties.

Uncertainties of teachers: how to cope with the ongoing technological innovations and how to recognise the quality of digital learning materials like games, apps, YouTube videos, open educational resources, etc.

Uncertainties of educational publishers about what teachers really want and how to compete with these open educational resources.

Uncertainties of educational scientists about how to investigate the quality of digital materials, especially if compared with paper textbooks.

At the end of this article we try to stipulate a direction that each group – teachers, educational publishers and educational scientists – could take to cope with these uncertainties. The concept of textbook quality may be a promising answer.

But first: the uncertainties. Let's begin with the teachers.

Uncertainties of teachers: where are we going?

Teachers are facing changes in their profession. And these changes together make them uncertain about where their profession is going. The main changes have to do with societal developments and developments in societal beliefs, with the economisation of education, and of course with technological changes. Let us start with the societal developments and developments in societal beliefs.

Societal developments and developments of societal beliefs

Of course: migration movements have had a great impact on the composition of classrooms. Teachers are facing different cultures to cope with, where they constantly have to seek a balance between their own cultural beliefs and those of migrants. We have recently had several incidents in Dutch schools where teachers were insulted by students or even worse.

And of course, the pedagogical burden of teachers has grown – not least because of broken families. And teachers are being confronted with psycho-emotional problems they were never confronted with during their initial teacher training. Teasing, for instance, has recently led to several suicides of teenagers between 12 and 14 years of age in the Netherlands. Teachers in the whole country wondered if the teachers of those kids could have prevented these terrible acts.

But perhaps the deepest uncertainty of this moment that teachers are facing is how to cope with what we would call the 'fun culture' of society. Dutch children seem to be the happiest children in Europe. Happiness however appears to be strongly associated with autonomy and with fun. Wasn't it Freddy Mercury who sang already in 1989, 'I want it all, I want it now'? The teenagers of that time are now the parents of little sons and daughters who do indeed get everything they want. A TV in their bedroom, a mobile phone, iPad or laptop, lots of games, etc. Fun is the ultimate goal of life. What would be teachers' and schools' answer to this? Many of them are struggling with this dilemma: either to join in the fun culture and keep in touch with their students, being their friends on Facebook, or to emphasise that schools have educational responsibilities which go beyond the here and now. Which of course leads to more distance from your students.

Our experience with teachers in training courses, in research-based interviews and simply when talking with them at birthday parties, is that teachers tend to see fun more and more as a goal of their activities rather than as a means of reaching other goals. And that their most challenging task is no longer to teach their pupils something, but to motivate them. When

teachers are confronted with new learning materials, be they textbooks or YouTube videos, the first and main aspect teachers notice is if the materials will motivate the pupils, or if pupils would 'like' the materials.

ICT coming into school life

A second source of uncertainty is ICT.

ICT entered school life in the nineties of the last century. From the beginning it was clear that ICT could, or even would, have a great impact on daily school life. And it also became apparent that teachers faced a generation of pupils who were more capable of operating ICT devices and programs than they were. The time when teachers were always the ones with knowledge and the pupils the ones without knowledge seemed relegated to history. This still holds true and may be one of the reasons why teachers are reluctant to use ICT in their lessons. On the other hand, ICT cannot be stopped at the school door. As in everyday life, ICT has a huge impact on administration, communication, information, etc. But does it also have an impact on learning? The introduction of the first digital educational materials made it clear that pupils could and would work more autonomously. This raised uncertainties about the traditional value and roles of the teacher, about which many are still anxious.

In the meantime, the production of digital learning materials gradually developed and entered schools. But the frequency of use of these materials still remains below expectations, as is shown in the yearly monitoring reports of the Dutch government. The reasons for this are diverse, varying from hardware not functioning well to a lack of didactical views on how to use digital learning materials properly and effectively in lessons. There is also great uncertainty about the quality of digital materials. More and more teachers are likely to use digital 'lessons' they find on the web, or call their pupils' attention to interesting YouTube videos, educational apps and games. However, teachers are uncertain about the didactical quality of those materials and therefore tend to judge their quality mainly according to whether the materials motivate pupils enough, which is exactly the biggest threat for the quality of education; if motivation were to become the measurement standard.

We were asked to judge the quality of an educational game, developed and produced by a well-respected European educational publisher. The game consists of different games in which children are led through math exercises. It is meant for the home market and is connected to a math program from the same publishing house. The game is all about good and evil and many things take place in dark environments in which one must shoot a laser to combat the evil. We really doubt if schools profit from games like this. The material has no stated learning goals and does not allow children to learn intentionally. Learning only happens implicitly. Playing the game is central, not learning. There is no feedback at all. Children do not know what mistakes they have made, but that wouldn't even bother them because playing the game is central. The material does not reflect reality. The math exercises have nothing to do with a real and recognisable context. The game is more oriented towards skills than towards math. It reflects a concept of children and man which many people will detest.

Fun? Yes, for some kids. A learning activity? We have serious doubts.

Teachers also face dilemmas when they have to decide whether to use certain devices such as laptops, smart phones or iPads in the classroom. Teachers still rely heavily on their paper textbooks. Some institutions are changing into so-called Steve Jobs schools, but still teachers

do not know what the consequences of using these devices will be for learning processes and learning results. We will come back to this point later.

One thing is clear: the advent of ICT into school life will gradually change the role of teachers from instructors to coaches, while the role of instructor will be taken over by digital media.

However, many of the uncertainties mentioned above can hamper this process. Teachers need to have trust: trust in the operational quality of the hardware, trust in their pupils, trust in the quality of the digital materials, trust in their own skills.

The economy of education

We come to the third source of uncertainty that teachers face. It has to do with what we call the economisation of education. We see this on the national level, but also on the school level.

On the national level we see that governments see education more and more as an economic factor of great importance. One of the most interesting developments in this respect is the popularity of assessment programs like PISA and TIMSS. PISA, especially, is gaining influence over curriculum and exam programs in different countries. Every three years the rankings have their effect on national educational policies. As a consequence, teachers are almost constantly faced with new policies which influence their classroom life and they have to deal with the changing – and often higher – expectations of society, politicians and parents. One of the impactful features in the Netherlands is the ongoing pressure on teacher education institutes to become more academic. This pressure has an effect on the self-confidence of teachers who might think that they are apparently failing in one way or another. This is especially the case in the Netherlands where 20-25% of the teachers in secondary and vocational education do not even have an appropriate degree to teach.

At the school level, we see that budgets for textbooks are lowering. Let me explain what consequences this has in the Netherlands. The first consequence is that schools are buying less textbooks and asking their teachers to develop their own materials. Developing materials, however, does not form any part of the teacher education program and teachers have never learned how to develop materials. We know, and publishers know, how complex the development of materials is. The fact that teachers are very reluctant to share their self-developed materials with other teachers means that they are uncertain about the quality or usability of those materials.

Another consequence of economisation on the school level is that schools unite so they can get bulk contracts with publishers. In these contracts it is arranged that schools buy all their new textbook series from the same publisher, of course, for a lower price. As a consequence, individual teachers or departments of teachers have hardly any influence on selecting new textbooks for their pupils themselves.

All these changes – due to societal developments and developments of societal beliefs, ICT coming into the schools, and the economisation of education – raise feelings of uncertainty for teachers, who, even without these changes, exist in a profession where uncertainties are everywhere.

So it is not surprising that teachers nowadays face many uncertainties and that they are looking for their new professionalism. How publishers and educational scientists can help them will be highlighted later on. But first we want to turn to the publisher.

Uncertainties of publishers: where are we going?

Educational publishing has gone through a lot of changes in the last decades. Most of these changes were caused by the introduction of ICT in schools. From the beginning, educational publishers have sought solutions on how to develop and produce digital materials with commercially-attractive business models. On the one hand, developing digital materials is much more costly than paper textbooks. On the other hand, there was (and still is) uncertainty about what teachers really want, and how much money schools and society as a whole want to spend on digital materials. At the same time, open educational resource initiatives became available for schools. The future of educational publishers became less certain than it was for years, accustomed as publishers were to a rather stable market. Publishing houses merged together to benefit from bigger scales. And they were bought by investment companies, often absorbed by big publishing houses. Margins of profits were raised to come into line with margins of other publishing branches. The content of educational publishing faded away. In the yearly report of the Dutch Educational Publishers Group, part of the Dutch Publishers Association, we see how educational publishing has been swallowed by the multimedia publishing of other branches. The central theme of the last yearly report was: “Validated trend watching and what that means for media and media consumption” (Nederlands Uitgeversbond 2012). Textbooks have become media, schools have become media consumers. And not only schools, educational publishers moved their focus to the home market also; to parents. New products also appeared: distribution platforms and educational games. Most of these games are primarily fun games, with a little educational sauce. Earlier we described an example of this. These games appeal to the uncertainties of teachers we described above.

Publishing now has indeed become a market-driven business industry where there is hardly any room for special groups like low or high achievers. Earlier, I mentioned the impact of PISA. Let me take the example of my own country, the Netherlands. In the Netherlands, publishers have a great influence on the quality of education. In more than 90% of all lessons, textbooks are used, and quite intensely. Dutch teachers rely heavily on textbooks.

Dutch PISA results lowered slightly over the last few years. And this was the case not just for average pupils, but also for the high achievers. The heavy reliance of teachers on textbooks makes them perhaps less creative in teaching the high achievers in their classes. And for publishers this market is too small to produce for.

This is where we are now, far away from the educational task publishers once had: making textbooks that supported the learning process of children. Of course these developments have to do with all kinds of uncertainties educational publishers face. What do teachers really want? Do digital materials work better than paper materials? What is the quality of the open educational resources? Will boundaries between school, home and society fade away or will schools develop strongly in the direction of learning institutes instead of funhouses?

Our concern is: where is the knowledge about teaching and learning that educational publishers had for decades? Where has the expertise gone about selecting content, organising content, choosing didactical strategies, etc.

Are we at a crossroads? Are we going into the direction of commercially, market-driven publishing, or of primarily having an educational task?

Could educational science and educational research give us the answers?

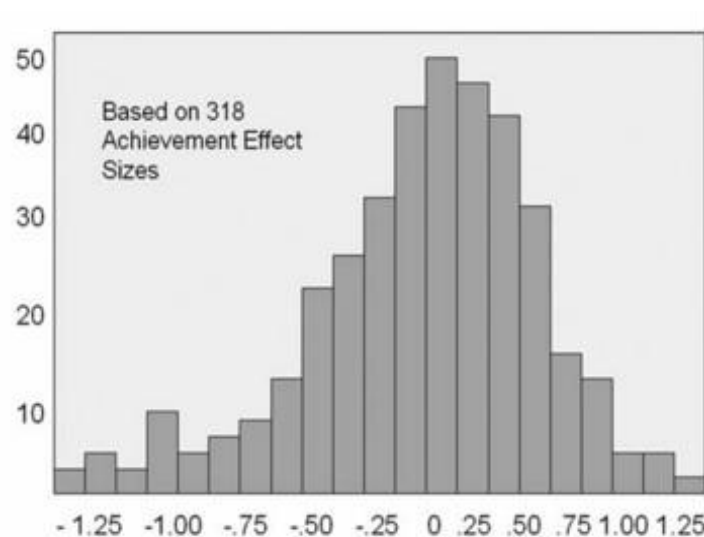
Can educational science and educational research give the answers?

As I stated above, educational publishers face a lot of uncertainties. One of these is whether digital textbooks work better than paper textbooks. Some important questions to ask are if educational science can give the answer to this question, and if educational science has, in fact, given the answer. To both questions I would say: yes and no. Let me start with the ‘no’.

Until the 1980s educational science flourished. As a new, upcoming discipline, many researchers and scientists studied learning processes in schools and from there they developed curriculum theories and models, innovation and implementation theories and models, and didactical theories and models. In the 1970s and ‘80s educational science developed a rich realm of theories and models. In the ‘80s this development suddenly stopped. The main cause for that was the introduction of ICT. More and more researchers began starting research on the technological and educational possibilities of ICT. The focus of that research became the question: what works? Numerous investigations about the use and effects of ICT in schools were undertaken, and of course, researchers wanted to know if digital materials work better than traditional instruction with paper materials. What were their conclusions?

In the 1990s, Dillon and Gabbard (1998) mentioned that up till then hundreds of comparative studies had been carried out showing hardly any difference in learning results between different media. In 2004, Bernard et al. executed a meta-analysis of 232 comparative studies, mentioning 318 achievement effect sizes between electronic distance learning and face-to-face-instruction (see Figure 1).

Figure 1: Effect sizes between electronic learning and face-to-face-instructions



We see that the vast majority of those studies reveal no effect at all or a very small effect. Only a few studies show a substantial effect size of 1.00 or more, equally distributed in favour of digital and face-to-face. The authors analysed the studies with the substantial effect

size and concluded that there was no consistent subset to recognise; it was impossible to conclude that specific features of digital or paper textbooks were responsible for these effects.

So this does not bring us any further in our search for evidence. Let us discuss the main problems with this kind of research. The first has to do with what we call the “Media Debate”, and thus the problem of what we are actually comparing. The second problem has to do with the lack of theories and models.

Anderson and Elloumi (2004) write about an ongoing debate on the question of whether it is the technology that influences the learning process and results or the instructional design. This has come to be known as the “Media Debate”. On the one hand, Clark (1983) states that the medium is only the vehicle of an instructional design, nothing more than that. On the other hand, Kozma (1994, 2001) states that the fact that you can’t compare different media does not mean that media do not differ from each other. We all know the possibilities of digital media, like the use of multimedia and the possibility of adaptivity and interactivity.

Yet the problem still remains: what are we comparing with what? When we compare the effects of digital materials versus paper materials, are we comparing different kinds of apples or are we comparing apples with pears?

Imagine two textbooks: a digital one and a paper one. And we want to compare the effects on learning of the two books. How can we compare the two? There are two possibilities:

1. We compare two different apples. That is: we only vary the medium: all other variables, like instructional design, lay-out, content, texts, illustrations, etc, remain the same. But what is the use of this comparison if we do not use the potentialities of digital media? We would say that this kind of research lacks ecological validity: we investigate something that never would or should be the practice in classrooms.
2. We compare apples with pears. That is: we vary not only the medium but also one of the other variables, for instance the use or absence of hyperlinks in the text. But then we have the problem of having varied more than one variable so we cannot conclude which variable is responsible for the learning results, if any are found anyway. We would say that this research therefore lacks legitimate results or conclusions.

Would the conclusion be that it is not useful to investigate the effectiveness of digital materials? No, there is hope. But then we have to pick up where we left off in the 1980s. We especially need learning theories and models, and we need to apply these theories and models to the concept of textbook quality. Only then we can say something about the effectiveness of textbooks. Because the vital question is not *if* something works, but *why* it works. If we do not understand why something works it will never give us the guarantee that it will work again tomorrow, or that it will also work in another place, in other circumstances, etc. We might take the risk and develop materials that we *think* will work, but as long as we do not *understand* why these materials work, we might have developed materials that do not always work, for every student, every teacher, every subject, etc. Therefore we need theories and models to understand why things work.

And so we arrive at the ‘yes’.

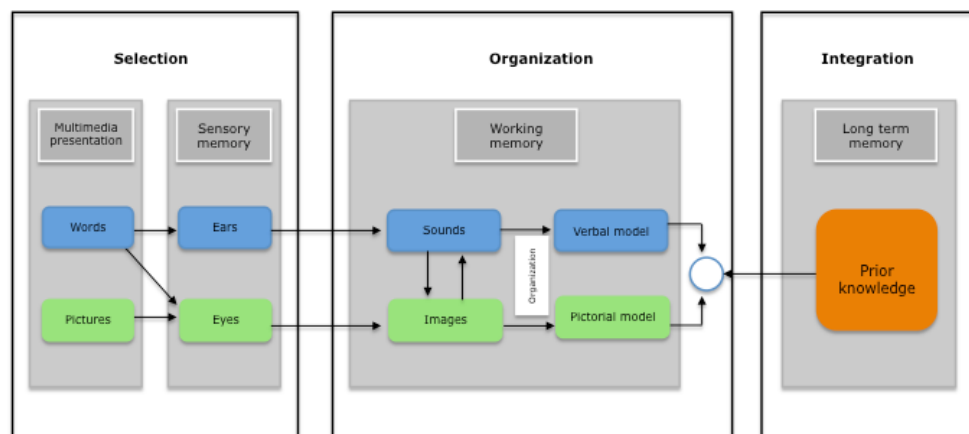
More and more educational scientists have a common notion about how learning takes place. In this respect the information processing model of Mayer and Moreno (2003) is often used (see Figure 2).

According to this model, information processing occurs along three phases:

- a. *selection* of relevant information in the sensoric memory;
- b. *organisation* of the selected information into mental models in the working memory;
- c. *integration* of the mental models and the prior knowledge into new knowledge in the long-term memory.

Information enters memory mostly by means of images and words, through the ears and the eyes. It has to be elaborated in the working memory, which has a limited capacity. Only when a learner is capable of connecting and integrating the information to and within the existing knowledge, learning takes place. The new information has been stored as new knowledge in the long-term memory.

Figure 2. The information processing model of Mayer and Moreno



By using this theory and model we can interpret research findings. And we can investigate not only what works, but also why it works.

Let us give you an example. Researchers in the United States found that 78% of the students working with a science app on an iPad succeeded in their tasks, while only 59% of the students working with the traditional textbook did (Fensterwald 2012). But what does that say when we do not know what caused the difference (apart from the fact that the research was sponsored by Apple and by a big software house)?

On the other hand, a large-scale meta-analysis in the journal, *Computers in Human Behavior*, revealed that the many click-decisions pupils have to make cause an overload in the working memory so that the processing of new information is disturbed. Here we have a study whereby the results are connected to learning theory, so that we do not only know what the effects of, let's say, an iPad, are, but also why these effects are as they are.

From this point of view it is not so difficult to see where the advantages (and pitfalls!) of digital textbooks lie. In the following section we will present our concept of textbook quality. We will illustrate this concept by giving several examples of the effectiveness of digital textbooks.

The quality of textbooks

Textbooks, paper and digital, are designed for educational purposes. That means that their main function is to support learning processes. So when we evaluate the quality of (digital) textbooks we primarily look at the degree to which they let pupils learn effectively. We see quality as the equivalent of learnability. But what is learning exactly? We will follow the definition of Boekaerts and Simons (1995): someone has learned something when we see a stable change in his or her knowledge or behaviour, as a consequence of learning activities, and it is characterised by a certain degree of transferability. This transferability is an important part of the definition. It refers to the capability someone has to apply what he or she has learned in other situations than those in which he or she has learned the specific knowledge or skill.

Transferability distinguishes information from knowledge. Information is not transferable and has only incidental meaning. Only in the case where the information has been stored in long-term memory, and thus may be used when a new situation arises where it is needed, do we speak of knowledge instead of information. In schools, not all information is used to create knowledge. Much information may be forgotten after consultation and cannot be seen as part of *learning* material.

Characteristic of the definition of Boekaerts and Simons (1995) is that they only talk about the *result* of learning: change in knowledge or behaviour, observable learning results. *How* learning takes place is another story. Although there are many theories about how people learn, many of them rely on the information processing model of Mayer and Moreno (2003).

According to Mayer and Moreno (2003), learning implies that presented information is transformed into transferable knowledge. This process normally takes place in three phases: selection of information, organising information, integrating information. Textbooks, including digital ones, have to be designed in such a way that these three processes are suitably supported. In the following section we will show how digital textbooks can do this.

Three quality domains

In evaluating textbooks three domains are usually distinguished: content, pedagogics and presentation (Elen 1993). This is a very useful distinction. First, because you can't learn without content: it is like looking without images or hearing without sound. But content in itself is raw material and has to be transformed pedagogically: pupils have to act upon the content. Without acting learning will not take place. And third: for information processing you always need senses. So the material must be designed and presented in a way that learning will be supported. Only when textbooks meet those three domains of quality criteria can we talk about good textbooks.

The three quality domains each contain three so-called learning functions of textbooks:

Content

- Selecting content
- Organising content
- Modalities of content

Pedagogics

- Didactical strategies
- Didactical activities
- Regulating learning processes

Design & presentation

- Readable texts
- Functional visuals
- Layout

In what follows we will see where digital textbooks can support (or hamper?) learning processes. In other words: what works and why?

Selecting the content

In selecting content, the exam programs, of course, play an important role, as do the learning goals. Besides, the content has to reflect the prior knowledge and interests of pupils and there must be possibilities to identify with the content.

One word about interest. Research from Krapp, Hidi and Renninger (1992) shows that textbooks with content that is interesting to pupils have a positive impact on the learning results. Interesting material motivates pupils to read, it influences understanding and results in better learning. According to Hidi (2006), interest attracts attention and stimulates memory. Interest facilitates learning, enlarges understanding and stimulates the mental effort as well as personal involvement. On the other hand, when texts touch pupils emotionally, there is a chance that pupils will be distracted instead of attracted. Interest must not be confused with fun. Interest arouses the necessary mental effort, while fun mainly distracts attention from learning.

Digital textbooks can adapt to the interests of pupils by letting them choose content. A good example is the reading program *Lesewerkstatt* from the Lehrmittelverlag Zürich, where pupils can choose between different reading stories.

Organising the content

If the content has been organised into a strong structure, this can help learners to process information better and to store it in their long-term memory. Brain research shows that:

- there must be coherence of content;
- relationships must be explicit and clear;
- pupils need to be supported to relate concepts or phenomena;
- strong connections enlarge the probability that information will become knowledge.

Digital materials make it possible to vary the content structure of chapters, paragraphs and texts, like many digital platforms do.

Choosing modalities

Content can be ‘packed’ in different manners: video, text, pictures, sound, music, etc. These different manners we call modalities. It is important that learning material varies between visual and auditory information.

The first reason for this is that pupils differ. Some pupils have a more visual learning style, others more auditory. It is even more efficient when you offer authentic material so that pupils can also learn from smelling, touching or tasting.

Secondly, it is important to use the right combination of modalities to relieve the working memory. The more relief, the better a pupil learns. The information processing model of Mayer and Moreno (2003), again, shows why this is (see Figure 2).

Information enters memory mostly by means of images and words, through the ears and the eyes. They have to be elaborated in the working memory, which has a limited capacity. The *dual channel hypothesis* plays an important role. Humans possess two parallel channels to process information: visual and auditory (Paivio 1986). If information enters memory through different modalities which make use of only one channel, for instance written text and a picture (twice visual), then the information-processing task is much heavier than the case in which the information can be processed by two different channels, for instance the ears and eyes. This is called the modality principle.

Other important principles are:

- presenting written text and pictures simultaneously (multimedia principle);
- presenting text and visual on the same page or screen (contiguity principle);
- avoiding redundant texts, sounds and visuals (redundancy principle).

Digital material has the possibility to support the sensory memory by offering static and dynamic visuals, written and spoken texts, sound and music. But be careful with all these possibilities. Remember that “less is more”.

Didactical strategies

In the last paragraphs we discussed topics like selecting and organising the content, and choosing its modalities. Now we turn our attention to the pedagogics of a digital textbook: pupils have to do something with that content in order to learn successfully. Therefore, developers of learning materials choose certain learner activities: exercises, assignments, questions, etc. These activities are meant to foster specific learning goals. When these activities are applied systematically we speak of didactical strategies. There are many different didactical strategies. Important strategies are activating prior knowledge and giving feedback.

Digital material is very suitable for giving feedback. But not all feedback helps learning. Hattie and Timperley (2007) made a distinction between three different kinds of feedback:

- Knowledge of Response (KR): pupils are told if the answer or solution is right or wrong.
- Knowledge of Correct Response (CKR): pupils are also told which is the right answer or solution.

- Elaborated Feedback: pupils are also told why the answer/solution is correct or not.

According to Hattie and Timperley (2007), pupils learn most from elaborated feedback and least from KR. Unfortunately most of the feedback in digital programs is of the KR-modus.

Didactical activities

Didactical activities are specifically chosen to attain certain learning goals. Using a taxonomy of learning goals, like Bloom's (1956), makes it possible to choose the right didactical activity for the right learning goal.

Pupils may differ in their learning styles, motivation and cognitive capabilities.

By enhancing *variation* in didactical activities it is possible to cope with all these differences. Besides, learner material can try to *adapt* the difficulty of exercises to the level of the pupils. Of course, digital textbooks are very suitable in adapting not only to the cognitive level of pupils but also to their learning styles.

Digital programs can adapt assignments to learning preferences of pupils. Some programs diagnose the learning style of a pupil beforehand and design a so-called user model for the pupil (program control). Other programs let pupils choose what assignments they want to do (learner control). There are many programs where learners can choose from a given set of assignments to choose from (shared control). Because it is very difficult to design reliable user models, and because teachers, especially, do not want their pupils to choose the assignments on their own, programs with shared control are often preferred.

Regulating the learning process

Pupils who are able to regulate their learning process learn more deeply and more effectively (Bannert & Mengelkamp 2008, Georgiades 2004). Valcke (2010) found that metacognitive cues in textbooks lead to better results. So we have to consider the possibilities of how digital textbooks can support these processes. Flavell (1987) distinguishes the following activities: preparing, planning, monitoring, evaluating. In digital textbooks all activities can be placed on a separate screen, with categories like preparing, planning, monitoring and evaluating. Pupils can be led to this screen from other screens by a link.

Presentation of the learner text

Characteristics of the learner text play their role on different levels: word level, sentence level, and text level.

On the word level it is important that a text contains many familiar words for the pupils. Beware of too many metaphors.

On the sentence level the length of the sentence plays a role, but is not always decisive. Text coherence is much more relevant (Schnotz 1984). Sentences must be connected to each other by signal words like 'because', 'thereafter', 'also', 'besides', etc. The use of these words is

especially relevant for poor readers (Land 2009). Longer sentences with signal words are better understood by pupils than short sentences with no connections between them.

Coherence is also of importance on the text level where signal words such as, ‘to begin with’, ‘secondly’, ‘at the end’, highlight the structure of a text. Also, headings are essential.

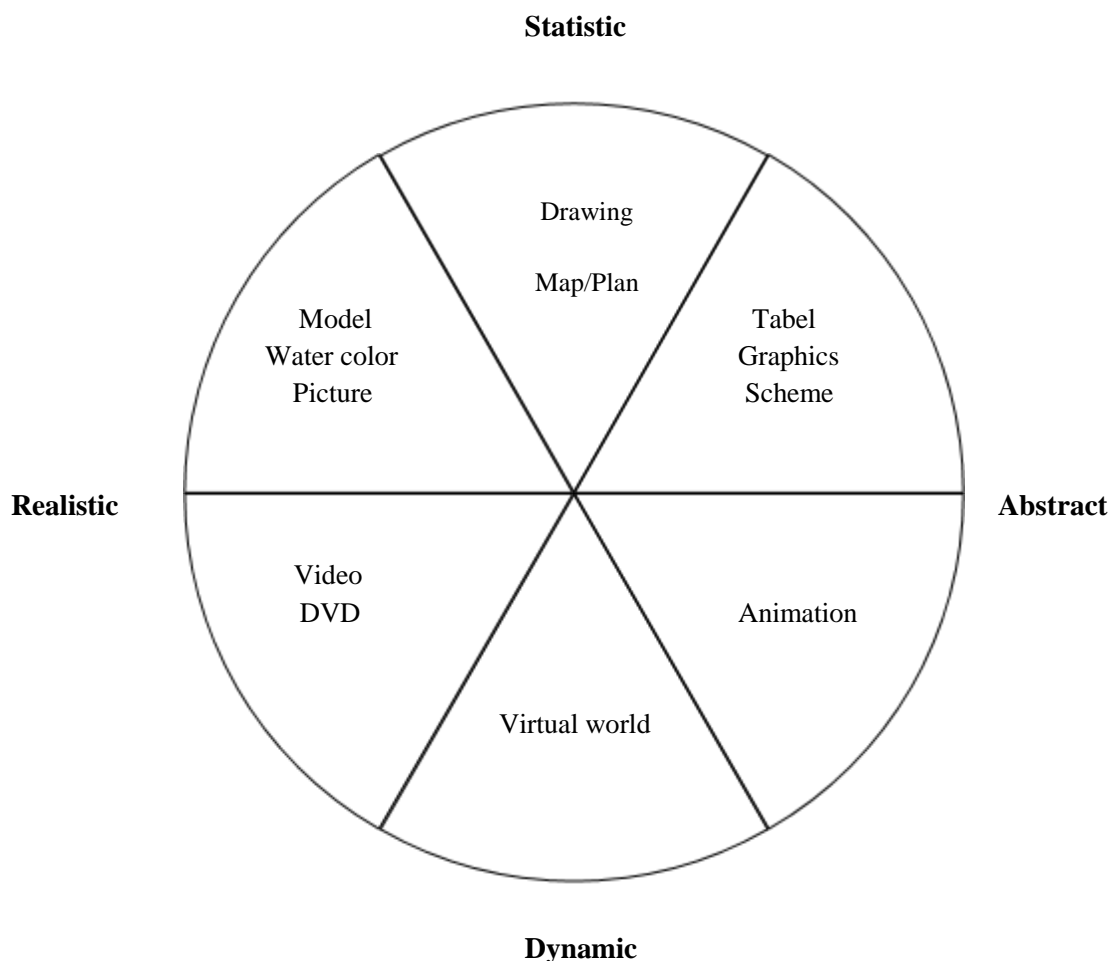
Most publications about how to write texts for screens are not meant for learning texts. There is hardly any research done concerning these kind of texts. We’re not talking about readers, but learners. Readers do not seem to read a screen text, but they scan these texts (Nielsen, n.d.). This is exactly the core problem of digital texts: how to design screens in such a way that learners are willing to study these texts?

Presentation of visuals

We discussed earlier that pupils will process information better when written texts are supported by visuals (the multimedia principle). Text and visuals need to be placed near each other (the spatial contiguity principle). In this section, we discuss which visuals support learning and which do not.

Visuals in digital textbooks encompass static (illustrations, pictures, models) as well as dynamic visuals (animations, videos, virtual reality). They can be realistic or abstract:

Figure 3. Different kinds of visuals



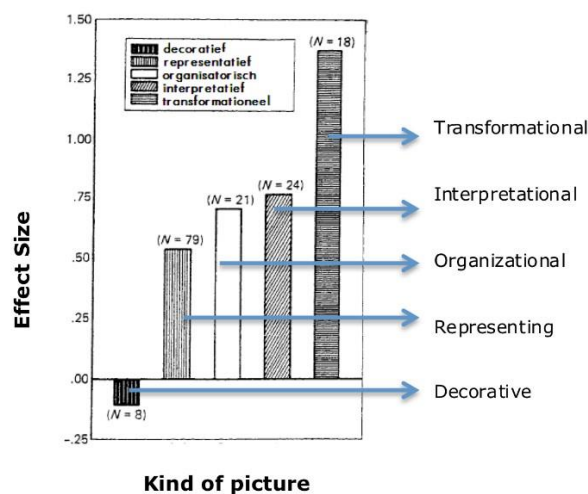
There are choices enough. But what are the functionalities of all these visuals? Carney and Levin (2002) distinguished the following kinds of visuals: decorative, representational, organisational, interpretational and transformational:

Table 1. Carney and Levin's types of visuals (2002)

Function	What they do	When to use
Decorative	Attract attention	Useful at the beginning of a new chapter to motivate. When used frequently they hamper learning.
Representational	Make content concrete	Useful when concepts, phenomena and objects have to be clarified.
Organisational	Give structure to content	Useful when concepts, phenomena or objects have to be analysed or processes have to be shown.
Interpretational	Simplify content	Useful when complex processes, abstract or complex concepts and phenomena have to be explicated.
Transformational	Aid memory	Supportive in remembering difficult, mostly meaningless facts.

Digital materials are very useful in presenting effective visuals, especially when they have an organisational or interpretational function. One of the most important studies on this subject comes from Carney and Levin (2002). They did a meta-analysis of 160 studies and found that pictures with a well-defined function (e.g. organisational, representational or interpretational) are important for learning, whereas decorative pictures, on the contrary, can even hamper learning (see Figure 4).

Figure 4. Effects of illustrations on learning outcomes



Layout

The layout of a (digital) textbook has two important functions: to direct attention and to structure the information (Hartley 1999, Lorch 1989). To direct attention, aspects like the typography, use of colour and markers are useful. To structure the information we can think of the type page, the combination of text and image, and the use of headers.

Digital materials are very suitable in adapting aspects of layout to individual differences between pupils.

From research we also know that layout may hamper learning. Especially when:

- there is abundant use of CAPITALS;
- there is abundant use of colour;
- there are combinations of coloured characters which are difficult to read (for instance, red on white, green on red);
- a text has many enumerations;
- there is abundant use of markers.

Closing remarks

Will digital textbooks replace the paper textbook? In 1913, Thomas Edison predicted in the *New York Dramatic Mirror* that “books will soon be obsolete in the schools... It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed in ten years.” (quoted in Saettler 1990, 98).

Why this still has not happened finds its explanation in the fact that all these new media, from motion pictures to mobile phones, are not primarily developed to learn from. They are primarily designed to amuse, to inform, to communicate, to administer, but not to learn from. While books, on the other hand, have had a tradition of instructing people for centuries. Now again, it is our conviction that digital textbooks will not replace paper ones. Screens on tablets do not invite pupils to think, and rethink and reflect, but more to wipe, click, and scroll. A remarkable fact: the Waldorf School for primary education in Silicon Valley, California, is very popular with parents working at companies like Apple, Yahoo, Google, HP, and e-Bay. The school has no digital materials at all...

In this paper we presented important features of digital textbooks, features that contribute to the learnability of (digital) textbooks using learning theories and models, in combination with empirical research. As jury member of the Best European Schoolbook Award I have evaluated numerous (digital) textbooks. Most digital textbooks hardly make effective use of the digital potentialities. The two strongest characteristics are multimodality and adaptability. The multimodality characteristic is sometimes used, but often in the wrong manner, presenting redundant visuals, sounds and texts, or by ignoring the principles of spatial and temporal contiguity, and so overloading the working memory.

As to the adaptability characteristic, we notice that mostly programs are not capable of adapting program elements to the input of pupils. Besides, pupils are seldom stimulated to reflect on their learning process, and programs mostly give only correct response feedback, without further explication of why the answer is correct or not.

And yet the way we think the educational publishing industry should go is towards quality. The quality of open educational resource materials at the moment is far from what learners and teachers need. Going for quality is the way for publishers to compete. And publishers can help teachers to overcome some uncertainties by offering them quality materials. Educational scientists can help publishers in designing quality materials and in helping to train teachers to use these quality materials properly. It is important for publishers and for our educational system that more attention be given to the quality (i.e. the learnability) of digital textbooks. Economic and educational arguments can and must go hand in hand.

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WORKSHOP 1
TEXT MATERIALS IN
MATHEMATICS AND SCIENCE

Imagology - A possible methodological approach to the study of narrative texts in mathematics textbooks

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Abstract

The aim of this paper is to propose a methodology suitable for analysis of mathematics (but also other) textbooks. The author wants to point out that the usual analyses, focusing on the curricular content, are not sufficient. Textbooks contribute to social discourse, they are performative, their narrative texts play a significant role in cultural reproduction and also partially constitute the so-called hidden curricula (i.e. what pupils learn together with the curricular content unwittingly). Textbooks of mathematics not only tell stories about our world, they do so 'by the way'. The users and authors focus on the mathematical content, on what is to be taught and learnt, in consequence of which the non-mathematical content is somatised often unawares. In the paper the author suggests a possible methodological approach borrowed from literary theory enabling analysis of these narrative texts.

Keywords: imagology, mathematics textbooks, social discourse, curricular content, cultural content, narrative text analysis

Theoretical background

Mathematics textbooks are a literary text *sui generis* combining curricular content with non-mathematical settings and narrative texts. In their analysis attention should be paid to both: the curricular content as well as to their cultural, literary content. However, current mathematics textbook research most often focuses on the curricular content and perspective of presentation. Content analysis for a mathematician or mathematics educator means analysis of what mathematics is included in the textbook and how it is treated. McCrory, Siedel and Stylianides (n.d.), in their comparative analysis of mathematics textbooks for elementary school, study three major curricular topics – fractions, multiplication, reasoning and proof – looking for the similarities and differences in their presentation, in the level of detail, depth and breadth of approaches, presentation of material, and functionality of the book. They pay no attention to the fictional worlds in these textbooks although they do point out that textbooks may be placed on a scale from purely encyclopaedic to narrative.

However, the role of narrative parts of mathematics textbooks (both expository narratives, i.e. the narrative texts in which new mathematics topics are introduced through a story in which, most often, children do things in the world and encounter mathematics while doing them, and word problems, which are meant to simulate real-life situations where mathematical algorithms are applied for their analysis and solution) is far from negligible in the process of

cultural reproduction. Textbooks of mathematics are narratives and belong to stories offering a core of cultural knowledge that future generations are expected to both assimilate and support. They tend to enforce and reinforce cultural homogeneity through the promotion of shared attitudes (Crawford 2003). They partially constitute the content of the so-called hidden curriculum. When solving problems from mathematics textbooks, pupils learn much more than just mathematical operations. While solving mathematical problems through the stories and settings, pupils' mental schemas, their perception of what the world should be like and what the roles of different people should be, what is perceived as the norm and what constitutes the "abnormal", are formed. In other words, work with mathematical textbooks contributes to pupils' preconceptions about the world around them, to their construction of social reality and if these texts, for example, present gender stereotypes, they affect pupils' gender stereotyping. These mental images and schemas affect pupils' future decisions and actions. Stories told in mathematical textbooks are cunning simulacra or phantasms, virtual realities that eventually look more real than reality; the so-called hyperrealist (Baudrillard 1998). They offer a picture of the world which is not only the *model of* but also *model for* reality (Geertz 2000). They are performative and must be studied as such. Clearly, significant influences in the formation of children's schemas come from the family, significant others, media, literature, stories for children and so on. Nevertheless, if children have mathematics lessons four times a week, the influence of the often-repeated images they come across cannot be considered negligible.

The proposed method

The question the author is trying to answer in this paper is a methodological one. How can the analysis of narrative texts of mathematics textbooks be approached? How can we work with themes and images presented in mathematical textbooks? What illusion of reality does the author of the textbook want to create or did he/she create unawares? What beliefs and schemas does the author help to reinforce?

The proposed methodology, imagology, is appropriate in the search for answers to these questions as it looks for inter-textual links, repeating occurrences of certain character types, patterns, themes, the broader cultural context. It is one of the methods the author is planning to use in her larger research project focussing on narratives in mathematics textbook texts, where not only stereotypes, images and themes present in textbooks of mathematics will be studied, but also authors' intentions and focus, publishers' interventions, teachers' awareness of these factors and pupils' attitudes.

Conceptual framework – Image and Stereotype

Image is a polysemantic word. Merriam-Webster offers the following definitions:

- (1) a reproduction or imitation of the form of a person or thing; *especially* an imitation in solid form, (2) the optical counterpart of an object produced by an optical device (as a lens or mirror) or an electronic device, (3) a likeness of an object produced on a photographic material, (3) exact likeness <God created man in his own *image* -- Gen 1:27 (Revised Standard Version)>, (4) a person strikingly like another person <she is the *image* of her mother>, (5) a tangible or visible representation <the *image* of filial devotion>, (6) a mental picture of something not actually present, (7) a mental conception held in common by

members of a group and symbolic of a basic attitude and orientation <a disorderly courtroom can seriously tarnish a community's *image* of justice -- Herbert Brownell>, (8) idea, concept, (9) figure of speech, (10) a popular conception (as of a person, institution, or nation) projected especially through the mass media <promoting a corporate *image* of brotherly love and concern -- R. C. Buck>, (11) a set of values given by a mathematical function (as a homomorphism) that corresponds to a particular subset of the domain.

On the one hand, “image” is understood as communication, especially visual communication or presentation (definition one), on the other hand “image” is considered a “mental picture” or idea of something that is not actually present (definition six). The concept of artistic image (1) refers to the sender, who performs or presents something; the psychological image (6) refers to the receiver, who interprets and comprehends the presentation somehow. “Image” in the presentational sense is to be understood as a choice of certain meaningful elements that will exist in a presentation and as a choice of leaving other available elements absent. For literary theory and analysis of narrative texts in textbooks, it is important to focus on the analysis of the process of selecting and leaving out certain elements. The image of a person (mother, father, teacher, African-American, Jew, etc.) becomes more relevant than his/her “selfhood”. It is crucially important to explore the motivation and the selection process of the author. What exactly did the author want to communicate? What illusion of reality did he/she want to create? What beliefs did the author help to reinforce? It is vital to bear in mind that “image” does not represent reality but pseudo-reality, an appearance of reality, but it may be taken by the pupils as representing reality.

“Image” in the psychological sense should be understood as a cognitive “knowledge structure” or schema (Strauss & Quinn 1997). The schema works like an informal theory concerning some object: it anticipates what kind of thing the object typically is (Hayesová 2007). It is in a way a projection to the future of former encounters and experiences. These encounters may be direct, but often are mediated, for example through speech, literature, pictures or other media, i.e. also textbooks. Thus human knowledge structure may often be built, not on direct experience, but on secondhand information (Karvonen 1997). An often-repeated image gradually becomes a stereotype. A stereotype is something conforming to a fixed or general pattern, a standardised mental picture (Allport 2004). Textbooks which often repeat the same images are undoubtedly one of the sources of creation and reinforcement of stereotypes. A stereotype, according to Merriam-Webster, is something conforming to a fixed or general pattern, especially a standardised mental picture that is held in common by members of a group and that represents an oversimplified opinion, prejudiced attitude or uncritical judgment. It is a mental image that can be called to mind very easily, usually using only one key word. It never depends on the extent of contact but on the amount and type of information about the object. That is why images must be scrutinised carefully if they are to be subverted and why textbooks of mathematics should also be examined from this perspective.

Imagology

In literature, the term “imagology” (the study of images) is used to refer to more than one branch of studies. Its ideological meaning, introduced by the Czech writer Milan Kundera, refers to the power of the social image imposed by those who determine fashion. Image is understood as a mask that is put on to send a specific kind of signal, for instance in the case of politicians. Kundera also speaks of imagologues – a powerful institution which guides

politicians, tells them what to say and how to say it, and which controls the public opinion. In Kundera's point of view, imagology studies relations between power, control, ideology and images. Apart from the image (the signal we communicate to others), Kundera discusses the image as a mental picture that surpasses ideas. He speaks of the triumph of "imagology" over ideology. As an illustration he shows that in the 1980s Marxism was no longer a logical system of ideas, but only a series of suggestive images and slogans (a smiling worker with a hammer; black, white, and yellow men fraternally holding hands; the dove of peace rising to the sky; and so on and so on). Not only with Marxism but much more generally, we are witnessing a "planetary transformation of ideology into imagology", and he suspects that there is no turning back. The triumph of imagology is a kind of "virtual reality" that has displaced reality. All ideologies have been defeated: in the end their dogmas were unmasked as illusions and people stopped taking them seriously. For example, Communists used to believe that in the course of capitalist development the proletariat would gradually grow poorer and poorer, but when it finally became clear that all over Europe workers were driving to work in their own cars, they saw that ideology was deceiving them. Reality was stronger than ideology. And it is in this sense that imagology surpassed it: imagology is stronger than reality (Neuhaus 1995). It does not refer to real things, but to a created, virtual reality and therefore cannot be beaten, cannot fold back on itself.

From the point of view of cultural studies and comparative literature, "imagology" (the term was coined by French comparatists in the 1950s) studies intercultural relations in terms of mutual perceptions, images and self-images. It can be employed for the study of attitudes and perceptions of certain phenomena in a society. As shown in the preceding section, "image" is not necessarily based on reality but it is a mark of attitudes of a society to a certain phenomenon and its repeated representation of it. It must be seen as a subjective construct rather than objective essence. It reveals more about the society that forms it than about the original model. The perceptions and identifications surely influence cultural and social practice and cannot be ignored if we want to get a clear picture of a certain society, if we want to study the discursively-constructed nature of many social and cultural values ("*On Imagology*" 2003). Only the study of images will enable to break with the past and set out resolutely to change the society (World Federation of Teachers' Unions, UNESCO 1983). Many things in our society are organised in a particular way because they are said to be natural. To prove the artificial origin of certain stereotypes means to open the way to their subversion. The increasing interest in the study of minorities and in "identity politics" in recent years has brought a renewed interest in imagology. Historians, anthropologists, literary critics, feminists, all look at images that the dominant groups in society constructed in response to encounters with minorities such as Jews, African-Americans, members of other nationalities, women, single women and men and so on. Only a detailed study of these areas can help to answer why there are still so many things regarded as natural which are not in fact (a woman's destiny is to have children, the man's task is to win bread, men are better drivers, etc.).

According to Werner Sollors, "imagology" in literature means devotion to studies of the "image", "mirage", or "stereotype" of one social group in literature by another (Sollors 1999). This definition limits the possibilities of imagology because it excludes, for example, images of women created by women. But this presupposes that authors of literature, or of textbooks, are absolutely free when selecting characters or their images who will inhabit their narrations. It will definitely be interesting to analyse narrative texts in textbooks of mathematics written by women and by men to see if their selection of images is different. Are women authors less traditional when creating their characters and do they tend to produce

more liberal images of the sexes? If not, it would be better to revise Sollors's definition and say that "imagology" is the study of images of groups of people in literature and other texts of a certain society.

When approaching ethnic, racial or gender issues in the analysis of narrative, imagology combines with thematic explorations. By theming we relate a text to other texts, we refer to things outside of the text, we look for thematic recurrences and the variations in the theme. The process of theming (analogically to the process of selecting traits of a specific image) may be guided by a variety of mixed-up, often unconscious interests – for example logical, aesthetic, statistical, financial, political, moral, genealogical, psychoanalytical, structuralist, nationalistic, or autobiographical motives (Sollors 1999). The process of selection and theming is negotiated with the reading public, with consumers of the texts. In the case of textbooks, with education policy makers, publishers, headmasters, teachers and also pupils. At the same time the selection should appear plausible in the text to ensure that the text remains readable. There are undoubtedly authors and publishers who try to subvert entrenched beliefs and stereotypes, but the most daring experiments in presenting cultural values and images in textbooks do not seem to be successful on the market. To gain the approval of society, the author must conform to society's morality and thus also helps to promote it and reinforce it.

However, structuralist and aesthetic motives must not be overlooked. Images and stereotypes in narrative texts are of a specific nature. Stereotypes in narratives, but also for example in advertisements, are underdeveloped, 'flat' characters recognisable in outlines. They are created by repeated generalisations in characterisations without any scientific authority. Soon they become a representation disconnected from reality or verisimilitude and are anchored only in rhetorical precursors, in the case of textbooks often in precursors from earlier textbook sets. From the structuralist point of view, stereotypes are very suitable for minor parts. Especially in fiction, which is densely peopled, it would be an enormous problem to introduce every character fully. Stereotypes, who lack individuality and psychological depth, can be given a few memorable traits which saves time and effort (Sollors 1999). And this is what is often needed in narrative texts in mathematics textbooks and word problems where the author does not have the space, the time and maybe even the energy for full development of characters. It would indeed be very strange to have word problems with long passages giving complex introductions of their actors. However, as discussed above, repeated use of these caricatures is performative, influences the readers' perception of the world and makes them accept these stereotypes as natural facts of the world. Therefore attention must be paid to the selection of these simplified images of people inhabiting the world of the textbook.

From the point of view of cultural studies and comparative literature, "imagology" studies intercultural relations in terms of mutual perceptions, images and self-images. It can be employed for the study of attitudes and perceptions of certain phenomena in a society. As shown in the preceding section, "image" is not necessarily based on reality but it is a mark of the attitudes of a society to a certain phenomenon and its repeated representation of it. It must be seen as a subjective construct rather than objective essence. It reveals more about the society that forms it than about the original model. The perceptions and identifications surely influence cultural and social practice and cannot be ignored if we want to get a clear picture of a certain society, if we want to study the discursively-constructed nature of many social and cultural values. Many things in our society are organised in a particular way because they are said to be natural. Bourdieu (1998) speaks of somatised habitus, of the *nomos*. As previously stated, to prove the artificial, non-natural origin of certain stereotypes means to

open the way to their subversion. Accordingly, images being rooted in discursive practices of the society must be studied in all the different fields: literature, media, advertising, but also in school documents and textbooks.

Conclusion

The proposed methodology for the analysis of textbook cultural content builds, like literary theory, on the assumption that the world presented in the text is a text created by a particular person, under particular circumstances, in a particular cultural context. As all texts are performative, if one is to uncover some of the roots of biases and stereotypical perceptions, of evolution of the *nomos*, one must analyse the texts that maybe feed/breed these mental schemas carefully. Characters inhabiting textbooks of mathematics are literary inventions very close to stereotypical minor characters of a novel. Word problems do not provide space for full development of the character, the situation is only sketched. Moreover, the authors of the text are mathematicians and can be expected not to pay much attention to cultural and literary aspects. These hypotheses need verification and imagology seems to be a convenient tool in this process as it keeps reminding the researcher that an inter-textual approach is needed, that the author's decisions, selection of themes and images are influenced by a number of factors and must be analysed as well as the text. The context often originates in the social world and so an interdisciplinary approach will definitely be needed.

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The influence of local culture on the choice and use of science textbooks by elementary school teachers

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Abstract

This article presents the results of a study carried out with fifth-grade teachers from three different elementary schools: one located in the countryside, one indigenous school, and the other in an urban area, seeking to verify how aspects of the local culture might interfere in the teaching practice of science teachers, and how they choose and make use of textbooks. Based in the theoretical assumptions of Ezpeleta and Rockwell (1989), we take the assumption that the school not only produces culture but is equally influenced by different cultures, contributing significantly to the understanding of the diversity and richness of elements that make up this environment. In regard to the use of the books, it was possible to notice that they are adapted by teachers to their reality and that especially in science teaching, the content, guided by the curricular plan, is adapted according to the students' reality. It was possible to establish the criteria of the books' choice as they corresponded to the local needs of the students, giving them a learning experience that broadens and offers a wider view of new knowledge.

Key words: textbooks, science teaching, local culture, elementary schools

Introduction

The cultural history of a determined community contributes to the understanding of many of its aspects. A locality presents elements that go beyond housing and road construction, because it points to general aspects that influence and are influenced by social practices. A school is part of a community, permeates its various social groups and is therefore linked to the cultural issues that work as interchange patterns because they form a coherent network of meanings (Pérez-Gómez 2004). In this way, an educational institution is configured and moulded by distinctions that its own culture faces.

Historically, a culture is influenced by other cultures contributing significantly to the comprehension of the diversity and complexity of all the elements that are part of the

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environment. In an arena of contrasts such as the school environment, we can start to distinguish the concrete multiple realities that each individual may identify and experience as school and understand that they are objectively different according to the place they are experienced (Ezpeleta & Rockwell 1989).

This diversity concerns the resources used for school education, among them textbooks. In this regard, it is important to point out a fundamental fact (according to Choppin 2000). Every book is historically and geographically determined; it is the product of a social group and a determined time.

In other words, the book represents the support, the storehouse of knowledge and techniques that at a certain moment, the society believes to be appropriate for youth to know and help to perpetuate their own values and culture.

Discussing the cultural, social and political relationship in the historical context of the school community, in the transmission of knowledge and symbols, it became meaningful to examine the individual's identity as a responsible agent for changes. These changes may be from local influence, from family life, from actions regulated politically in the educational organisation which also reflect on the use of the means available, like the textbook. It is impossible to understand the use of this resource at school without having all this cultural knowledge, of actions carried out and shared by the social group and its life stories and the interactions inside and outside of this group.

The textbook presents itself culturally at school and represents a resource that integrates all actions, as much for learning inside the classroom as the historical comprehension of educational issues. The classroom is a place that builds many possibilities for dialogue between people and elements that help in the mediation of the teaching act.

Understanding school as a social construction (Ezpeleta and Rockwell 1989), all the pedagogical resources that somehow make up school history, are considered important means of interaction between social and pedagogical practices. In these terms, a textbook used in schools located in different cultural contexts, for instance, a school in a rural setting (the countryside), an indigenous school and a school in an urban area, may constitute a resource that dialogues, in different ways, with teachers and students and with a current curriculum that may produce conflicts and tensions that (dis)organise the pedagogical practice. Seeking to understand this situation better, this paper reports on some findings of research aiming to identify how the local culture affects the choice and the use of the textbook by elementary school science teachers of schools in different cultural contexts.

The elementary school and textbooks in Brazil

A significant change took place in Brazilian education in 1961 with the introduction of the Education Law (Lei de Diretrizes e Bases da Educação Nacional-LDB, no. 4.024, from 20/12/61), which gave all Brazilian states the autonomy to make decisions about teaching affairs, providing that the outline presented in the law was honoured.

From 1970, the National Book Institute (INL) started to develop the Textbook Program for Elementary Schools (PLIDEF) and in 1976 with decree no. 77.107, INL was replaced by the National Teaching Material Foundation (FENAME) whose resources are administered by the National Education Development Fund (FNDE). According to Oliveira et al. "an agreement established between FENAME and the State Education Department" required that the federal

government hand out a certain amount of textbooks to poor students that were officially part of the elementary school system (1997, 64).

In relation to the education of children and young people, LDB 4024/1961 was restructured as Law 5692 from August 11, 1971, and the curriculum was broadened, and elementary and high school developed professionalising courses. Eight years of public schooling became mandatory and free of charge for children from the age of seven to fourteen years.

In 1985, the National Textbook Program (PNLD), replacing the PLIDEF, established several changes, such as:

- *that textbooks be suggested by teachers: teachers should take part in the process of choosing the textbook;*
- *the reuse of textbooks;*
- *public and community schools offered an enlargement for first and second grades;*
- *the end of financial involvement from Brazilian states, the Student Support Foundation (FAE) ensuring that teachers decided on the choice of textbooks.*

After a period of political non-involvement, the new Brazilian Federal Constitution from 1988 ensured the realisation of PNLD and a more effective participation from the federal government in the program, advising in the article 208,

In regard to education it is a duty of the State to ensure (it)

VII - attendance of students at elementary school through supplementary programs of textbooks, transportation, food and health care (article 208).

In 1996, a new Education Law (LDB 9394/1996) was approved and as a result, many complementary documents started being elaborated. Hence, in 1997, debates about National Curricular Parameters (PCN) begin to surface in order to guide the new law to be initiated.

PCN presented a proposal for the first four years of elementary school adding cross-disciplinary themes such as: environment, sexual education, and ethics to the traditional subjects in the curriculum, amongst other parameters that continue to be elaborated. However, as this paper focuses on the first years of schooling, the other themes will not be considered.

With the extension of the length of elementary schooling to nine years, through the Law no. 11114 from 2005, among several changes, one in particular must be highlighted: Article 40 of the Resolution no. 7/2010 from the National Education Board and Basic Education Chamber, which determined the National Curricular Guidelines for the nine years of elementary School:

Article 40 (Resolution no.7): schooling of people in the countryside, indigenous people and quilombola families requires respect for their particular living conditions and applying a befitting pedagogy to their own way of producing knowledge, observing the National Curricular guidelines for Basic Education (Resolution no. 7/2010).

In order to ensure the above-mentioned article was carried out according to article 208 of the Brazilian Constitution, one of the actions of the PNLD referring to the schooling care for these people is related to the choice of the textbooks specific to the initial years of

‘Countryside Education’, and at the time of writing was expected to come into effect in 2013. It involves the following curricular subjects: literacy, Portuguese, math, history, science and geography.

Methodological procedures

A primary exploratory study on the research topic was undertaken with teachers from the municipal educational system of Irati, located in the south of Paraná, about 150 km away from Curitiba (the capital of the State).

After obtaining formal authorisation from the Municipal Secretariat of Education, two schools in Irati were visited: an urban school and a rural school. The objective of the visit was to verify how the selection process of textbooks was conducted, as well as how the books were used in the classroom by teachers of the 5th grade of elementary school. The criteria used to select the schools to be visited were: the profile of the community where they were based – considering cultural differences and different habits – and the size of the schools – which should be similar to each other.

During this first contact, it was verified that textbooks were rarely used in these schools, due to the new municipal curricular proposal having been implemented in 2009. Thus, the teachers organised a compendium with the entire program to be followed when teaching the subjects. The activities and texts were given to the students in printed format and constituted a source of information and explanation of scientific concepts.

A survey was conducted with teachers from other schools in Irati, based on the data collected during the visits to the two schools. The objective was to complement the initial information gathered and delimit the scope of the research, which was focused on the use of textbooks by teachers in different cultures.

The survey was personally conducted in 15 schools, ten of which were located in urban areas and five in rural areas. In total, 24 surveys were conducted, of which 18 were answered and returned to the researcher. Considering the main goal of the research, which is to understand how textbook choice and use are influenced by the local culture, the initial analysis verified the need to carry on with the investigation, as only a few urban schools presented a positive response about the use of textbooks.

Therefore, the researchers decided to visit other elementary schools which would have similar curricular proposals and were representative of different cultural realities, but in which the textbook was actually used by the teachers. The search looked for schools that would meet these criteria and were located in the surrounding areas of Irati, where the Regional Centre for Education (NRE) has its headquarters. The municipalities of Rebouças and Inácio Martins seemed very promising. The rural school in Rebouças and the indigenous school in Inácio Martins were selected to continue to develop the research. Furthermore, there was a search for an urban school with similar characteristics to these other schools, which led to the collaboration of a school in Irati, subjected to the same procedures as the other schools.

Participating Schools

The schools that were selected for this research, an urban school, a countryside school and an indigenous school, present similar features in terms of size, number of classes and students but differences in terms of the location of communities where cultural identity is well defined by behaviour, tradition and values. These peculiarities are defined by the school's Political-Pedagogic Project, from which all the necessary information was obtained.

The Brazilian Constitution, ratified in 1988, states that education is a common right to all Brazilians. Along with the constitution, the passing of the Law of Directives and Bases of National Education no. 9394/96, gave the countryside and indigenous education national recognition. By law, these communities must be respected according to their local reality, their cultural values and their language, since indigenous education aims at bilingual teaching, meaning that learning must take place in the students' native language and also in Portuguese. Furthermore, it is important to ensure their own territories, social organisation and socio-cultural production.

Countryside education, in turn, had its particularities recognised through LDB no. 9394/96, in relation to issues concerning school organisation and pedagogical matters. The countryside conceptions, according to National Curricular Guidelines for Rural Education of Paraná State, refer to the identity and culture of countryside people, appreciating them as people who have cultural ties to and values associated with rural life.

Countryside education, as much as indigenous education, has a specially-designed policy which recognises that people in rural areas comprise distinct social groups of Brazilian people and for this reason they deserve to be valued and respected as a culture that has historically influenced behaviour and customs that have been passed from generation to generation.

The urban school

The urban school is located in Irati, Paraná State, 153 kilometres from Curitiba, the capital of the state. It is in a neighborhood four kilometres from downtown and it is managed by the Municipal Secretary of Education. The neighborhood has facilities for its residents, such as: a supermarket, a health centre, stores, transportation, and more. The majority of the students that attend this school are from low-income families; most of them have parents that work in factories, popular commerce and in household service, all jobs that do not pay beyond a minimum wage.

The school has 307 students during the day. It has a pre-school section, an elementary school (where the first years of the 9-year program are offered), a resource room, extracurricular reinforcement classes, and a special needs education section. In the evenings there are classes for youth and adult education (EJA). After finishing the fifth year the students usually attend the final years of elementary school and then high school in a state college in the same neighborhood.

The school's political-pedagogic project is based on the curricular proposal of the Municipal Secretary of Education, supported by pedagogical orientations for the nine-year schooling of SEED (Secretaria de Estado da Educação)/Paraná, and organised with special emphasis on historical-critical pedagogy. This theory is based upon a Marxist philosophy that addresses

the social and political problems in society, and in the historical-cultural psychology created by Vygotsky. These pedagogical conceptions are supported by Saviani (1989, 2003) and from the necessary adjustments, a flexible and suitable plan will be developed for the school.

According to the curricular proposal, in teaching science it is fundamental to provide the student with a method that helps him to understand the historical process of building scientific knowledge. The textbook content is organised bi-monthly and points to: astronomy awareness, transformation and interaction of matter into energy, health/better quality of life.

The countryside school

This school is located in Rebouças, Paraná State, 192 kilometres from Curitiba, the capital of the state. The school community is 20 kilometres from downtown and is managed by the Municipal Secretary of Education. The school has 236 students in the morning and afternoon periods. It has pre-school education, teaches the initial years of elementary school, a special needs education class, a resource classroom and extracurricular reinforcement classes.

Most of the students in this school are from very low income families whose parents do not have a fixed monthly income because they are small-scale farmers and live off subsistence agriculture, some of them also doing temporary jobs, especially during harvesting season. Most families have poor houses and they hardly emerge from their social environment.

Students come from different rural places to this school because the smaller schools have been closed down in order to centralise the teaching in one place. This was done with the aim of better meeting the students' needs and to enable the teacher to play his role better. In the previous system, besides teaching mixed-grade classes, the teacher also had to cook and clean the school, and frequently used to live in the community due to the long distances involved with commuting and the dangerous conditions of the road.

The students come from many different places and must leave home early to catch the school bus, or to make the long walk to school where bus access is hard. After concluding 5th year, students attend the final years of elementary school and high school in a state college located in the same building.

As in the case of the urban school, the countryside school's political-pedagogic project is based on the Curricular Proposal of the Municipal Secretary of Education, supported by pedagogical orientations for the nine-year schooling of SEED/Paraná. Therefore, science teaching is defined as a means for the teachers and students to become aware of the relations and objects of science through: astronomy awareness, transformation and interaction of matter and energy, health and quality of life. The textbook contents are organised bi-monthly by the country teachers.

Indigenous School

The indigenous school of the Guarani indigenous family is located in Rio D'Areia, county of Inácio Martins, Paraná State, 253 kilometres from Curitiba and 45 kilometres from the centre of Inácio Martins. The indigenous village is accessed via an unpaved road. The school is managed by the State Secretary of Education. In the morning, the school offers 3rd, 4th and 5th years and in the afternoon the school offers 1st and 2nd years and these classes are taught in

the students' native language. After the 5th year, students are supposed to attend a school located in the urban area of the town. However, from 2013 there will be new classrooms for the groups from the 6th to 9th year in order to keep students in the indigenous village.

The staff in the indigenous school are chosen by the Simplified Selecting Process (PSS) and if there is a vacancy, a qualified professional from the community can take the post, no matter his score. The staff that work in the indigenous school must have a consent letter from the indigenous community allowing them to work and stay in the school as well as in the indigenous village. In the case that there is no qualified applicant, the highest scoring applicant in the selection will be presented to the village for approval. In relation to the principal's position, SEED has determined that this vacancy must be occupied by one who has gone through a competitive tendering. This person also needs the approval of the indigenous community.

The Political Pedagogic Project is still under construction and has the support of National Curriculum Standards for Indigenous School (RCNEI), from the Ministry of Education (MEC) (1998) and also the pedagogical and administrative guidelines for the basic education from SEED (2005). According to RCNEI (1998) there are some essential characteristics that are part of the indigenous school that might guide indigenous education in order to make school education more effective. These characteristics must include intercultural teaching, bilingual and multilingual teaching, amongst other things. For science teaching, RCNEI (1998) suggests that physics, chemistry and biology must be taught the same way, respecting the students' personal development and recognising their level of ability and limitations.

Data analysis

This paper aims to find out how the teachers from such different schools choose and use science textbooks, considering their cultural reality. The subjects of this research were 5th year elementary school teachers from each of the schools being studied. Table 1 summarises their education area and the number of years they have been working as teachers.

Table 1. Participants in the study

SCHOOL	EDUCATION	WORKING TIME
Countryside	Languages- Portuguese/ Spanish	3 years
Indigenous	Pedagogy	22 years
Urban	Pedagogy	27 years

The data were obtained through a questionnaire and a semi-structured interview because the participants had a complex stock of knowledge about the area under study (Flick 2004). For the interviews, a script was followed with questions about the participants' experience as students and teachers, curricular aspects and planning for science teaching, factors to be considered in textbook choice, and textbook use in science teaching. The interview was conducted after the questionnaires were completed. Using Ezpeleta and Rockwell's (1989)

theory of the social construction of the school as a theoretical basis, some categories were established to analyse the questionnaires and interviews:

1. Educational and professional path.
2. Science teaching and the use of the textbook.
3. Factors that guide the choice of the textbook.
4. Local culture and the use of textbooks.

The objective of category 1, *Education and professional path*, was to ascertain information regarding the teachers' experiences in their own education and in relation to teaching. The second category, *Science teaching and the use of the textbook*, sought to acquire information related to curriculum matters, the work and organisation of the schools, and input from the teachers regarding the use of textbooks in class. The third category, *Factors that guide the choice of the textbook*, aimed to discover the most important points that are taken into consideration when choosing a textbook, and the fourth category, *Local culture and the use of textbooks*, aimed at discussing and analysing the relationship between local reality and the textbook.

Some insights and findings

The interviews were conducted in the respective schools of each of the teachers. This, in itself, enabled the perception of the contrasts of each place. To fully understand such different realities the researcher's attitude was to observe the physical characteristics of the school, some cultural aspects of the community through information from the Political-Pedagogic Project of the school and by observing the classroom organisation, the school material, the pictures and the murals in the schools. The results of the interviews showed the influence of the culture upon these teachers' perceptions and teaching.

Education and professional path

During the interview, the teachers freely reported the most relevant elements and narrated their memories of their life as students and their professional path spontaneously. For the teachers from the urban and countryside schools these memories traced back to their current workplace, where they started their professional life. The most relevant facts mentioned were methodological matters and the material used as students such as classical music to calm down the students, a resource that the urban school teacher uses in her classes nowadays. This teacher mentioned a booklet that was bought by her parents and helped her and her brothers to learn how to read and that is why this booklet is special for her. This interviewee also related another aspect that is important for her: the school where she works is the same school where she studied her whole life and also where she started working as a teacher.

The interview with the teacher from the countryside school reminded her about the lack of books while she was a student and she mentioned that there is much more material and more books available nowadays than back then. She started her professional life in a school in the same district where she works now; however, she remembered that the building was a "little house" and the groups were mixed-grade. She used to teach, clean and prepare meals for the students.

In the indigenous school, the teacher reported that even though she was not an indigenous descendant, she had a different basic education because she started her studies in a school that belonged to Ukrainian nuns. There were rituals and traditions such as: language, handcraft, religious rites and a different curriculum which helped her to adapt to and respect the special needs of indigenous people. It was in this indigenous village that she first started teaching after her graduation.

These experiences are important in helping to understand the behaviour of teachers in the classroom because, according to Rockwell and Ezpeleta, “the knowledge that a teacher develops by working with a group of children absorbs elements from other domains of his life” (1989, 25).

Science teaching and the use of the textbook

For the interviewees, the textbook represents a support for learning scientific knowledge and it is used in class with some adaptations of the texts and activities in order to make the students understand it better. The teachers then promote a “didactic mediation” (Lopes 1997) in which there is “a process in which a reality is built through contradictory mediations, complex relations, with a deep dialogic sense” (563). This contradictory mediation is noted in the indigenous school to ease the transition from Guaraní to Portuguese, in the countryside school to overcome students’ difficulty in understanding more complex terms, and in the urban area school in the search of more summarised texts, according to the teacher. The intention is to present scientific knowledge basing it on common sense and respecting the learning limitations some students might have in this process.

Lopes (1997) asserts that school has the explicit objective of providing a scientific background and at the same time the implicit objective of shaping everyday knowledge, necessary “to rescue and highlight school’s role of socialising and creating knowledge” (Lopes 1997, 563). When the teachers are concerned with making knowledge accessible for their students, this is usually by simplifying and adapting contents in a way that these changes correspond to the needs and particularities of each cultural reality. In the indigenous village this socialising process becomes more noticeable because there is a movement away from the native language, which is necessary for the future adaptation and interaction in a different school and also for inclusion in society. For this purpose, it is important that the teacher looks for alternatives that promote this break but without devaluing students’ origins.

The textbook also helps to make the teaching of science content very intelligible, through images that are important in the three realities and have the function of complementing and illustrating the text and even elaborating concepts for the indigenous students. An image may help in acquiring scientific knowledge. But in order for it to be helpful, it is the teacher’s duty to help the students read the image because the image itself it is not considered a learning source. It is true that every image sends a message but its use in the classroom as a learning support for scientific and technological knowledge must be guided, otherwise the interpretation of the phenomenon or object that is being studied by the students may be very far from the intended scientific content, or common ground (Carneiro, Barros & Jotta 2003).

This common ground consists of relating image reading with elaboration and re-elaboration of the contents to be worked on in class. The teachers’ reports indicate the great importance of these images, which are a good support in learning, in developing students’ interest in the textbook, and are a more compelling way to show scientific concepts. These images also

determine the place where the student must devise the knowledge production process (Macedo 2004), that is to say, consciously or not, there is a pursuit of these images in locating the viewer from the position from which the image must be seen (Macedo 2004).

Factors that guide the choice of textbook

The free distribution of textbooks for the schools and their transformation into an accessible resource for all meant, for the countryside school teacher, an achievement and a fulfillment, because her students can have this object not only to browse and return, but also to use, handle and make a part of their learning process.

Even though this experience had not happened in a more significant way for the teachers from the indigenous school and urban school, due to the textbooks' absence for analysis, the choice of textbooks would be fundamental in respecting the differences of each school. Even so, despite not being able to choose the textbooks, the countryside teacher has a great expectation with the new books that are coming as she expressed: "I've worked with new books only once." There are not enough books for all the students but the school's staff has been trying to organise the available ones and use them in class.

The criteria that guide the choice of science textbooks are the same for all the interviewees: accessible language, images that help in the understanding of scientific concepts and activities that encourage a dynamic style of interpretation and resolution. However, the teachers expressed concern about whether their chosen textbook would be the one distributed in the schools. In their opinion, the quality of the textbook is linked to the teacher's participation in the choice of these books, and the chosen ones must be sent to the schools. The countryside teacher confirmed that it does happen that textbooks that teachers did not choose are sent to the schools, but that she hopes that the MEC will send the chosen books this year: "We never get the books we choose, but I believe this year will be different." If the chosen book is delivered, as hoped, this will ensure that all the discussion and analysis of these books happens during the classroom activities.

Among the three interviewed teachers, only the one who works in the urban school could analyse texts in detail and choose the book according to her school routine. The other teachers stated that they were not able to fully achieve this in their schools, but that when it does happen, it will allow the teachers to teach with tools that will complement their activities, keeping in mind that they believe that textbooks are sources of information and they contribute to students' education.

Local culture and the use of the textbooks

Although the questions prepared for these interviews did not mention cultural elements and their influence on the teachers' activities and on the textbooks, during the interviews these issues started to be voiced by the teachers. Touching on aspects related to their work, the choice of the textbook and their teaching experience, cultural influences surfaced naturally.

Different behaviours and realities found in the three researched schools are clear when it comes to the choice and use of the textbooks by the teachers. For example, even though there is some specific material for the indigenous school, the textbook is a source of reading and the presentation of content. On the other hand, the countryside teacher believes that a specific

book for her students focusing on their own reality would not be so appropriate because these students must have exposure to other perspectives of knowledge that go beyond their reality, providing the students with an accessible approach and encouraging them to participate.

The way that textbooks are related to the local reality can be seen in the distinct ways that each type of school uses images as a motivational resource. For the countryside school, these tools will allow students to have a broader view, inciting and providing them with new knowledge and interaction.

For the indigenous school, textbook images are a language that decodes the written text and builds on the concepts presented. Values and ritual aspects remain in the textbook because the adaptations carried out by the teachers respect the limits and the local differences, as well as the lack of printed material and extra material for use in the classroom. Teachers believe that, although some extra material is developed to focus on their own reality, students should be in touch with other cultures as well. This concern is reflected in their search for a suitable textbook that, besides providing learning according to the students' reality – proper language, proper content and contextualised activities – also allows wider learning, which enables the students to make inferences, interpret the experiments, create and recreate and assimilate their context (Freire 2011).

Final considerations

The proposal of this research was to investigate how local culture influences elementary school teachers' choice of science textbooks. The relationship between cultural aspects and the use of textbooks was deemed to be of relevance since schools present a great variety of behaviours that organise and identify a community. Textbooks are distributed by the federal government to all schools and the books become an important resource for teaching. As it was pointed out in this article, textbooks are cultural artefacts and that is why they are part of school culture and supported by PNLD, which shows along its way a relationship with the political changes in basic education in Brazil.

This relation contributes to reach comprehensiveness and achievement in the distribution of textbooks to all, besides ensuring no distinction in handing in these materials, and the teacher must be the mediator between the choice and use of them in class. Debates about the best choice for this resource occur from existing interactions in this professional experience. However, this study made evident that there are still problems to be addressed in the implementation of textbooks in schools, for example, books may not arrive on time, or may not arrive at all, which is disappointing for the teacher and the students.

Scientific knowledge, embedded in the textbook, produces ways of thinking, knowledge and procedures. Thus, the textbook is a resource that influences the thinking, the behaviour and posture of the student towards school and life. In this sense, this resource has been produced amidst cultural and social perspectives that point to what can be taught and learned inside the school and somehow go beyond this limit.

Specifically talking about science teaching, these influences refer to understanding the phenomena that occur in nature and their implications for people every day. With the changes in curriculum according to the pedagogical orientations for nine-years teaching, the Municipal Secretaries wanted to better understand the new posture concerning the learning

process in the researched schools, which is related to the theory of historical-critical pedagogy.

The actions derived from these new curricular perceptions directly confront the use of teaching material and give emphasis to methodological processes to learn the content. As happens with all changes, there are essential adaptations that demand from the teacher a new way of thinking about his practices. There is a conflict between the experiences gained throughout his professional life and the prescriptive demands of the school system.

There is evidence that science teaching in the first grades, even though it has been part of the school curriculum since 1970, still needs to be discussed, specifically with regard to the new trends and pedagogical approaches in order to make the scientific knowledge presented in classroom scientific textbooks more appropriate.

In addition, based on the research conducted with the three teachers in this study, it was possible to confirm that local culture interferes with the choice of textbook. These particularities can and should be pointed out in schools' Political-Pedagogical Project, a document that identifies all the historical and standard processes. Thereby, there is a national guideline that regulates in a more general way the content found in the books to correspond to different peoples' educational needs. This cultural identity should not be considered from an outside view towards a determined social group, but with respect and political programs that might contribute and add value to the specific needs of students.

This research also showed divergences between the curriculum standard of the schools and the content covered in the textbooks, which is derived from national public policy and prioritises what has been established in the PCN. However, as the states and municipalities have autonomy to elaborate the study program – for instance, Paraná has state curricular guidelines, which substantiate the orientations for the initial years of elementary school – there is a difference between the national proposal and the state proposal, especially in the content organisation to be taught each year.

The interviewed teachers indicated that the science textbook was a very important printed material, despite these curricular differences, and after having undergone adaptations. For many students, especially from rural and indigenous schools, the textbook is the only means of interaction with scientific knowledge, thanks to the public distribution via the PNLD. Therefore, it is necessary to strengthen and promote a permanent dialogue between the schools and the municipal and state secretariats. These dialogues would allow the identification of the real obstacles faced by teachers when using and selecting textbooks. These discussions are also an important way to find out about educational policies, such as the PNLD, and the production process of textbooks at a national and local level.

Although the indigenous and rural schools were not able to ensure the textbooks they received were the ones they wanted, the teachers were nonetheless interested in looking for books which would present explanatory images and appropriate language for the students, just like the teacher from the urban school. This shows a concern about the students having access to material which will provide them with information relevant to both family and community life and also social and educational life, giving them new study perspectives and reinforcing the social, instructive and educational functions of school, as defined by Pérez Gómez (2004).

The research indicated that the teachers were concerned about choosing materials which can help the learning process of the contents presented in the curriculum, at the same time as focusing on the area where the school is located. The local experiences, habits and traditions are relevant in pedagogical practice, and the textbook is considered a significant tool when teaching sciences. Its use is directly related to facilitating content learning and using images to promote better comprehension and more interest from the students, besides enabling the interaction with other forms of daily language.

As we have seen, local culture, which may be understood as the identity of a nation, is present in the school environment and affects the school culture, its curriculum standards and even its organisation as an institution. In this study we have seen how the relation between these cultures is expressed in teaching, contributing to an understanding of teachers' actions regarding textbook choice and the use of teaching resources.

Besides this aspect, the teachers' cultural and professional background, as well as the local culture where they work, should be considered as strong elements that influence the choice and use of the textbook. These are the interrelationship that reveal a significant system and, as Williams (1992) says, "they do not exist only as institutions and work, and not only as systems, but also as active practice and a state of mind" (207). Practices that, according to Pérez Gómez (2004), establish that, "apart from the symbolic representation of the said reality, the members of a community must share their common elements as a prerequisite for understanding and survival" (208).

In this respect, with specific books predicted to arrive for countryside and indigenous education, new reflections will be raised. Will there be a change in the choice and use of these books as they will be more specific? How will PNLD dialogue about the pedagogical and cultural issues with schools located in culturally different places? How will these issues be discussed in the elaboration of the materials that will be destined for these institutions? What criteria will be considered in the elaboration of textbooks?

These concerns make sense because the textbook is an important element of school life so it is important to better know the relationship between the scientific knowledge that is presented in them and the adaptations of the latter when used in the classroom. This leads to another area that needs exploring, which is developing an understanding of the meaning that teachers give to science teaching and what theoretical and methodological tools they have acquired during their professional path, as in their personal experience and their ongoing education.

In general, though the textbook has adaptations and curriculum differences, the interviewed teachers pointed out that the science textbook is an important, if not the only, printed material with which the student has contact and it allows them to deal with scientific knowledge.

In this regard, the choice and use of textbooks, which are a very helpful support material for teachers, is under the direct influence of the school context in which they are inserted.

To conclude, it is important to emphasise the effective participation of public school teachers in the process of choosing the textbook; it is a productive time to think about the relationship between the available material for teaching and the local culture and reality where they will be used.

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WORKSHOP 2

TEXT MATERIALS IN SOCIAL SCIENCE AND HUMANITIES

Using learning materials for design based interventions: Choosing texts for an intervention and the interplay between text readability and scaffolding beginning readers' ability to read

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Abstract

This article considers a methodological issue concerning the use of learning materials for interventions in design-based research. When the researcher uses existing or creates new didacticised learning materials for research purposes and tests their applicability in authentic contexts, many variables are in play. When using or designing a learning material a lot of choices have to be made and effects are difficult to isolate. The advantage of using learning materials for interventions is that results could have high ecological validity.

In the article this methodological issue is exemplified through a research project using and developing digital learning materials for developing literacy in the early grades. One of many important choices to be made in elaborating this learning material concerns which texts should be used for supporting students' literacy development in the lower grades. This issue is very important in general – and a subject of controversy. It is argued that the choice of texts depends on which theory of reading and which definition of readability are used, which in turn depends on the design for learning and the scaffolding which frames the student's encounter with the text. Two theories of word reading, dual-mechanism and connectionist, are introduced, compared, and their practical consequences for scaffolding students' independent reading and literacy acquisition are analysed along with the consequences for choosing instructional texts. The choice of texts and the definition of readability may be the one thing that makes the intervention using the digital learning material unsuccessful – or it might contribute to achieving the desired goals. The effect of this particular choice and the other choices in the intervention are difficult to determine.

Keywords: Digital learning materials, design-based research, readability, connectionism, literacy acquisition

Introduction

In my PhD research project I am using design-based research (also referred to as educational design research) as an approach to developing a digital learning material that allows whole classes to work independently with the same unfamiliar, meaningful text in ways that will lead the students to acquire decoding skills while simultaneously developing other necessary

components of literacy, i.e. the necessary resources to be more than a code breaker, but also a text participant, a text user and a text analyst (Freebody et al. 1990).

I am studying digital learning materials for reading instruction, or rather reading acquisition. My aim is to transform reading instruction so students of languages with deep orthographies like Danish and English can acquire literacy resources through a digitally-scaffolded learning process involving meaningful texts. My approach is theoretically based on connectionist models of reading acquisition and Share's self-teaching hypothesis.

In this paper I will explain how connectionism offers a cognitive explanation of reading acquisition which makes it possible to combine some of the assumptions from the main paradigms in the research on reading. This unification is much needed in the field of reading research. Research on reading is a fragmented field. The theories of cognition in reading often address limited aspects of reading; there are only a few candidates for a unified theory of cognition in reading (Sadoski & Paivio 2007). In addition, the theories and research on cognition in reading disagree on many important issues (Lupker 2005, van Orden & Kluos 2005). To make matters worse, research communities like whole language or new literacy studies are in opposition to traditional cognitive psychology focusing solely on the broader contexts of literacy and not on the individual or cognition (Gee 2010, 20-22).

Everybody in the field agrees that ultimately all students should end up being able to both decode and comprehend written text. But the traditional research on cognition in reading, often associated with the phonics tradition, suggest that in early, formal reading instruction it is necessary to focus narrowly on strengthening students' decoding skills at the expense of strategies for meaning making, because a dual focus will inhibit development of decoding skills (Elbro 2006, 123). To avoid cognitive overload the student should focus on learning to decode (NICHD 2000, 3-8).

The National Reading Panel reviewed 38 studies of phonics-based instruction and arrived at the conclusion that systematic phonics instruction is more efficient than other approaches in preschool and first grade, but the effect is somewhat weaker in grade 2 (Shanahan 2005, 2-28). In the summary of the report the researchers consider if systematic phonics instruction could be a suboptimal compromise, given the circumstances in a typical classroom:

Although phonics instruction that was not systematic was better than no phonics instruction, it was not as effective as systematic phonics programs; perhaps because it is too difficult to juggle this amount of individual diagnosis, teaching, and review within the demands of a regular classroom. (Shanahan 2005, 12)

In support of this hypothesis Pressley et al. conducted a survey among preschool - grade 2 teachers, who had been singled out as the most effective in promoting literacy by their supervisors. The survey showed that the teachers most often mixed whole language and phonics in their instruction. Not only did they teach decoding, but emphasis was also put on reading comprehension, motivation, literacy enculturation and that students should read different texts of high quality. Also, according to these teachers, phonological skills should be taught in the context of actual reading and writing (Pressley et al. 1996, 375).

This could indicate that many literacy teachers need learning materials to help them support students in their zone of proximal development. Perhaps only the most competent teachers are able to teach literacy in a broad sense in grades 1 and 2, but if a digital learning material could help ensure that students were given sufficient challenges, support and feedback in

acquiring literacy, then many teachers could make their teaching more meaningful and effective for the students. The point is that we should never cease to search for more optimal designs for learning and that ICT could be an important element in these designs.

I am developing and testing prototypes of digital learning materials and designs for learning involving digital learning materials. I hope to show that scaffolding students' independent reading of unfamiliar text using a digital learning material with graded support and text-to-speech support can prove more effective and motivating than the learning materials and designs for learning that are common in today's classrooms and that decoding skills do not have to be taught at the expense of other components of literacy in the early grades.

I have used published digital learning materials with new designs for learning, i.e. in ways not anticipated by the producers. The current phase of my project entails creating a new digital learning material for Danish second graders and testing the prototype in actual classrooms. Design-based research suggests an ongoing, iterative process of testing and adjusting the learning material until it works for different students in different contexts. Developing learning materials, doing so in cooperation with teachers, and testing these learning materials in real-life classroom contexts is in accordance with the commitment of design-based research to solve actual educational problems through developing theoretical insights and practical solutions simultaneously (McKenney & Reeves 2012). This approach can give the results high ecological validity. If the learning material works as intended it could have a significant and immediate impact on education. The learning material used in this way permits that theory and research is transformed into an artefact that is usable and understandable for users, i.e. teachers and students.

A potential problem with design-based research is analysing the theoretical implications of the interventions.

Creating a *didacticised* learning material, i.e. a learning material which contains tools and texts and has prescriptions for teachers' and students' use of the material for teaching and learning (Hansen 2006, Bundsgaard et al. 2011) means that a lot of choices have to be made by the researcher. Theory and research on reading, reading acquisition and reading instruction and theory and research on education and pedagogy has to be combined and, in Basil Bernstein's terminology, recontextualised (Bernstein 2001) to become usable for students and teachers. This process of transformation involves choosing between alternatives.

To give an example, the theory of reading acquisition I am using for my research, connectionism, is based on computer simulations, and there is very often a significant discrepancy between how a computer can be taught to read from examples and what we can make a group of students do in real life. So quite often, educational theory, what we know about children's psychology, learning, teaching and so on, will pull away from what would be the optimal solution according to the connectionist theory of reading.

In the following I will elaborate on this methodological issue by showing how I argue for the choice of texts concerning the digital reading materials in my intervention. This is only one consideration amongst many others when making the didacticised learning material for supporting literacy acquisition, but an important one for the intervention. To make this argument I will present two cognitive theories of reading and definitions of readability that arise from the theories. Furthermore, I will argue that the readability and usability of a text depends on the design for learning and the scaffolding which frames the student's encounter

with the text, which are also choices that need to be made in order to anticipate student and teacher activities in the learning situations.

Text difficulty and scaffolding

Danish is a deep-orthography language (Frost 2005, 278) which poses serious challenges for reading instruction. Because the relationship between orthography and phonology is only transparent for a minority of words, students in beginning reading instruction are rarely given the opportunity to read unfamiliar text independently. English orthography is quite similar to Danish in this respect, so the challenges discussed in this article apply equally to English-speaking communities.

In the simple view of reading (Gough et al. 1996), decoding an unknown word without support is an all or nothing activity; either the student identifies the correct word or he does not. It is normally assumed that students should only read texts independently if they can read with at minimum 95% accuracy in decoding and word recognition (Adams 1994, Clay 1993). Eighty-nine percent or less accuracy and less than 75% comprehension is assumed to lead to student frustration. According to this view, independent reading of unfamiliar text should be accompanied by a rather precise match between the skills of the reader and the difficulty of the text.

In typical reading instruction various sorts of scaffolding measures are taken to ensure that students will be able to decode the text. Typically this entails students being thoroughly familiarised with single words which could challenge the student, and the whole text is read aloud repeatedly before students read independently. Furthermore, text difficulty is kept at a minimum if the whole class is supposed to read the text. In this design for learning students are thoroughly prepared before reading independently. I will argue that this way of scaffolding has serious disadvantages and I will suggest an alternative way of staging students' encounters with text.

Some researchers have shifted focus from matching reader and text to scaffolding and supporting students' reading process (Fischer, Frey & Lapp 2012). The significance of text difficulty in itself can be lessened by appropriate scaffolding that can keep students motivated, moving forward and focused on interacting with the text in ways that are supposed to lead to literacy acquisition. In this paper I will argue that in their third year of school, when most students should be well on their way into the consolidated alphabetic phase (Ehri 2005), it makes sense to use age-appropriate texts written for kids to entertain, inform or whatever instead of using texts with controlled vocabulary based on phonetically regular words, phonetic patterns or highly frequent words (Hiebert n.d.). In second language education these are termed *authentic* texts because they are produced as real-life texts with a social purpose in the real world, not written for language teaching purposes (Nuttall 1996, Peacock 1997). The aim of this paper is not to discuss what defines a quality text for children, but I will assume that the chance of selecting a text that motivates students increases when using authentic texts written for children.

In the following sections I will present the results of an intervention using a published digital learning material. The results lead me to pose a series of questions concerning the appropriateness of the analogue learning material the students in the intervention are used to. The phonics-based learning material the students are used to is analysed using theory of word reading and scaffolding and the consequences for choice of instructional texts are described.

Connectionist theory is used to present an alternative to the phonics-based design for learning and the possible consequences of connectionist theory on choice of instructional text are outlined.

Intervention, results and questions

An intervention involving a digital learning material with text-to-speech (TTS) was carried out (Gissel 2014) to determine if students could use this scaffold for self-teaching (Share 1995, 1999) in Danish. Students in late grade 1 ($n = 17$) were instructed to read an unfamiliar text in a digital learning material which features graded, multimodal texts (Kress & van Leeuwen 2001) and optional TTS support when clicking on single words or a button for having the whole page read aloud. The text was deliberately chosen so it would normally, i.e. without the students' encounter with the text being scaffolded with TTS, be considered at student frustration level. This means that most students would need the TTS support.

The theoretical base of the intervention was connectionist theory of reading and Share's self-teaching hypothesis (Share 1995, 1999). The assumption is that exposure to orthographic patterns, the successful decoding of words or supplying students with a target if not being able to decode independently will strengthen students' decoding skills. Therefore students were instructed to try to read the words in the text independently before using the TTS support. Also it is of importance that the words are read in a meaningful context which is why the teacher was instructed to work with activating students' prior knowledge to make them focus on the narrative and understanding the text.

Using screen recording software it was possible to record a visual representation of the students' interaction with the software and the students' verbal output when reading aloud. It was found that only a few students tried to decode independently but these students did not react to their miscues. Others did not try to decode independently and overused TTS. Sixteen of the students fell into the following three categories of behavioural patterns:

1. Four students tried to read every word independently but did not use the support even though they had miscues.
2. Ten students never tried or very quickly (i.e. the first time they encountered a word they could not read independently) refrained from trying to decode themselves and had the whole story read aloud. Some of these students didn't even bother to have the story read aloud.
3. Two students quickly clicked on single word help if they could not read a word instantly.

This study is by no means representative of the total population of Danish students at this age. Nevertheless, the results raise the question why the students seem so paralysed when reading unfamiliar text. Why do the students in the first category not react to their miscues even though the miscues clearly disrupt their attempt at creating a coherent message from the text? Why do many of the students in categories 1 and 2 not seem curious about what the text says? And why do they not all try to read independently? I will try to answer these questions from a theoretical standpoint.

A phonics-based scaffold

I suggest that the reason for students' paralysis towards independent reading of unfamiliar text is to be found in the way the analogue learning material that the students normally use scaffolds their encounter with written text.

Interviews with the teacher showed that the students normally use a Danish, phonics-based material called "Den første læsning" (The First Reading). The reading material creates a certain reading culture and favours certain strategies for reading. The material scaffolds students' encounter with text by thoroughly preparing them for words that are assumed to pose difficulties and by a strictly controlled vocabulary. The material prescribes direct and systematic instruction in the alphabetical principle. The material is furthermore based on the dual-mechanism theory of word reading (Seidenberg 2005, 238). The dual-mechanism theories assume that we have two types of knowledge and different mechanisms for processing two types of words: regular words and exceptions. A regular word in which every letter represents its most common sound is processed through the *nonlexical route*. Here rules can be used to decode the word. The exceptions are handled through the *lexical route*. In the lexical route we have memorised spellings and pronunciations of irregular words (Coltheart 2005).

The practical consequences of the theory could be, as it is in "Den første læsning", that the texts should contain as many regular words as possible. Irregular words are unwelcome elements in the texts, because students will not in this design for learning receive any strategy for reading new, irregular words and reading irregular words is not supposed to have any transfer value. But it is not possible to write coherent texts without using many of the most frequent words in Danish, and most of these contain irregular letter-to-sound relationships. The students have to learn these words by rote. The irregular words that are introduced are repeated many times in the texts and the teacher has to prepare the students carefully for the irregularities.

In this material the students do not start to learn about the less regular phonetic relationships until second grade. The material does this by introducing a phonetic phenomenon (e.g. the letter "o" which is regularly pronounced [o:] is sometimes pronounced [ɔ]) and the instructional text will contain many examples of the phenomenon which makes it seem like a regularity for the student.

Applying theory of scaffolding (Wood et al. 1976) to the phonics-based design for learning can give us insights as to its advantages and disadvantages. When the student has been prepared for the irregular words in the text by the teacher, then only the regular words – or the words that conform to the phonics phenomena that the student has been taught – are left. This works as *a reduction in the degrees of freedom* because the student only has to try to decode the words that are decodable with the learned strategy. And the alphabetical principle is quite simple to learn. Thereby the controlled vocabulary also acts as *direction maintenance* and *frustration control*: The student should keep decoding using the alphabetical principle (instead of guessing or using contextual cues) and he will experience that the principle works. Furthermore this *marks the critical features* of the task; the regular words are the ones that the student has to decode using his decoding strategy.

Some of the disadvantages of the phonics-based design for learning are well known. First of all texts written with controlled vocabulary could be assumed to be of lower quality, which should have a negative impact on motivation. From a constructivist point of view it is a

problem that all students receive the same instruction before doing what they are supposed to learn, reading, and that students spend little time reading but lots of time listening to the teacher. There is no evidence to suggest that students when reading actually apply the taught phonics rules that complement the alphabetical principle. But it seems highly unlikely because, to mention a few reasons, a skilled reader uses many more rules than can be taught and skilled readers do not have to know and apply conscious rules when reading (Gough 1996).

From a scaffolding perspective it is crucial that students are able to use what they have been taught outside the classroom, when the scaffold is not there – and vice versa. Another serious problem with the phonics-based scaffold is that the student could very well be frustrated when trying to read texts outside school without controlled vocabulary. A text without controlled vocabulary will contain very few regular words and the student has only learned a few irregular words by rote. In other words the student has never been prepared for encountering new, irregular words. If he has not yet learned about the phonetic phenomena in the word he is trying to read or learned it by rote he has no strategy for handling the word.

This could explain the results from the intervention described previously. Students will expect to either know the word or to be able to sound it out. They are not used to learning by attempting to read. In support of this hypothesis previous research indicates that reading material and teaching methods do influence the strategy used by students when reading words (Barr 1974). Students instructed by a strict phonics method seem to produce more non-response errors or create non-words than students trained with a sight-word method (Cohen 1974, Barr 1974, Ehri 2005). Students trained with a sight-word method, on the other hand, tend to guess based on contextual cues and substitute with words previously introduced in their reading material, hence paying less attention to orthographic input (Barr 1974, Ehri 2005).

Connectionist models of reading

Connectionist models explain how students learn to read in deep orthographies without learning phonics rules and words by rote. Connectionist models of reading acquisition assume that we learn to read through exposure to words and text.

When encountering an orthographic input we use a finite set of units representing spellings (orthography) and pronunciations (phonology) of words (Seidenberg 2005). The representations are distributed; they represent a large set of spelling/sound patterns. All cognitive information is stored as a series of connections between units. Each possible pronunciation has a weight depending on the frequency of previous exposure and all the possibilities connected to the spelling pattern are activated when the reader encounters the spelling pattern. The connections between units grow stronger or weaker with exposure to print.

According to connectionist models of reading we use the same mechanism for processing words regardless of the degree of consistency between spelling and sound. English and Danish orthographies are not rule-governed, they are in fact *quasi-regular* (Seidenberg 2005, 238). In a deep orthography like Danish or English there are regularities, but the regularities are found at different grain sizes: some letters are always pronounced the same at certain positions, rimes are regularities but these regularities are mixed with more atypical phonetic phenomena which also have to be encoded by the reader (Seidenberg 2007, 7).

The practical consequences could be that a more indirect approach to reading instruction is possible, even preferable. The students do not have to be taught a lot of “rules” and practice applying them. Instead students should be exposed to print materials as often as possible. Students, according to this model, learn to read by reading. They must process spelling patterns and combinations of letters and compare this to how words really should be pronounced. TTS can provide students with feedback as to how a word should be pronounced. But as the aforementioned intervention with the digital learning material (Gissel 2014) showed, students cannot be expected to try to read independently or to activate the support when they need it. If the student does not try to decode using orthographic information, he does not get exposure to the spelling patterns and the activity will not lead to developing the connections that are necessary for reading words faster and more accurately.

In my PhD I am making a prototype of a digital learning material which scaffolds students’ reading attempts directing their attention to the relevant spelling patterns and to understanding what they are reading. An important challenge lies ahead of me in fine-tuning the scaffold so that students will put in the necessary effort and activate support when this is beneficial.

Skilled readers differ from poor readers in their knowledge about sub-word spelling patterns (Adams 1994, 114). Becoming a skilled reader means being able to quickly identify and process the relevant units. The flexible-unit-size hypothesis (Brown et al. 1999) describes children as flexible and adaptive as to which levels of spelling-sound correspondence they use for reading; instructional design, task requirements and support influences when students are able to focus on larger units like skilled readers do. Pointing the student towards the relevant units could be all the support the student needs to read an unknown word. Certainly, the student strengthens his decoding skills each time he successfully reads a word and the constituent word parts.

When the student reads a word-part this activation helps him read all other words where the word-part is present. A word like “ikke” (not), which is an exception word from a dual-mechanism perspective, is not particularly difficult to read from the connectionist view. The word is extremely frequent. The syllable “ik” is consistent because it is only used in the word “ikke”. The syllable “ke” is extremely frequent across many words; it is at the end of more than 1,500 Danish words. So when the student reads the word “ikke”, he will also practice reading “-ke” in all these other words.

Connectionism hasn’t really been tested and used for practical purposes in terms of reading instruction/acquisition. But when comparing the results of the computer simulations based on the two theories and the explanatory power of the two approaches in relation to visual word recognition, it looks like a dead heat (Lupker 2005).

Connectionism and choice of reading material

Connectionist models of reading lead to a redefinition of readability concerning beginning reading materials because regularity is viewed differently than in dual-mechanism theory. According to connectionist theory it is the frequency of use of the word and the consistency of its constituent parts that determine if a word is relatively easy to read.

How important is it to use texts that have many examples of the same spelling patterns? Surely, in the big picture it is not important. Exposure to written text should expose the

student to natural language, and we could even argue that it may be counterproductive to give students an unbalanced encounter with the written language. In the computer simulations which are used to test the theories, the researchers sample word material such that the probability of being selected is a function of a word's frequency (Seidenberg 2007, 7). This could mean that it is not necessary to control the vocabulary in the texts; we can use age appropriate texts where the semantics and syntax is not too challenging.

Context and meaningful text

If we can put connectionist theory of reading into practice through a learning material and design for learning that supports and motivates students to keep trying to read words and getting appropriate feedback to correct their miscues, then students could be better prepared to try to read texts outside school. The students could get used to *attempting* to read – and building knowledge from their attempts. In the following sections I emphasise the necessity of making students accustomed to reading in a meaningful context and of students learning to pay attention to context as part of their independent reading.

Students' lack of interest towards reading in school, of which we saw an example in the intervention mentioned previously in this article, could be a consequence of the low quality of the instructional texts in the phonics-based reading materials. Few would probably disagree that it would be an improvement if it were possible to use authentic texts (i.e. without controlled vocabulary) for reading instruction in the early grades.

Jenkins et al. (2004) showed that at risk 1-graders instructed in the same phonics program, but either reading storybooks with phonetic control (85% decodability) or without control (11% decodability), surpassed a control group on measures of decoding, word reading, passage reading, and comprehension, but the two tutored groups did not differ significantly. O'Connor et al. (2010) found no significant difference in growth in fluency between students reading easy practice materials (92% - 100% word reading accuracy) and those using difficult materials (80% - 90% accuracy). Others point out that students no longer need to work with decodable text, defined as materials where word-material in the instructional texts is matched to the content of the lessons, when they enter the orthographic phase (Mesmer 2001). Other research indicates that depending on the design for learning, text difficulty can be raised. For example Morgan et al. (2000) found that in dyad reading, using materials two grade levels above the instructional reading level was more efficient than reading at instructional level.

The independently reading students from the intervention (behavioural pattern 1) did not react to their miscues. I suggest that the phonics-based design for learning described in this article makes students ignore the co- and con-text of the word, instead focusing their attention on decoding the text word by word. Previous research has shown that students with poor comprehension in grades 2, 4, and even 6 focus narrowly on decoding text instead of making meaning of text (Canney et al. 1979). In the phonics tradition it is assumed that teaching students to decode should be the core in the beginning of reading instruction. Understanding written text involves the same mechanisms as understanding spoken language so students are typically assumed to be perfectly capable of understanding texts (Elbro 2006, 29-31) and the students will need all their cognitive energy for decoding. The goal is not to teach students to use contextual cues in their reading (Elbro 2006, 33). Therefore it is an advantage if the student can practice decoding without this activity being influenced by the context (other, non-verbal modalities in the text, previous knowledge and so on). In the design for learning proposed by the phonics-based reading material analysed in this article students reread the

texts many times before reading independently. At this point students know the text and they no longer have a need for creating a coherent message from the text.

In contrast, the connectionist model of reading combines a bottom-up and top-down approach. In the connectionist model of reading (Figure 1) four processors work together: The context processor, the meaning processor, the orthographic processor, and the phonological processor.

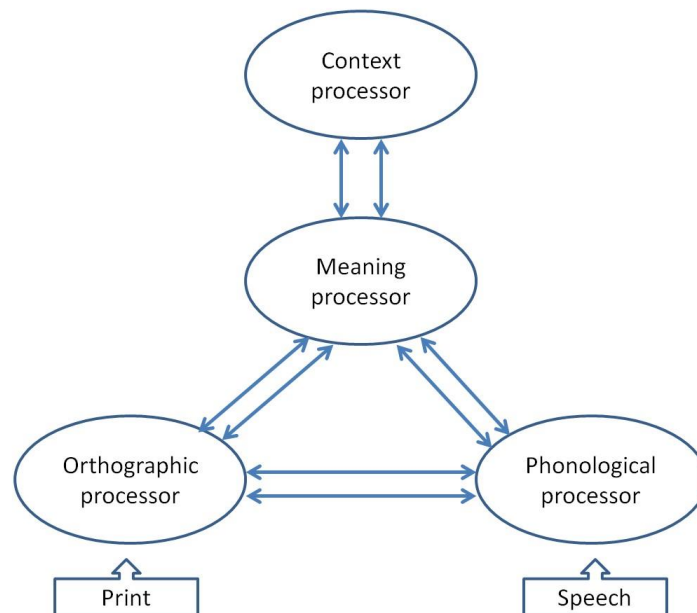


Figure 1. Parallel distributed processing (pdp) model from Adams (1990: 158).

It is very important that there are bidirectional arrows between all the processing mechanisms. Readers use all the mechanisms all the time. The mechanisms all work together and contribute to readers identifying the right word.

Most often a skilled reader can go from orthographic input to meaning quite directly. When a skilled reader reads aloud to a child we mainly go from orthographic input, process meaning and then pronounce the word; if we don't try to relate the word to the context we will not give the word the right pronunciation; we will not be able to decide which of two homographic pronunciations are right and to make the words come alive. Unskilled readers rely very much on the phonological processor when they read because they have not seen spelling patterns enough times to jump quickly to the meaning. Beginning readers sound words out and read out loud to themselves. They go from orthographic input to phonological processing and hopefully to the meaning.

The context processor is where readers try to create a coherent message from a text. Context also helps the reader anticipate what the next word could be. In the absence of the support of a grown-up/more skilled reader the context processor is the only thing that will support self-regulatory feedback (Hattie 2009), i.e. tell the student if he has read a word incorrectly or if he does not understand what he is trying to read. In this model of reading the con- and co-text are important feedback mechanisms for the student reading independently. It follows that decoding is not a skill which should be taught independently of meaning making. Furthermore, good readers have been shown to differ from poor readers in their ability to read

words in context even though the two groups performed the same when reading words in isolation, suggesting that good readers use semantic and syntactic cues (Miller et al. 1976).

If students learn to read by reading, by processing spelling patterns and combinations of letters and compare this to how words really should be pronounced, then the main challenge for a learning material would seem to be motivating the students to read and try to process the orthographic input. This is another reason why we need quality texts. Quality texts that are interesting enough to reward the student for his endeavours could be the key to motivating students.

Fortunately, if texts for reading instruction do not have to be written to facilitate students practicing the application of phonics rules, it is much easier to find age-appropriate and interesting texts. Also the students must check for the right word if the context processor signals that something does not add up. When trying to make sense of an interesting text the student will have an incentive to react to the signals from the context processor.

Methodology Revisited

I have argued that it is necessary to use texts without controlled vocabulary for the intervention and I have based my argument on previous research and theory. But the exact opposite argument could be made using other theories and different research. My choice of text is very much a product of my ultimate aim with my research: to make learning to read more interesting, relevant, and effective for students.

Because design-based research involving a didacticised learning material must necessarily be a multifaceted intervention it is difficult to isolate the effect of particular parts of the intervention. For example, the intervention described above cannot isolate the effect of connectionism. Neither can I isolate the effect of the choice of texts. It might be the scaffolding with TTS that has an effect, it might be that students are more motivated by the meaningful texts or it might be something else. Should the data from the intervention not show a significant effect or a negative effect I could not claim that connectionism had been falsified. In other words this research is not theory-testing because the real-context situations are too complex. The upside is that, should the digital learning material work as intended – that is if students approach the task of reading unfamiliar text in ways that improve their literacy using the learning material – then the results will have high ecological validity. Teachers and students will have a learning material that supports reading acquisition in new ways; design-based research has the potential to produce knowledge that works even though we may not be sure exactly *why* it works.

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Textbook evaluation: A content analysis of selected social studies textbooks at stage 4 level in Zimbabwean primary schools

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Abstract

The research study sought to find out if social studies textbooks used at stage 4 level in Zimbabwean primary school are deficient in content. The focus was on the relevance and adequacy of the content to meet national curriculum standards. Available literature points to the fact that some textbooks are big but teach less and that graduates from various courses are coming out raw in terms of content because of poor textbooks. To this end a rigorous content analysis of the textbooks was carried out.

The study adopted a qualitative approach to ensure that various facets of the textbooks were interrogated, using a crafted instrument for textual analysis. Two books at stage 4 level, grades 6 and 7, were examined for content adequacy and suitability. The books were examined in terms of their constructivist approach, space allocation for the various topics and the objectivity of content. Elements of bias, prejudice and bigotry were unravelled. The content analysis of the prescribed textbooks yielded massive data on numerous elements about the textbooks. Data was presented, analysed and discussed in line with the research questions and the analytical instrument.

The findings show that there are glaring omissions of significant content in the textbooks. It also emerged that aspects like objectivity of text, multidisciplinary approaches, multiculturalism and the constructivist approach have not been addressed adequately in the prescribed textbooks.

The need to engage all stakeholders in the writing of course material and evaluation of prescribed textbooks would go a long way in assuring the availability of quality prescribed textbooks to learners. In this regard recommendations have been proffered that would ensure that textbook development benefits the teaching-learning process. Social studies is a relatively new subject in the Zimbabwean primary school curriculum and it appears the subject area is not well resourced, hence it needs interrogation.

Keywords: textbook evaluation, content analysis, constructivist, stage 4, social studies

Background and motivation for the study

After independence in 1980, the government of Zimbabwe embarked on major curriculum reforms particularly in the primary school system. The shift from the teaching of history and geography in primary school to the introduction of the 'new' subject, social studies, is of particular concern in this research. However, the inclusion of social studies in the national curriculum was a major innovation as the old subjects of history and geography had become

irrelevant in independent Zimbabwe. The old history and geography popularised imperial interests at the expense of national interests and indigenous knowledge forms; such colonial approaches were culturally toxic.

Banks (1990) says social studies is that part of the curriculum which has the primary responsibility of helping students to develop the knowledge, skills, attitudes and values needed to participate in the civic life of their local communities, nation and the world. While the introduction of social studies was an innovative curriculum reform it can be noted that content in social studies is very diverse and there is a need to constantly edit and re-edit social studies textbooks in line with changing patterns in the world. Editing would ensure the subject content remains relevant to prevailing situations (Van Zyl 2007).

The National Report on the Development of Education in Zimbabwe acknowledges the textbooks problem as follows:

As for the content of education, the system is grappling with the challenges of recruiting suitable material writers and timeous production of materials. The main problems and challenges facing the education system at the beginning of the 21st century include inadequate textbooks and stationery in schools. (2004, 6)

Hence this research has been prompted by the need to find out the relevance and adequacy of content in current social studies textbooks. Textbooks content at stage 4, grade 6 and 7, can ensure pupils understand critical social issues from local occurrences to international perspectives. Textbooks can seek to give pupils access to relevant information. Such detail in the textbook would ensure pupils meet new demands and are exposed to emerging issues in various social institutions across the world.

Hendrickson (2008) supports the above contention when he states that pupils will be equipped with innovative knowledge so that they understand complex societal concepts.

Kochhar (1984) alludes to the fact that social studies is interdisciplinary and it would appear that educationists are not clear on the social studies content. Social studies textbooks have to be crafted to meet the multi-disciplinary approach of the subject. This ideal calls for competent authorship to address the various concepts inherent in social studies.

In my experience of teaching social studies I have observed that some textbooks in social studies for primary school do not cover the syllabus content adequately. This research sought to carry out an empirical investigation to determine if the social studies textbooks do have a content deficiency and the way forward in resolving the problem.

The textbook is a vital vehicle in passing on information and knowledge, particularly in third-world countries where resources are limited. Textbooks can cover the syllabus adequately in the absence of other resources (Kapfudz 2003). It is important to bring this problem to the fore so that the 'new' subject does not suffer in terms of effective and relevant publications.

Examining textbooks demonstrates diversity in research, as not much has been written in the social studies area. Nicholls (2007) states that, "it does not take expert frequency and space analysis to realize that published discussions of generic methods in textbook research are under-represented." (9)

If an innovative approach to textbook evaluation, production, evaluation and adoption is not envisioned, the aims of the relatively 'new' subject of social studies will be negated and the subject will drown into irrelevance as happened in the 1920s.

Statement of the problem

The shift from history and geography to social studies in Zimbabwe's primary schools had its own problems in terms of implementation; of particular concern is resource allocation to facilitate effective implementation of the social studies programme. The main problem this investigation seeks to unravel is the question of content deficiency in the prescribed textbooks for stage 4 social studies in the primary schools in Zimbabwe.

The structural content deficits in the textbooks would affect the effective and adequate coverage of the social studies syllabus at stage 4 level. The deficiency in content would lead to the production of a grade 7 graduate who is uninformed. There is therefore need to establish the content levels in stage 4 social studies textbooks in Zimbabwe from educators and also a content analysis of the prescribed textbooks.

Main research question

Do the social studies textbooks at stage 4 in Zimbabwean primary school, have relevant content and cover the syllabus adequately?

Sub-research questions

The following sub-questions were formulated to assist in answering the main research question:

- Is there sufficient coverage of all the topics in the social studies textbooks from national, regional to international issues?
- Do the social studies textbooks adopt a constructivist approach to knowledge construction?
- Do the textbooks cover contemporary issues as envisioned in the syllabus?
- Is the multi-disciplinary nature of social studies exhibited in the textbooks?
- Is the social studies textbook content accurate, objective and recent (i.e. is there evidence of bias, prejudice and bigotry)?

Justification of the study

The research is essential as it seeks to get a comprehensive empirical content analysis of the textbooks. The findings would assist in improving practice in the schools and also from the various stakeholders.

The findings of this research would instil confidence in practicing teachers in the use of textbooks. The social studies arena in Zimbabwe is littered with many programmes that have not been evaluated. This has dissatisfied this researcher and hence this research is aimed at self-satisfaction.

An identification of any problems with the prescribed textbooks should surely lead to improvement in this area. In the course of this research project an analytical instrument for textbook content evaluation was designed. It is envisioned that this instrument will help in textbook selection and adoption processes in the future. It is also assumed that the findings of this research will find their way to policy makers and professionals in the education fraternity through library reading or further research of this nature. This will assist in coming up with policy that is based on empirical investigations.

In textbook evaluations, pertinent steps relevant to textbook evaluation found in McCormick (1981), Williams (1983), Shaw (1993), Cunningsworth (1995), Chambers (1995) and McGrath (2002) are often included in checklists. Most of these checklists are relevant to English language teaching. In this project, I have designed an analytical instrument which is social studies content-specific. The instrument is designed to be usable throughout the pre-use, in-use and post-use of given textbooks. Thus it will be a universal instrument on content analysis (Cunningsworth 1994). The instrument aims to evaluate the potential and suitability of the textbooks. Rubdy (2003) advocates for a needs-analysis process in the construction of checklists, i.e. does the text have potential for self-directed, independent learning? This goes along favourably with constructivists' thinking. Textbooks are crucial to the effective implementation of the curriculum (Chisholm 2000) and should cover all aspects of the curriculum (Tyson-Bernstein 1993).

Theoretical considerations

In examining social constructivism I do so with the understanding that it is a philosophical foundation informing this research. Its philosophical underpinnings are that knowledge is a social construct, hence textbooks should demonstrate the learners' experiences in society in their totality. It is society which determines whether the level of knowledge one has at a particular level or grade is socially acceptable. Society determines which graduate is content-deficient and which one is knowledgeable. However, no book can manage such huge content. The activities and questions at the end of each chapter can seek to broaden the informational base of the learners, coupled with relevant diagrams and other relevant illustrations. The textbook must act as a conversational partner in knowledge acquisition (Bakker, Blokland-Eskell & Ruane 2010). This is the essence of the constructivist pedagogy.

Theoretical framework

A theoretical framework is a conceptual model of how one theorises or makes logical sense of the relationships among several factors that have been identified as important to the problem (Sekaran, 2000, Radhakrishna, Yoder & Ewing 2007). The definition of the word framework is a theory which can be used as a lens to look at a set of facts (OPPapers 2010). It determines what things you will measure. The theoretical framework ensures objectivity in research as preconceived ideas (biases) are erased. Thus a theoretical framework is a guide in research.

This study is informed by the theories of content analysis. This theoretical overview of my research will guide the research processes as to the precise intentions of the investigation. Trafford and Leshem call this the picture of the theoretical territory or theoretical scaffolding (2008, 44). It gives clear guidelines, an architectural plan, of how the research will be conducted.

The theoretical framework gives a strategy for the research planning and the actual investigation, i.e. data collection and analysis. That means the analysis of content in the set textbooks will be done using the stated theoretical framework. General views in terms of policy issues in textual analysis will be adopted from the theoretical framework. Hence the framework will integrate the theory and practice.

Content analysis models

Newman et al. 1995

Newman's model is grounded on critical thinking and the unit of analysis is thematic. Newman advocates for group learning, deep learning and critical thinking (Wever et al. 2006). In his model on analysis of content he includes ten categories, as follows: relevance, importance, novelty, outside knowledge, ambiguities, linking ideas, justification, critical assessment, practical utility and width of understanding. Newman proposes the use of indicators YES or NO for the categories envisaged.

In this research I adopt Newman's model of content analysis because it is grounded in constructivist pedagogy and the unit of analysis is the theme, which are characteristic of themes in social studies. Newman's ideals of critical thinking, group learning and deep learning form the bedrock of constructivist approaches to textbook production. The model of Newman et al. is also a hybrid model developed from Henri's (1992) and Garrison's 1991 models, making it a more comprehensive content-analysis model.

Overview of the methodology

According to Berg (1998), the implementation of qualitative and quantitative methodologies is appropriate in order to facilitate triangulation. And on the choice of a research design, White states that, "it ought to be clear even at this early stage that a researcher can choose to combine the qualitative and quantitative approaches in the same study" (2005, 80). To maximise the validity of the findings, both qualitative and quantitative paradigms were used in this investigation. However the qualitative approaches dominated. The basic research design in this thesis is a case-study method which naturally falls under the rubric of qualitative research (Insch, Moore & Murphy 1997).

Samples and sampling procedure

A set of two books was identified for content analysis. At stage 4, teachers use a set of three books in Zimbabwe. One set of books by M. S. Machawira, *Social Studies in Action Stage 4 Grade 6 and 7*, was randomly selected for content analysis. This set of books was published in 1989 by Harare publishing house. The researcher also noted from his experience in the education field that these books are representative with regard to the textbook situation in social studies in Zimbabwean primary schools.

Data collection techniques

In this study, the researcher used document analysis to ensure the impartiality of the data collected. Cohen and Manion (1994) encourage the use of a multi-method approach to facilitate triangulation. Document analysis was carried out and an extensive literature study was undertaken to analyse textbooks. The two textbooks were analysed for each theme, covering all the ten themes in social studies, using the analytical instrument (see Appendix 1).

Summary of the main findings and discussion of the findings

In this section, I summarise the findings of this research, based on each sub-research question. I also present an analytical instrument which I propose may be used for subsequent content analysis of social studies textbooks. The limitations of the study are discussed and I also suggest avenues for further research in this area. Finally I conclude this research and proffer some recommendations as regards textbook content analysis.

Sub-research question 1: Is there sufficient coverage of all the topics in the social studies textbooks?

What emerged from the study is that the content coverage in the textbooks is inadequate. The content analysis varied in some cases, and in some sections was satisfactory, but overall, implicit in the data was the fact that content coverage was inadequate.

Schulman (1986) suggests that if content is deficient to some degree in the textbooks the amount of content they pass on to the learners is also undermined. The content analysis of the ten themes in the social studies textbooks also reveal that there are glaring omissions in content in the textbooks when measured against the national curriculum standards.

Sub-research question 2: Do the social studies textbooks adopt a constructivist approach to knowledge construction?

Constructivist theorists advocate for learner activity in the teaching/learning process. Learners have to construct their own knowledge through various activities that are crafted by teachers or are found in the prescribed textbook. As stated earlier, Newman's model on content analysis advocates for critical thinking, group learning and deep learning. These ideals form the basis of constructivist approaches even to textbook production.

The textbooks analysed showed some evidence of group learning and also some activities or tasks set out for learners. However, the tasks were not challenging enough at stage 4 level as they did not develop deep learning and critical thinking. Stage 4, as an exit stage, requires learners who are interrogative and inquisitive, not submissive. The textbooks fail to produce this envisioned learner. The textbooks studied propagate transmission learning, which results in surface learning and uncritical thinking, as outlined by Wever, Schellens, Valcke and Van Veer (2005).

Sub-research question 3: Do the textbooks cover contemporary issues as envisioned in the syllabus?

The study revealed that this aspect has been grossly ignored. The textbooks do not have any section to cover this critical component in the social studies program.

The social studies graduate must be an informed person who is well versed in current issues. The textbooks could have had a section or session to deal with this important aspect. This could have been in the form of set tasks at the end of the chapter or at the beginning so that learners are able to link past, present and future practice, characteristics common to social studies. Project 2061 (2012) buttress this assertion when they say that textbooks should help learners understand and apply important concepts. The application component is closely related to current practice. Social studies is a living subject that calls for dialogue on day-to-day occurrences.

Sub-research question 4: Is the multidisciplinary nature of social studies exhibited in the textbooks?

The study revealed that the textbooks tend to concentrate more on history and geography and neglect the other subjects that constitute social studies. Of particular concern is the major omission of anthropological studies. The learners need to be exposed to various cultures in terms of the ten topics in social studies. For example, there is a need to know about clothes and food in various cultures as we are now living in a global village.

The textbooks fail to adopt a multicultural perspective in their approach and yet this component is crucial to social studies. Social studies needs to be examined as a whole and the knowledge not be compartmentalised (Mehlinger 2000).

Sub-research question 5: Is the social studies content accurate, objective and recent?

The study noted that the textbooks that were under scrutiny were published in 1989 and they have some elements of outdated content characteristic of all publications of this period. However much of the content is accurate. The textbooks are quite objective in most instances but the more political topics tend to have glaring biases and prejudices bordering on indoctrination. Such biases create learners who are less critical of leaders and institutions (Graseck 2000, Longstreet 1996, Print 1996 cited in McKay & Gibson 2004). The textbook content needs to be reviewed so that it remains relevant to current situations. Objectivity should be a virtue in prescribed textbooks so that we develop independent thinkers in our societies.

Sub-research question 6: What is government policy in terms of the provision, evaluation, publication and adoption of prescribed textbooks?

The study noted that the provision of textbooks is the responsibility of the Education Ministry through allocated funding to schools to purchase books. However, the choice of books rests with the school, i.e. the administration and teachers. In some schools the headmaster chooses all the books while in some there are committees set up to choose from the prescribed textbooks. The problem is that they end up purchasing all the three sets of available books previously mentioned. Provision of textbooks is generally adequate but supplementary textbooks are not available.

Textbooks in Zimbabwe are published by private publishers and the evaluation is carried out by individuals selected by authorities in the Curriculum Development Unit (CDU) which ultimately adopts the prescribed textbooks. There is a need for a broader approach on policy on textbook provision, evaluation, publication and adoption.

Conclusion

The adequacy of content in prescribed textbooks at institutions of learning is a critical component in the improvement of the quality of graduates that these institutions produce. This is also relevant to Zimbabwe's graduates at stage 4, grade 6 and 7. This research points to some major anomalies in the textbooks. There is a need to put in place structures for the improvement of the textbooks so that they benefit the learners. All stakeholders need to be involved in this enterprise so that the final product is quality textbooks that facilitate the development of critical thinkers, deep learners and informed graduates.

Recommendations

From the findings in this research I am presenting the following recommendations.

- That all textbooks be reviewed every three years to ensure that content remains relevant.
- That teachers receive ongoing training in the subject area to keep them abreast of current practice.

- That schools should have facilities to find information on content in various fields and also current issues, i.e. connection to the Internet.
- That the textbooks prescribed for use should be more task-oriented than just transmitters of content.
- That schools should set up more vibrant current affairs programmes to ensure that learners are kept abreast of current happenings.
- That a more multicultural approach to the teaching of social studies be adopted.
- That textbooks be devoid of elements of bias, prejudice and bigotry. They need to be highly objective.
- That all stakeholders in the education system pupils – teachers, headmasters, education officials and publishers – be involved in the adoption of prescribed books for use in schools.
- That teachers and headmasters should be involved in the writing of books, as used to happen in the CDU, as private publishers tend to be more commercially-oriented and produce books that may not suit the needs of the child.
- That a clear, detailed instrument for textbook content analysis be used in evaluating textbooks, rather than a mere checklist which lacks detail.

Limitations of the study

An outline of the limitations of the study is presented here so as to inform future research of this nature.

The study was carried out using only one set of textbooks. It would be difficult to generalise these findings to the whole of Zimbabwe. However the content analysis of textbooks is quite representative as these textbooks are used in all schools in Zimbabwe.

The textbook evaluation concentrated on content analysis only, leaving out other features of the textbook. Future research may also want to address other aspects of the textbook. This was done in the interest of time and costs.

The dominating research paradigm in this study was qualitative in nature. A more quantitative approach to the same study may be interrogated.

Stakeholders like publishers were not adequately engaged in this discourse. It would be interesting to engage them in future research.

It would be interesting to include the wider participation of pupils in a study of this nature in future. This would be beneficial when addressing older high school learners who would respond more favourably.

Suggestions for further research

This study was limited to one set of books at stage 4 level social studies in Zimbabwe. There may be a need to make a comparative study of the other two sets of textbooks.

Future studies may also address the instruments that are used for content analysis in Zimbabwe's textbook selection process to determine their effectiveness.

If the above suggestions are carried out it may help in the development of knowledge as regards the textbook situation in Zimbabwe.

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Appendix A: New knowledge contribution

ANALYTICAL INSTRUMENT FOR TEXTBOOK CONTENT EVALUATION IN SOCIAL STUDIES¹

INTRODUCTION

Content should be analysed against each of the following criteria under each category which is the theme in social studies, i.e. each theme will be interrogated against the criteria from A to J.

AUTHOR DETAILS

What are the authors' and publishers' credentials?

How recent is the publication?

TOPIC SPACE ALLOCATION

Are all the syllabus topics included in the textbook?

How much space in pages is allocated to each topic?

TEXTBOOK CONTENT ADEQUACY AS PER NATIONAL CURRICULUM STANDARDS

Does the textbook cover content as prescribed in the National Curriculum Standards (Syllabus)?

Are there significant omissions or gaps in the content or some over-emphasis on particular topics?

Does the content address the social context of reality, i.e. citizenship education?

Does the textbook have new knowledge concepts at stage 4 level stipulations?

Does the textbook have accurate and up-to-date content, i.e. contemporary issues?

Is there any repetition from stage 3 work in the textbook?

Does the textbook content link with current academic research in the field?

Is content coverage adequate?

Does the textbook content cover syllabus aims and objectives adequately?

THE INTERDISCIPLINARY NATURE AND CONTEMPORARY ISSUES

¹ This instrument has been crafted based on the social constructivist theory and the major theories of content analysis as espoused by Henri and Newman.

The instrument was designed to examine (categories) themes in social studies using the outlined criteria. The cases or objects in this analysis are stage 4 grade 6 and 7 textbooks. This is content analysis of the textbook and not an evaluation hence it requires no ratings. Content analysis possesses advantages of richer detail unlike evaluation checklists.

Is there evidence of the interdisciplinary nature of social studies in the textbook content?

Does the textbook address the past, the present and the future with an evident chronology?

MULTICULTURALISM

Is multiculturalism addressed in the textbook?

Does the textbook consider rural and urban settings?

EXPOSURE

Does the textbook address national, regional, continental and international issues?

CONSTRUCTIVIST APPROACH

Does the textbook adopt a constructivist approach to new knowledge construction for enrichment purposes e.g. tasks, exercises, extension work, homework?

Does the textbook encourage investigation and a critique of evidences and not mere memorisation of facts?

Does the textbook content have sufficient depth that encourages critical thinking and independent learning?

MAPWORK AND ILLUSTRATIONS

Does the textbook content have adequate, relevant map-work and illustrations, i.e. diagrams, graphs and tables?

OBJECTIVITY IN THE TEXT

Is there evidence of bias, prejudice and bigotry in the content of the textbook, e.g. nationalism, patriotism, partisanship, afrocentricism, ideologies, politics, religions, race, gender, etc.?

Are controversial issues handled appropriately in the textbook?

REFERENCE TO AUXILIARY TEXTBOOK PACKAGES

Does the textbook refer to auxiliary textbook packages?

Analysis and state of the research on musical education textbooks for the 3rd cycle of basic education in Portugal

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Abstract

Over three years a research project was developed to analyse musical education textbooks for the 3rd cycle of basic education in Portugal and the pedagogical practices they influence. Some of the key steps in a double methodological approach have already been completed, including the development of the instruments for collecting qualitative data (reporting tables of content analysis of textbooks on the Portuguese publishing market) and quantitative data (questionnaires for teachers and students).

With regard to the questionnaires, the valuation protocols were validated by a group of experts and the average rating was above 4 (on a scale 1-5) for the relevance and suitability of the two questionnaires. Considering the written comments, some adjustments were made and final version created, which was approved by the Ministry of Education and Science, and distributed in schools.

Regarding the content analysis, a report has been completed citing the results. However, in the 2012/2013 academic year, three new books were published which should be incorporated into the existing analysis. The main results so far indicate the following trends in terms of the textual, sound and picture elements: texts demonstrate attitudinal contents, in alignment with the national curriculum; sound samples are predisposed towards traditional ethnic music styles; pictures generally depict adults, males, and an overall plan to emphasise the action. Also, in terms of text, image and sound: there is no attention to special educational needs; attention to cultural exchange and multiculturalism is reduced; and recreational activities involving the use of technology are rare.

Keywords: musical education for the 3rd cycle, pedagogical practices, textbooks analysis, textbooks use

Introduction

This work is part of a Ph.D. thesis being developed at the University of Vigo (Spain) in the field of musical education. It is funded by the Ministry of Education and Science of the Government of Portugal with the reference 841/2009, by means of a PhD scholarship granted

by the Directorate-General of Human Resources for Education (public document: order of 6/25/2010).

With the curricular reorganisation of 2001, the Artistic Education for the Third Cycle of Basic Education was introduced in Portugal (Ministry of Education 2001). This way, several subjects within the domain, including musical education, were made available to the students in their schools. By this means, vocal and instrumental practice directly assumed an important role in the development of the musical (singing, playing, composing, etc.), cultural, intellectual and behavioural skills of the students. Eleven years later, the Decree-Law No.6/2001, of January 18, underwent some changes with the passing of Decree-Law No.139/2012, of July 5, which reviewed the curriculum structure of basic education (Ministry of Education 2012). Artistic education suffered severe cuts in terms of workload allocation, and the musical education option was eliminated from many basic education schools.

As in other curricular areas, musical practices are not always developed at school in a motivating and creative way for students. On the one hand, this fact can be explained because schools do not have materials that enhance the enthusiasm for this subject and, on the other hand, because the textbooks do not meet expectations and are not used correctly by both teachers and students. Creativity and motivation are aspects that should be valued in pedagogical practice (Kidd & Czerniawski 2011), in particular in musical education (Díaz & Llorente 2007, Díaz, Bresler, Giráldez, Ibarretxe & Malbrán 2006).

To gain an overview of what has been researched in Portugal regarding textbooks, a bibliography was compiled, from which it was concluded that the research on this topic is at a very early stage in this country. In general, the most recurrent research has studied the textbook itself, and focused on the didactic approach of a particular theme or of a particular subject. Of the latter, the most representative are related to the natural sciences (Amador & Pereira 2007), Portuguese language (Rodrigues 2000, Tormenta 1999), mathematics and history (Carvalho 2009). The most common works around the theme of textbooks are of a sociological and semiotic nature, focused on gender issues (Nunes 2009), ethnic groups, image (Botelho, Borges & Morais 2002), citizenship (Brás & Gonçalves 2011, Santos 2001), analysis of ideological content and even the use of metaphors.

The investigations on textbooks deal with several issues. Some study the legislation and the marketing of textbooks (De Castro & Magalhães 2005), others their history (De Castro, Rodrigues, Silva et. al. 1999) and the evolution of their analysis in the different ages (Costa 2011). On the other hand, there are some that deal with the influence of textbooks in the training of teachers (Coelho da Silva 2000) and the system of loaning them among students (Educational Resources Observatory 2011).

It is regrettable that there is a lack of research focusing on comparative analysis, the treatment of curricular content present in different Portuguese textbooks, as well as investigations on how textbooks are used by teachers and students (Santo 2006). Among the different dimensions implied within the study of the textbook, the process of creation, evaluation, promotion, adoption and purchase have had greater priority over the analysis of their use in the pedagogical context.

The Portuguese National Library catalogue presents only two bibliographic entries that discuss the topic of musical education textbooks, which means that very few have devoted their work to the analysis of this type of educational resource, for any of the cycles of basic education. The entry refers to a project (by Eduardo Bueso in the Faculty of Psychology and

Educational Sciences of the University of Porto) presented to obtain a master's thesis in Educational Sciences in 2003, titled: “The textbooks of musical education: Indicators of multiculturalism and cultural exchanges”. The second is a project of a PhD student in history, in 2011, titled: “Da capo al coda. The development of musical education textbooks in Portugal (1967-2004): Configurations, functions, organization”. The author is Fernando José Monteiro da Costa, from the Faculty of Psychology and Educational Sciences of the University of Porto. This is an original study in the area observing the evolution of musical education textbooks throughout the ages.

Since the textbook plays an overriding role in the educational process, being recognised as one of the main instruments of work in different curricular areas, including musical education, it makes sense that an investigation about this feature and the dynamics surrounding their pedagogical practice is made. In general, the textbook is one of the most-used educational materials for pedagogical practices of all times (Johnsen 2001). However, it hasn't been sufficiently analysed yet, nor have the practices in which the school manual engages, particularly in the musical education area. For this reason, it seems appropriate to develop a study that can enlighten this topic.

Publishers have shown more interest in the theme of the preparation of textbooks. However, there is also the question of bringing to light how teachers use this resource in the subject, how often they do it, or if they select another type of didactic means in order to accomplish the goal of improving their pedagogical practice. Fortunately, Colomb and Williams (2008) consider that the way students use and classify textbooks is also an important issue for investigation. In this respect, Knecht and Najvarová (2010) presented to the Czech Republic the educational reality that students' opinions and evaluations of textbooks provide very interesting stimulus to improve this type of resource.

The fact that the textbook plays a hegemonic role in the educational process (Fernández Reiris 2005, Pereira 2010) ensures that it is one of the main resources in different subjects, including musical education. However, one cannot forget that we live in a technological world and so it is important to rethink education (Collins & Halverson 2009) in such a way that emerging technologies can go hand in hand with the school textbook, students' motivation (Kidd & Czerniawski 2011), their educational success and best practices (Cuban 2003). It is important to remember that, to have a successful learning outcome in the classroom, students need to be active learners, highly motivated by inspiring professionals (Menter 2009), but also to be properly monitored by the family (Cheminais 2011), who holds a preponderant role.

From the limited existing studies on textbooks of musical education in Portugal, one cannot ensure, accurately and with enough emphasis, that these materials have any relevance for educational practice. For this reason, an unpublished and original study was undertaken, the main purpose of which was to undertake a deep analysis of the musical education textbooks for the third cycle of basic education, as well as to find out their influence on the pedagogical practice of this subject. With this intention in mind, the following specific objectives were included:

- To analyse the contents of the textbooks in terms of text, sound and image, as a vehicle of possible musical practice and as indicators of multi- and intercultural education and attention to diversity.
- To find out the suitability of the textbooks' contents in terms of adhering to the school curriculum.

- To identify the activities included in the textbooks that require the use of ICT.
- To analyse the type of practical activities presented in the different textbooks.
- To verify that textbooks address the content stipulated for “Music and Technology”, through content analysis.
- To understand the effect of the use of ICTs from musical education textbooks on students.
- To understand how teachers and students work with musical education textbooks.
- To submit solutions or pedagogical proposals to improve the preparation of textbooks, by presenting innovative practices in the area of musical education of the third cycle of basic education.

Framework and project financing

The study is being carried out in the Faculty of Educational Sciences of the University of Vigo (Spain). The project is part of a Ph.D. thesis supervised by Professor Carmen Ricoy. The scholarship holder, Vânia Ferreira, was awarded a scholarship compared to a doctoral scholarship, in the amount of 1,200 euros per month, the equivalent of a basic education teacher's salary in the second grade. This is a specific condition of work from teachers who work for the Ministry of Education and Science of the Government of Portugal, which is subject to a maximum annual renewal of 4 years, depending on the progress undertaken.

This project began on September 1, 2010 and was initially forecast for three years' duration. It was recently awarded a fourth additional year since the investigation is not finished. At the time of writing, the project is predicted to be completed on August 31, 2014.

State of the research

The research presented in this paper has been divided into four core areas. The first area deals with advances in methodological processes. The second area relates to the qualitative study, and we present the results we have obtained for this section thus far. Thirdly, we look at the results we have obtained for the quantitative study. Finally, we discuss the tasks still pending development.

Advances in methodological processes

The fact that it is considered necessary to analyse and study the textbooks in depth as well as the dynamics that surround their use, led to the selection of a double methodology (McMillan & Schumacher 2005). The practice of combining methods is defended by many researchers as a procedure of enrichment in the educational sciences (Creswell 2012, Flick 2011, Ricoy 2009) and a sign of educational innovation (Murga-Menoyo 2009, Touriñan López & Sáez Alonso 2012) essential to scientific work.

After a review of the scientific literature in the methodological field, for this work we chose to take into account the complementarity of approaches for the double methodological approach (Albert Gómez 2009, Beltran, Igea & Agustín 2003, Corbetta 2007, Flick 2011). For the initial phase of this investigation, a qualitative approach was favoured using the hermeneutic or the interpretive paradigm (Gialdino 2006, Ricoy 2006). The technique of content analysis (Mundina 2005) of musical education textbooks for the third cycle of basic

education was chosen. The quantitative aspect of the research comprised data collected via a questionnaire given to teachers and students. The complementarity of the methodologies is defended by several authors (Bernal 2006, Creswell 2009, Sánchez 2003); it is also used as a research strategy (Ruiz Olabuenaga 2007, Sampieri, Collado & Lucio 2006) with the purpose of triangulating the results obtained.

The fact that the results and conclusions of the analysis of textbooks and their use, both by teachers and by pupils, are connected, is promising in terms of enabling improvements to educational outcomes in the subject of musical education (Boggino 2007), inspiring future educational changes (Hargreaves & Shirley 2009) and in improving the textbooks (Martinez Bonafé 2002).

Sample

The sample used for analysis was conditioned by several aspects. In this respect, it is relevant to point out that the first school year in which musical education was generally incorporated in Portugal in the third cycle of basic education (attended by students between 12 and 14 years of age) was 2001-2002, when there wasn't any edited textbook yet in existence. During that year, teachers had to call upon other types of curricular materials for musical education classes. For a better understanding, we present in Table 1 the main data of the complete list of musical education textbooks for the 3rd cycle of basic education in Portugal published between 2002 and 2012. The textbooks to be included in our study sample have a grey background.

Table 1. Musical Education textbooks for the 3rd cycle

Publication year	School grade	Title	Publisher	Author
2002	Annual: 7th	<i>Fábrica dos Sons</i> 7	Porto Editora	Maria Helena Cabral Maria Luísa Andrade
2002	Triennial: 3rd cycle	<i>Sons e Sentidos</i>	Texto Editora	Armando Costa
2003	Biennial: 8th e 9th	<i>Fábrica dos Sons</i> 8/9	Porto Editora	Maria Helena Cabral Maria Luísa Andrade
2003	Triennial: 3rd cycle	<i>Musicando</i>	Editorial o Livro	Isabel Carneiro, Mário Relvas Manuel Encarnação
2004	Annual: 8th	<i>Educação Musical</i> 8	Areal Editores	Nuno Rocha Nuno Ribeiro
2006	Biennial: 7th e 8th	<i>Menu Musical</i>	Areal Editores	Nuno Rocha Nuno Ribeiro

2006	Annual: 7th	<i>Musix – 7º ano</i>	A Folha Cultural	Isabel Carneiro, Mário Relvas Manuel Encarnação
2006	Biennial: 7th e 8th	<i>O Sentido da Música</i>	Lisboa Editora	Lina Trindade Santos Carlos Carlos
2006	Triennial: 7th, 8th and 9th	<i>MP3</i>	Porto Editora	Maria Helena Cabral André Sarmento
2012	Biennial: 7th e 8th	<i>Menu Musical</i> (new edition)	Areal Editores	Nuno Rocha Nuno Ribeiro
2012	Biennial: 7th e 8th	<i>MP3</i> (new edition)	Porto Editora	Maria Helena Cabral André Sarmento
2012	Triennial: 7th, 8th and 9th	<i>MusicBox</i>	Raiz Editora	Isabel Carneiro Lina Trindade Santos Carlos Carlos

The elected sample of textbooks for this study is a result, in part, of a circumstantial selection, since from the twelve textbooks drawn up so far for the 3rd cycle of basic education, four have not been marketed since 2009. At the time of writing, the sample chosen for qualitative analysis includes five of the remaining textbooks on the editorial market for the considered subject (Table 1). This is because in the 2012/2013 school year, after six years of no editorial changes for this subject, three new textbooks came onto the market. We have plans to conduct analyses of these new books and update our research findings.

It is also important to highlight that the publishing of textbooks is dominated by the publishers in the north of Portugal: Porto Editora and Areal Editores.

Table 2. Sample of the textbooks analysed

Textbook title	Abbreviation
<i>Fábrica dos Sons 7</i>	M1
<i>Fábrica dos Sons 8/9</i>	M2
<i>MP3 7/8/9</i>	M3
<i>O Sentido da Música</i>	M4

The sample for the quantitative analysis corresponds to the total population of teachers who teach the subject throughout the territory of continental Portugal (excluding the archipelagos of the Azores and Madeira), totalling 272. The questionnaires for teachers were administered to the entire national territory because the number of teachers in each of the five Regional Directions of Education by themselves was insufficient to collect a statistically valid sample.

The geographical scope of the students' questionnaire distribution was limited to the Northern Regional Education Direction (DREN). The students' sample is probabilistically stratified into eight areas of the northern region of Portugal, corresponding to eight Frames of Pedagogical Area – QZP.. As a result, it corresponds to a total of 2,401 students, 1,297 students from the seventh and 1,104 from the eighth grade. Naturally, for the sample frame definition, appropriate statistical and specific procedures and formulas were used, for a 95% confidence interval.

Table 3 indicates the total population and the corresponding sample framework, as well as the number of questionnaires to be administered to each zone and the number of pupils in the 7th and 8th grades to be surveyed, totalling 2,401.

Table 3. Population and sample students of the DREN

Population			Sample		
QZP	Number of 7th grade students	Number of 8th grade students	QZP	Number of 7th grade students	Number of 8th grade students
Braga	535	599	Braga	137	153
Bragança	66	99	Bragança	17	27
Douro Sul	294	273	Douro Sul	76	70
Douro e Vouga	778	419	Douro e Vouga	199	107
Porto	2024	1833	Porto	518	469
Tâmega	483	449	Tâmega	124	115
Viana Castelo	565	523	Viana Castelo	145	134
Vila Real	316	113	Vila Real	81	29
	5061	4308		1297	1104
Total	9,369		Total	2,401	

For the calculation of the sample, formulas and statistical procedures were used and calculated to a 95% confidence level.

Different instruments of data collection were applied and accurately prepared, which guaranteed the value of the results obtained. The treatment and analysis of the collected information were made using the most relevant computer programs. For the content analysis of textbooks, the programs Microsoft Excel and Word were chosen (which allowed the construction of the categorisation scheme according to the content being analysed). As for the questionnaires, SPSS (Statistical Package for the Social Sciences) version 20 was used to determine descriptive statistics, correlations and inferences.

Results of the qualitative study

So far, some of the main stages of the investigation have been accomplished, such as the elaboration of the instrument for qualitative data collection, as well as the registration boards for the content analysis of textbooks on the Portuguese editorial market for musical education in the third cycle (Table 2).

For the content analysis of the textbooks a report has been prepared citing the results, amongst which the following stands out:

- The textbooks were assessed with regard to text, sound and images. In the text, the attitudinal contents prevail, meeting the requirements of the national curriculum. Regarding the sound, there is a prevalence of traditional ethnic music samples, those of other countries being infrequent. As far as images are concerned, those of adults are more common than images of youths or children; there is a predominance of male gender representations over the female figure; the most frequent image type represented follows a general plan, which is a reproduction of the entire body and little surrounding context, to give emphasis to the action.
- Crossing the board from the three levels of assessment (text, sound and image), there is not much care shown regarding special educational needs or much attention paid to cultural exchanges and multiculturalism.
- The practical work that is proposed the most is listening activities, playful activities involving the use of technologies being rare. There is a weak tendency towards instrumental practice appreciation, a situation that is accentuated in M1 and M2 as these include few scores. Two of the other textbooks (M3 and M5) present a greater predominance of instrumental practice activities, but many of these are unsuitable for the students' reading skills and the lack of available instruments in the classrooms. The most level-headed textbook is M4 since the displayed activities are simpler and enable students to carry out the instrumental practice which is summarised in the curricular guidelines.
- The activities included in the textbooks which use ICTs more frequently are aural activities. There was a total of 473 occurrences in all of the analysed textbooks, M3 drawing upon this type of resource more often. The second highest use of ICTs was in activities requiring students to research information through electronic addresses, presented in only one of the five textbooks (M4) with 18 suggestions.
- The module "Music and Technology" is included in only two of the five analysed textbooks (M2, M3). These two simply address some of the fundamental points of the curriculum guidelines regarding this module, and only very superficially. In addition,

M3 is a reissue of M2, and there is no other textbook to establish a valid comparison to this module. Therefore, the contents presentation of the module “Music and Technology”, in the two analysed textbooks, is a mere repetition.

Results of the quantitative study

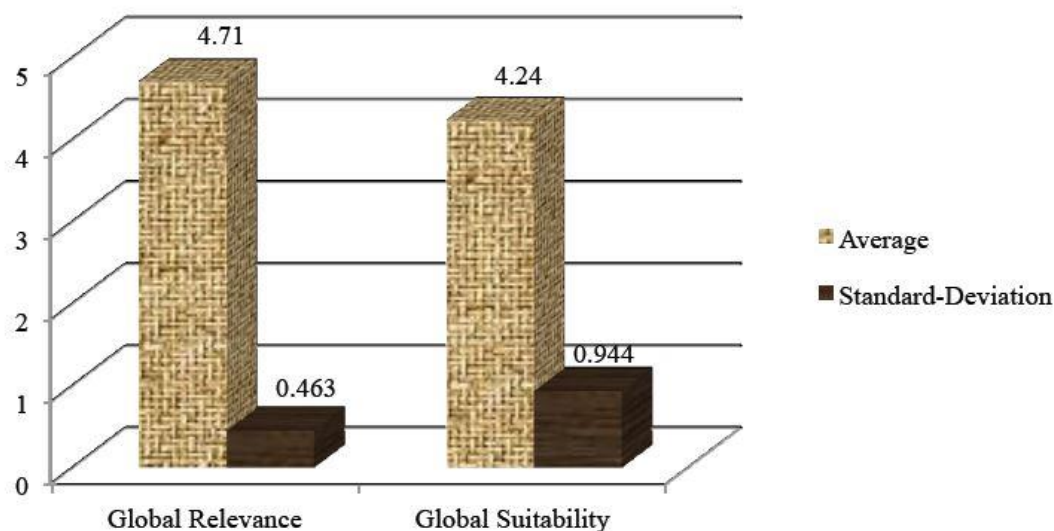
The construction of the quantitative data collection instruments has already been carried out: the questionnaires for teachers and students. For the validation process of these questionnaires, protocols for the valuation of both were drawn up in order to be filled in by experts. For this purpose, it was decided to create a version in Portuguese and another one in English, so as to increase the participation of international specialists. These questionnaires were assessed by a group of twenty-one scientific professionals. The selection was carefully chosen based on academic training, vocational training, professional (university and subject taught) and scientific activity (proving that they relied on scientific publications on the topic of textbooks and education). The experts' profiles are as follows:

- The age range is between 33 (minimum age present in the sample) and 61 years old (maximum age present in the sample), with an average age of 46.18. The female gender is more highly represented, including thirteen experts (61.9%). The remaining eight experts were males (38.1%).
- The majority of experts (11/21) had a PhD (52.4%), four had a degree (19.0%), three had a master's degree (14.3%), two had completed postgraduate studies (9.5%) and one had completed postdoctoral research (4.8%). The most highly represented field within academia was the educational sciences with ten experts (47.6%). Six experts were from the field of musicology (teachers of musical education of the third cycle), representing 28.6%, and six others in the music area (23.8%).
- The most highly represented occupational categories among the experts were teachers of grouping framework (six specialists, accounting for 28.6%) and associate professors (six others, 28.6%). It should be noted that five experts were full professors (23.8%), three were assistant professors (14.3%), and only one was a university professor (4.8%). The group of experts comprised mostly professors of higher education, with fifteen participants (71.4%), and the remaining six experts were teachers of basic education (28.6%).
- From the total 21 experts, nine (42.9%) were from Spain (Universidad del País Vasco, University of Santiago de Compostela, University of Barcelona, University of Coruña, University of Valencia, UNED - Universidad Nacional de Educación a Distancia, Madrid). Eight experts (38.1%) were from Portugal (Minho University, Higher School of Education of Lisbon and Grouping of schools). On the other hand, there were two experts (9.5%) from Brazil (the Federal University of Rio Grande do Sul and the Federal University of Amazonas). One expert from Argentina also participated (4.8% - University of Palermo) and another one (4.8%) from Venezuela (Universidad Nacional Experimental Francisco Miranda). The majority of the experts each came from different universities/institutions, with the exception of two that were from the University of Santiago de Compostela (9.5%), two more from the University of Barcelona (9.5%) and two others from the País Vasco (9.5%).

After collecting the comments, criticisms and suggestions from the experts, a quantitative analysis of them was made. The valuation of the student questionnaire reveals that the global average, regarding the relevance, is 4.71 ($\sigma = 0.463$) on a Likert scale of 1 to 5 levels. As far

as the suitability of the student questionnaire is concerned, the total average is 4.24 ($\sigma = 0.944$) (Figure 1).

Figure 1. Global relevance and suitability values for the student questionnaire



The same analysis indicates that the average global valuation of the relevance of the questionnaire for teachers is 4.67 ($\sigma = 0.483$) on the same scale of 1 to 5; the overall valuation average for suitability was 4.48 ($\sigma = 0.602$), as it can be seen in Figure 2.

Figure 2. Global relevance and suitability values for the questionnaire to teachers

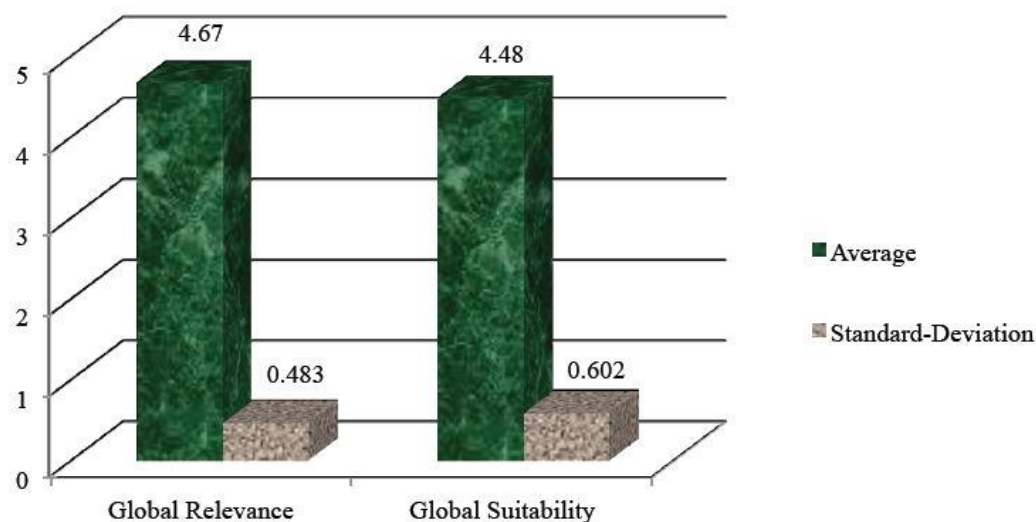


Table 4. Categorisation of the experts' answers in the valuation of the questionnaire for teachers

Questionnaire for teachers	
Category	Subcategories

1.	Amendment suggestions	1.1. Revise
		1.2. Replace
		1.3. Change to an open question
		1.4. Divide the question
		1.5. Avoid footnotes
		1.6. Reorder the questions
		1.7. Suggest multiple answers
		1.8. Add something to the question
		1.9. Add questions
		1.10. Expand the space for the answer
		1.11. Write complete sentences
		1.12. Remove items
		1.13. Compile items
2.	Remarks	2.1. Lack of information
		2.2. Error in the date
		2.3. Formatting
3.	Clear disagreements	3.1. Ensure anonymity
		3.2. Relevance of information
		3.3. Incomprehension

The qualitative analysis of the comments, criticisms and suggestions written by the experts in the assessment protocol of the questionnaire for teachers was undertaken using a system of categories and subcategories (Table 4). The collection of results is very positive and confirms the suitability and relevance of the two data collection instruments, specially developed for this investigation.

After consideration of the expert assessments for the teachers' questionnaire, and taking also into account that all issues presented an average value of relevance and adequacy over 4 (on a scale of 1-5), few changes were made to the data collection instruments.

The comments, criticisms and suggestions given by the experts in the assessment protocol of the questionnaire for students were equally analysed according to a system of categorisations created according to the type of suggestions presented (Table 5).

Table 5. Categorisation of the experts' answers in the valuation of the questionnaire for students

Questionnaire for students	
Category	Subcategories
1. Amendment suggestions	1.1. Revise
	1.2. Replace
	1.3. Reorder the questions
	1.4. Add something to the question
	1.5. Remove items
	1.6. Compile items
2. Remarks	2.1. Lack of information
	2.2. Error in the date
	2.3. Formatting
3. Clear disagreements	3.1. Ensure anonymity
	3.2. Relevance of information
	3.3. Incomprehension

Some of the categories created for the teachers' questionnaire were not used by the experts in the students' questionnaire, whereupon it was decided to maintain the same category name, but the numbering was redone for the student questionnaire.

In the experts' evaluations of the suitability of the questionnaire for students, special attention must be given to the fact that only four questions had an average rating of less than four. They are the issues numbered: 8, 21, 24.1. and 24.2. Each of them had the following valuation average: 3.94; 3.80; 3.76; and 3.67. As a result, these issues were subjected to a deeper reformulation.

From what has been said, the few modifications in both questionnaires were justified since the average expressed for each issue (and the respective standard deviation) was not

representative of this need. With the minor modifications completed, final draft versions of the questionnaires were subjected to an internal review by the Ministry of Education and Science of the Government of Portugal. The result of this evaluation was positive, and the application of both questionnaires in the school context was authorised by the Directorate-General for Education (DGE) of the Ministry of Education and Science of the Government of Portugal (according to the information in the site <http://mime.gepe.min-edu.pt/>, investigation number 0381600001). After receiving this authorisation, population data was requested from the educational institutions in order to define the sample of teachers and students to complete the questionnaire.

Once this was obtained, fieldwork began and questionnaires were administered to the sample. The questionnaires were directly given to the students and sent electronically to the teachers. The data collection phase for the questionnaires to students and teachers has been completed and the conclusion of the respective data treatment is expected.

Work plan: steps and schedule

In developing the project, several stages were established, initially scheduled over three years. Later, they had to be extended to four years, according to the planning Table 6.

Table 6. Summary of the stages of project development.

STEPS	SCHEDULE
1st step: 2010/2011	
▪ Bibliographical research and state of the question	1/9/2010 to 30/4/2011
▪ Preparation of instruments for the analysis of textbooks.	1/5/2011 to 31/8/2011
2nd step: 2011/2012	
▪ Collection and processing of data for the analysis of the textbooks.	1/9/2011 to 31/12/2011
▪ Preparation of the questionnaire for teachers and for students.	1/1/2012 to 31/8/2012
3rd step: 2012/2013	
▪ Valuation process for the validation of the questionnaire for teachers and students.	1/9/2012 to 31/1/2013
▪ Development of the questionnaires for teachers and students on the use of textbooks and pedagogical practices that these influence.	1/2/2013 to 31/3/2013
▪ Sample definition for the questionnaire for teachers and students.	1/4/2013 to 31/8/2013
▪ Fieldwork: apply/administer the questionnaire to teachers and	

students in the Regional Directions of Education from the definition of the performed sample.

- Statistical treatment of the data of the questionnaire to the students.
- Data collection from the observation of classes (conditional).

4th step: 2013/2014

- Statistical treatment of the data from the questionnaire to teachers.
 - Processing of the data collected from the observation of classes (conditional). 1/9/2013 to 31/12/2013
 - Diffusion of the research project at the 12th Conference of the Association for Research on Textbooks and Educational Media (IARTEM).
-
- Preparation of the report with the results of the questionnaires in research.
 - Debate with members of the scientific community on the topic of good practices (university from another country – European Doctoral) 1/1/2014 to 30/4/2014
 - Compilation of conclusions.
 - Preparation of innovative pedagogical practices proposal for the subject of musical education.
-
- Revision of the essay for the final version of the thesis.
 - Preparation of the thesis defence and presentation of the results before the jury. 1/5/2014 to 31/8/2014
 - Follow-up of the diffusion before the scientific community (mainly in scientific events and publishing articles in journals of generic or specialised education) and finally before the school community.
-

As seen above, the work plan was distributed across four years. For the first year, two blocks of activities were settled: reading the scientific literature on the subject to the state of the question; and the preparation of instruments for the analysis of textbooks. For the second year, two other blocks of tasks were established: the collection and processing of data for the analysis of the textbooks; and the preparation of the questionnaire to be applied to teachers and students.

At the moment, the statistical treatment of the students' questionnaire data has started. The data collected during class observations is conditioned by the fact that it is not known if the information gathered meets the goals of the investigation.

On the other hand, the third planning year included: the validation process for the creation of the questionnaire for teachers and students; sample definition; the application/administration of the questionnaire to teachers and students and the statistical treatment of students; data collection from the observation of classes.

The final phase of this work is planned for the 2013/2014 school year, during which time we wish to see three major tasks completed:

- First, the statistical treatment of the teachers' questionnaire data; the processing of the data collected during class observations (if any collection work needs to be done); and dissemination of the findings of research project at the 12th IARTEM Conference (International Association for Research on Textbooks and Educational Media).
- Second, the report with the results of the questionnaires; a debate on the theme of good practice with members of the scientific community, in particular a university from another country with a view to the European Doctorate; compilation of the conclusions; preparation of proposals for innovative pedagogical practices in the subject of musical education.
- Third, a review of the final version of the thesis; preparation for the defence and exposition of the research results before the jury. Everything will be combined with diffusion to the scientific community (in particular in other conferences and the publication of papers in generic or specialised education journals) and finally the introduction to the school community.

The completion of the project, following the phases shown in Table 6, will lead to the body text of the doctoral thesis intended to be organised in two major parts.

Part I - Theoretical foundations, divided into four topics:

1. Educational resources (1.1. Conceptual approach; 1.2. Classification: overall and in musical education; 1.3. Functions; ICT as a general resource and for musical education)
2. Textbook (2.1. Historical concept; 2.2. Types, dimensions and functions; 2.3. Frequently asked questions; 2.4. Legislation; 2.5. Treatment of diversity; 2.6. Textbooks for musical education; 2.7. e-textbook);
3. Musical education in school curriculums;
4. State of the Question.

Part II - Methodological foundations, including five sections:

1. Research design (1.1. Researching the problem and issues; 1.2. Goals; 1.3. Methodology);
2. Reporting research (2.1. Qualitative study results; 2.2. Quantitative study results;
3. Proposals of good practice (3.1. Textbooks; 3.2. ICT – Open resources);
4. Limitations and looking forward;
5. References.

This is still an open structure that is subject to minor amendments until the completion of the project.

Some preliminary conclusions

In the analysis of the textbooks, as far as the text is concerned, one cannot find a predominance of procedural content as would be expected. Regarding the sound, the audio samples are not representative of the different traditions in the world. On the topic of images, it is not clear why textbooks made for students display a greater number of pictures of adults, when images of young people in instrumental or artistic practice should prevail. Possibly, young people do not relate to the images presented so they do not feel motivated to reproduce those actions. Another image-related finding is that representations of the male gender predominate over those of the female gender. Furthermore, the depiction of disabled persons is non-existent, and cultural and multicultural references are rarely used.

The most common activity is listening comprehension, over instrumental practice and the exploration of new technologies applied to musical education. The results obtained lead to the conclusion that there is a tendency in the textbooks to suggest repetitive use of listening exercises as frequent proposals of ICT use. The high number of listening exercises in most textbooks shows the pedagogical preference for this type of task at the expense of any others.

It is important to highlight that the type of comments made by the experts in their analyses of the student questionnaire were the same as those listed for the teachers' questionnaire: suggestions for amendments; remarks; clear disagreement. However, the subcategories listed in the student questionnaire were fewer, indicating that there was less feedback from the experts regarding the student questionnaire and it was more consistent, when compared to the experts' responses and feedback to the teachers' questionnaire. The results of the validation procedure for the questionnaires denote the suitability and relevance of the two original data collection instruments elaborated for this investigation. We can conclude that the different data collection instruments were elaborated with accuracy and in order to ensure the validity of the achieved results.

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WORKSHOP 3

TEXTBOOKS AND TEACHERS: TRAINING, SELECTION, USE

Instruments of evaluation and choice of physics textbooks

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Abstract

This paper presents the results of an investigation which aimed to elaborate a more user-friendly and accessible instrument for teachers to guide their selection of physics textbooks. This instrument was constructed based on official normative documents and the results of investigations into physics teaching. The research is relevant due to the importance of the textbook selection process in teaching, and also due to its dimension within the expansion of the PNLD (National Program of the Textbook) and the Program for High School Textbooks. Furthermore, a more discerning and critical evaluation of textbooks may give teachers better conditions for working in the classroom. The analysis tool was developed based on aspects pointed out by Aran (1996), by the leading documents on education and by the PNLD Notice, along with the PNLD Teacher's Guide of 2012, among others. The main constitutive elements were developed based on themes developed in academic works (theses, dissertations, articles) focusing on physics teaching and its relationship with textbooks.

Keywords: physics teaching, didactic manuals, analysis of textbooks, PNLD, PNLD EM.

Introduction

Law number 9394 (1996), which corresponds to the Law of Guidelines and Bases of Brazilian National Education (LDB), in Item IV of Article 9, allows for the establishment of skills and guidelines by the states, federal districts and municipalities, together with the union that will guide the curriculum and its minimum knowledge requirements for early childhood education, elementary education and secondary education, in order to ensure a common basic training. In turn, the National Curriculum Guidelines for Secondary Education (DCNEM), created to guide curriculum organisation proposed by the LDB, stipulates in Section 4.2 that basic training to be delivered in high school will take into account the constitution of competences, skills and dispositions of conduct more than the amount of information. This encompasses: learning how to learn and think, relating knowledge to the data of everyday experience, and giving significance to learning and grasping the meaning of the world,

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bridging the gap between theory and practice, substantiating criticism, arguing based on facts, dealing with the feeling that learning awakens.

To strengthen and clarify the desired linkage between content and skills in the construction of the curriculum, the National Curriculum Guidelines for Secondary Education (PCNEM) that were developed to guide in more detail the proposals for teaching the various subjects of high school, in the specific case of physics, after critically exposing the situation in which this subject is developed and making suggestions for overcoming criticised aspects, show that the set of examples and topics presented here should not be understood either as prescriptive or as a complete or exhaustive list. The guidelines attempt to explain, in different ways, that more than a simple reformulation of content or topics, the intention is to promote a shift in emphasis, aiming at the individual, social and professional life, present and future, of the children who attend middle school (28).

In search of a better explanation of the procedures to be adopted by teachers, a set of reflections was prepared to assist the teaching practice through the *Curriculum Guidelines for Secondary Education*, which not only includes several key aspects to be observed in the content and methodology, but also makes comments about the textbooks used by students and teachers.

By showing how the presentation of the subject content in textbooks occurs, it is argued that when subject content is presented in textbooks, the sequence of transformations which occur mask any difficulties. Concepts are shown in a simplified form and the student believes that all that is necessary is to simply memorise any formulas and key concepts, without needing to ask where the knowledge came from (49).

These questions, presented in summarised form and taken from the law and its normative instruments, served and have served as parameters for the organisation of the various aspects of the National Textbook Program, which had as its initial target to meet the demands of elementary school, but since 2004 has also been implemented with high school students through the National Textbook Program for Secondary Education (PNLD EM).

Given the numbers involved in PNLD EM, whether in the quantity of distributed books, or the associated values, different mechanisms of selection and evaluation of books have been developed in order to best utilise the resources allocated to the program, both in its educational and economic aspects. Thus, from among the various stages, from the release of the announcement for publishers and authors to the arrival of the books in the hands of students in schools, this work will give special attention to those stages relating to the evaluation and selection of books by the teachers who will potentially use them in their classrooms, given that, according to what is stated in the PNLD EM 2012 Announcement, in teaching activities, the textbook assumes a significant role. Indeed, the textbook represents a cultural object, created as a framework for theoretical and methodological foundations and intended to guide the activities of school education. Specifically, in relation to work with languages, the textbook must “open” the student's interest to much broader and socially-relevant questions (23).

The textbook represents a support for the teacher, sometimes the most accessible support, which implies a demand for school books which, in fact, prioritise the expansion of students' skills in the production and reception of the different practices of the various languages (23). In this regard, Rangel (2005) argues that the evaluation of the Ministry of Education (MEC), by relying on abstract and general criteria, independent of particular contexts and realities,

put on one side the official review and, on the other, the reality and the demands of school. Thus, the options offered by the Guide and by the Political-Pedagogical Project of the school, which sometimes come into conflict, assume that teachers will be responsible for choosing the books, being one of the main users of them. Thus, it is essential that teachers have a knowledge of several areas to be mobilised in order to be ethically responsible in knowing how to select textbooks, and not only this, but also be able to assess the possibilities and limitations of books recommended by the MEC, since the book should be one among several tools for teaching (Núñez et al. 2002).

How and why books are selected and chosen are questions of major importance, which is why the organisation and research of assessment instruments for textbooks, the aims of this study, are justified. The next section will focus on highlighting the necessity of use and construction of an analysis instrument.

The selection of textbooks: the process and the importance of analytical tools

The evaluation carried out by PNLD EM resulted in an intervention, as indicated by Batista (2005), not only in the publishing and control field of its production, but also an intervention in curriculum and in its control. From the moment in which the state takes care of instruction, building its education systems, the textbook becomes, according to this author, an object of special attention, with specific mechanisms for controlling its production, selection and use, and what and how to teach.

According to a specific announcement, the books registered in the selection process by the PNLD EM are subjected to analysis by a team of teachers and researchers who are supported by rigorous and wide assessment instruments, checking for the presence of certain aspects considered to be important and necessary for a good quality book.

In this review, textual and graphic-editorials criteria are privileged over those of a conceptual and methodological nature. The books selected by these professionals become part of the Textbook Guide, which contains the reviews prepared by the evaluators and is an instrument chosen by the state to act alongside the teacher in choosing the textbook, a process which should be carried out in teams.

Some of the criteria given in the Announcement of the PNLD EM (2012) for physics used by teams who select textbooks that will become part of the catalogue indicate that books should be checked to ascertain whether or not they:

- Present conceptual contents of physics within their necessary contexts, in relation to their social, cultural, historical and economic production contexts, whether concepts are presented in relation to everyday contexts which make their use relevant, and avoid the use of artificial contextualisations for such content.
- Avoid presenting mathematical formulas as ready and finished results without providing explicit deductions, when relevant and appropriate, even in the form of additional items or supplements to the main text.
- Present experimental arrangements or didactic experiments achievable in typical school environments that have been previously tested and controlled for any potential safety risks, and underscore the need for warnings about the specifics of each procedure.

- Propose discussions on the relationship between science, technology, society and the environment, promoting the formation of citizens able to appreciate and to critically appraise the contributions and impacts of science and technology on social and individual life.

These criteria are consistently in line with what is given in the current guidelines for education and deal with factors which are objects of discussions in the area of physics education, and which, when present, aid in teaching and learning, and should therefore be present in instruments intending to assess textbooks.

In considering the evaluation carried out by MEC, Rangel (2005) argues that we must remember that the evaluation of MEC is based on criteria whose rather broad scope derive from those elaborated in the National Education. The criteria are abstract and general, that is, independent of particular contexts and realities. Thus, between the official assessment on the one hand, and the reality and demands of a given school on the other, there is a certain discrepancy, that only a proper process of choosing the textbook will be able to resolve. Thus, the book chosen must be consistent with the reality in which the school is situated and its pedagogical project, and it should be an aid to the teachers in their teaching material. In this sense, school planning and staff planning for each teacher, insofar as they involve a systematic discussion of didactic materials, can tell us, at every moment and for every situation, which material is (more) appropriate, what the parameters and suitable procedures for a qualified choice are, and what pedagogical values define and promote critical use (Rangel 2005).

The assessment of the textbook by the teachers will enable verification of its quality and suitability for the educational work of the teacher, thus the construction of tools that can assist in this essential task of selecting textbooks systematically and formally, following well-established criteria and organising analysis, is warranted.

Textbook analysis: the need for analysis tools

When considering that the responsibility for analysing curriculum materials to use in classes is one of the tasks of teachers, Aran (1996) argues that such analysis should be done in a formal and systematic way and highlights the need for analytical models of curriculum materials, from the perspective of significant and functional learning, addressed to the teacher so that he/she can make a formal and systematic evaluation to help him/her select and establish criteria for use of the analysed materials (79). In his work entitled “Curriculum materials: How to develop, choose and use them”, he proposes a script sample analysis which proved adequate for Spanish textbooks. He also points out that the model has to be understood as a useful tool to assess curriculum materials, but this assessment must be made “within a broader context of inter-related elements, hence the importance (...) of analysing the proposed material in relation to the established agreements in curriculum design” (80).

In addition, it should also be considered that the analysis of textbooks includes analysis of their contents, which is necessary to analyse what is behind the words, a task which teachers need to be aware of and prepared for when analysing a textbook. In this sense, Franco (2003), quoting Bardin, emphasises the importance of content analysis, pointing out that the intention of content analysis is to examine inference. Thus, content analysis, when producing inferences, gives theoretical relevance to this procedure, and simply comparing information, merely describing the content, is of little value.

Carvalho (2007), quoting Mohr (1994) and Delizoicov (1995), comments on the need for teachers to be prepared to perform this analysis, recording that “we see the negligence when providing incorrect information, indicating the need for investment in guiding teachers, with a view to their improvement, so they might be prepared to undertake critical analysis of content present in teaching tools”. Alongside this need, in analysing textbooks, it is expected that “teachers must have a mastery of the many areas to be mobilised in order to take the ethical responsibility to know how to select the textbook, and not only that, but also, be able to assess the possibilities and limitations of books recommended by the MEC, as the book should be one, among other tools, for teaching” (Núñez et al. 2002).

Highlighting the responsibility placed on teachers in the task of analysing textbooks and knowing that the book to be chosen needs to relate to reality and meet the requirements of the proposed educational policy of the school, besides being a material that assists the teacher in his/her pedagogical practice, we can see that the construction of instruments which, following well-established criteria, may assist in the essential task of selection of textbooks to be used by teachers in their teaching work will be extremely worthwhile.

The construction of the theoretical elements of the analysis tool

Highlighting issues of a theoretical nature on the subject of textbooks and their assessment, Aran (1996) developed an analytical model of textbooks that proved to be efficient for curriculum materials in Spain. This model, however, is not fully adaptable to the Brazilian reality and assessment of our teaching materials. Given this difficulty, we started to examine the national conditions, which would enable the production of an instrument that suited our reality.

The first stage was to analyse the guidelines given in the national education documents, identifying elements considered desirable for incorporation into various educational processes, elements which have also been the subject of discussion and research in the field of physics education research. Many of these aspects have also been consistently incorporated in the Announcement of the PNLD EM as criteria to be considered in the production and assessment of textbooks, and the basic categories for the construction of the analysis instrument was based on them. The categories taken into consideration were the following: graphic-editorial and textual aspects, interdisciplinarity, contextualisation, modelling, problem solving, experimentation, texts, information technology, teacher’s manuals and review.

In preparing the instrument, issues related to textual and graphic-editorial aspects were supported in both directions from the PNLD EM Guide and also in the model proposed by Aran (1996). The category for the teacher’s manual relied exclusively on Aran (1996). On the other hand, for the elaboration of the questions relating to the other categories, we looked at academic texts (including theses, dissertations and articles) that addressed the issues in question.

These academic texts were found after careful investigation of the recent literature and, besides discussing and making proposals for the teaching of physics and being in accordance with the points raised in the guidelines, also dealt with questions related to our listed categories. Thus, they served as a theoretical support for the organisation of the necessary elements in the construction of the questions that compose each category.

In this way, for the interdisciplinary category, the article “Interdisciplinarity: Fact to consider”¹ (Cardoso et al. 2008) made it possible to include items in the instrument that could determine whether the work in question presented an interdisciplinary approach and highlight noticeable aspects concerning interdisciplinarity.

The contextualisation category was theoretically supported by the dissertation of Pagliarini (2007), “An analysis of the history and philosophy of science present in physics textbooks for middle school”, which was concerned with elements that could indicate factors relating to socio-historical contextualisation and the philosophy of science.

The modelling category drew theoretical support from the article, “The scientific modeling of physical phenomena and physics teaching” (Brandão, Araujo & Veit 2008). For this category, the aim was to check how scientific models are presented and whether the validity of the domain is specified.

For the category of problem solving we tried to identify the skills required for problem resolution and whether there were activities that would favour the formation of the investigative spirit. This approach was taken from the article, “Technical skills versus structuring skills: Problem solving and mathematics’ role as physical thought structuring” (Karam & Pietrocola 2009).

For the experimentation category, we examined whether or not proposals for experimentation were present in the textbooks, and of those that were, whether the proposals presented were viable and did not entail any risks in their performance. The articles, “Experimentation in science teaching” (Pacheco 1997) and “Practical activities: Possibilities for change in physics teaching” (Fernandes 2008), formed the basis for this method.

For the texts category, we followed the approach of Ribeiro and Kawamura (2006) in their article “Scientific disclosure and the teaching of physics: Intentions, functions and strands”, trying to verify if scientific dissemination was present in the material, how its various aspects are discussed and how they appear as features of the languages used.

For information technology two articles formed the basis for our methodology: “Science, technology and society: The relevance of the CTS approach for the high school context”, by Pinheiro Silveira and Bazzo (2007) and “Education in physics: Discussing science, technology and society”, by Angotti, Bastos and Mion (2001). For this category, we looked at what aspects should be present and highlighted in articles where a CTS (science, technology, society) approach was identified.

The category concerning the teacher's manual was based on Aran (1996). We sought to determine whether the manual gives clear guidelines and presents a pedagogical proposal giving direction to the teacher, if additional activities are suggested and if there are proposed interdisciplinary connections. Also included in this category were the assessment proposals, for which we borrowed our approach from two articles: “A comparison between traditional and alternative assessment in high school physics” by Vidotto, Laburú and Barros (2002), and “Concepts and methods of physics assessment used in the high schools of Belo Horizonte” by Tallim and Oliveira (2002).

¹ The titles of articles have been translated into English here but are listed in the original Portuguese in the references.

The assessment instrument for textbooks

The format of the developed instrument consists of a document organised into blocks, where each block corresponds to a category, except for the category “textual and graphic-editorial aspects”, which was divided into two blocks for better systematisation. As well as analysing the student book, we examined the teacher's manual.

The issues listed are of a qualitative nature, seeking to deepen the themes defined by the categories. Each issue, given in the form of a statement, needs to be responded to in two ways: there is a space for comments on the right side of the table, and a rating scale (in the middle of the table) where a description of the frequency that the given element is addressed in the textbook can be given, as follows: (N) Never, (A) Sometimes, (Q) Almost always or (S) Always.

Table 1. *Graphic-editorial aspects.*

QUESTIONS TO REVIEW		RATING				OBSERVATIONS about the item
		N	S	O	A	
Graphic-editorial aspects	The visual elements (images, fonts, headings, etc.) are presented in a suitable format and articulate the content without performing a purely illustrative function.					
	The illustrations are appropriate to the purposes for which they were prepared, being clear, precise and consistent with the text.					

Table 2. *Contextualisation.*

QUESTIONS TO REVIEW		RATING				OBSERVATIONS about the item
		N	S	O	A	
Graphic-editorial aspects	Historical moments in which the scientists discussed lived are presented.					
	The political situation experienced by scientists is presented.					
	Activities seeking information, including on the history of science, are presented, contextualising the subject under study.					
	Importance is placed on the philosophical aspects of science during the development of work.					

Each of the above-mentioned categories are included in the instrument. The evaluator will check if each element is present or not in the textbook, and, depending on the frequency with which it appears, give their evaluation. In the comments section the teacher can elaborate on anything they may have noted during their analysis. Tables 1 and 2 (below) illustrate some evaluation sample areas for the categories “Graphic-Editorial Aspects” (the second block belonging to the first category) and “Contextualisation”.

The initial elaboration of the instrument was based on normative documents in PNLD EM and academic texts, but the instrument was subsequently re-evaluated and improved upon. It

was deemed necessary to modify some of the instrument evaluation criteria, and also subdivide other criteria.

After validation of the criteria, the instrument was given to some teachers who had agreed to participate in the study, so they could perform an analysis of the textbook that they use in their classrooms, in order to further verify the validity of the instrument. Teachers were also given a separate questionnaire regarding the use of the instrument where they were invited to make comments and suggestions. Feedback from the teachers indicated that they felt that the instrument was interesting and easy to understand. Nonetheless, we feel that it is necessary to trial the instrument with a larger sample of teachers for the results to be meaningful. Thus, the instrument is still in the process of being validated and improved upon.

Final thoughts

Any textbook must work in accordance with the school reality in which it is being used and the Pedagogical-Project of that school. A review was submitted to PNLD EM taking into account more general aspects, but without taking into consideration the regional aspects of school context and its characteristics. This is a factor that supports the argument for teachers themselves conducting thorough analyses of books to be adopted, since they have knowledge of the school reality and also their own personal experience of using textbooks in their teaching practice, and are thus in a very good position to select the book that best meets the needs of the reality encountered in their workplace.

The aim of the instrument, in verifying whether the textbook material covers aspects addressed in normative documents and very discussed in the area of physics teaching, is to help the teacher check the material under analysis to ensure that it is really significant and may provide a more effective learning outcome. The instrument guides teachers through a systematic and careful analysis, ensuring that no aspects go unnoticed, or without further attention. The process of instrument validation will confirm its applicability as an aid in the analysis of textbooks in line with the guidelines given in the normative documents.

Although there is a concordance of the research with the National Textbook Program, and despite the fact that the PNLD EM has been updated and has required that books also be updated, there still remains a gap between desirable aspects to a physics textbook and teachers' training, which continues to be delivered in the traditional way. The classroom context needs to be contemplated in the discussion and research on physics teaching, because when improvements to teaching are proposed, these improvements need to reach the school and the textbook, covering the intersection between normative documents and these discussions. This interaction could potentially lead to methodological innovation, which must be reflected in textbooks, since these constitute the main teaching tool used by teachers to prepare their teaching work.

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What future teachers learn about the use of textbooks in their physics teachers' courses

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Abstract

This paper presents the results of an investigation which aimed to examine how students in teacher training courses are being prepared to use physics textbooks in their future high school classes, especially now that, through the National Textbook Program in Brazil, all public school students will receive textbooks. The research was conducted in teacher training courses for teachers of universities and institutes in southern Brazil. Results showed that teachers consider that students receive insufficient guidance on textbook use in their courses and they believe the students will only develop a sense of analysis when they become teachers themselves. It was also determined that textbooks are rarely studied during students' undergraduate courses. Since textbooks are naturally always present in schools, they don't receive particular attention. Teachers also expressed that students, as future teachers, should be considered "transformative intellectuals", as described by Giroux (1997), and should be prepared to develop critical thinking skills and to reflect on the choices they need to make, including regarding textbooks. They also indicated that the lack of attention to the study of the books in other disciplines within the physics courses compromises the work done in the subjects that propose to provide such training.

Keywords: physics textbook, teacher training, physics teaching, science teaching.

Introduction and rationale

Despite increasing technological advances the textbook still seems to be irreplaceable, since in most cases, guidelines are obtained from it in order to construct curriculum projects that will be developed throughout the year in schools. The pages of the textbook are the main – and often the only – source of information used by a significant proportion of students and teachers. The ideology and culture of a society are also depicted in them (Batista 1999, 531).

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Another aspect is related to the character of the textbook also functioning as a producer of knowledge. According to Batista (1999, 533), research conducted worldwide has shown that the idea that the knowledge presented in textbooks is produced exclusively in the field of culture and science is false. Rather, much knowledge is produced in the school and is subsequently appropriated by the spheres of scholarly and scientific knowledge.

Beyond these reasons to believe that the textbook will not cease being part of school culture anytime soon, its permanence in the school environment has been encouraged by federal public policies that, through millionaire programs, set about raising the status of textbooks to the level of necessary and fundamental objects for the process of teaching/learning both for teachers and students, as well as treating them as goods of high interest, especially for publishers.

Specifically in relation to physics and science books, Garcia (2009) quotes the results of a survey conducted by Ferreira and Selles (2004) showing that, similarly to what occurs in other fields of knowledge, there is a predominance of studies that examine the content of textbooks, conceptual errors, structural presentation, specific themes, comparisons with alternatives or spontaneous or commonsense ideas of the students, the presence of analogies, daily life use, amongst other things, but that there is little research investigating the relationships that students have with textbooks and the ways they appropriate them inside and outside the classroom.

We agree with Garcia (2009) when the author notes that, although still being small, the number of educational research projects with this focus are of paramount importance for a clear understanding of the functions performed by the textbook and deepening “the understanding of ways in which teachers produce their classes, particularly regarding appropriations from the content and methods present in books that they use” (4). Underlying research with this purpose is the assumption that much of what is learnt and taught in a classroom depends on the relationships that individuals have with their peers and with the element of the particular school culture present in the classroom.

With regard to teacher training and trainees’ preparation for their activities in their classrooms, work in education (Carvalho 2001 & 2010, Rezende 2004, Carvalho & Martinez 2005, Franco & Sztajn 1999, Galiazzi & Moraes 2002, Garcia & Garcia 2009, Gatti et al. 2004, Terrazan 2007, Vianna 2003, Villani et al. 2002, and Zimmermann & Bertani 2003) indicates a gap between the training of teachers, their professional practice and student learning, pillars which should be closely related, but which, education researchers acquiesce, show significant discrepancies.

Villani et al. (2002) observed inefficiency in the distribution of tasks when teachers were not well prepared to be in the classroom. The problem is that none of the bodies designated by the government (universities, state and municipal secretaries) can “handle a training course capable of leaving the teacher in a position to face the classroom with the necessary skills to overcome these challenges” (1).

In another study, the same author (Villani 2006) notes that the lack of articulation regarding activities that constitute the curriculum for teacher trainees makes it difficult to implement theoretical proposals for research on the topic. Moreover, “the lack of projects that strengthen the links between higher education in teacher training institutions and institutions of basic education” means that the initial training becomes very theoretical and unrealistic (76).

Vianna, elsewhere, argues that literature “is full of models and we know there is no point in only showing the students well-structured content and/or models of innovative practice” (2003, 85). Teacher trainers can and should “point out shortcuts, saying that there are obstacles to be overcome, as well as spaces to be discovered” (85), besides planning lessons that will serve as an example for what polls show to be the ideal.

For Gatti et al. (2004), with regard to the teaching of science in schools in Brazil, it is not necessary to undertake an in-depth analysis “to verify the profound gap between innovative proposals, the result of investigations in the area of teaching sciences, and the actions developed in high school classroom courses” (2004, 492).

For Carvalho (2001), the problem stems from the conception of teaching that teachers acquire during their studies, and she feels that the solution lies in making changes to classes given at the university as well as increasing the supply of courses for ongoing training for teachers.

For Zimmermann and Bertani (2003), in turn, the problems encountered in the initial training of teachers are historical. In general, research in this area points to the gap between the theory seen in colleges and practice experienced in classrooms and the existing separation between the specific disciplines and pedagogical disciplines (2003, 44). The authors argue that for the teacher to perform satisfactorily in the classroom, he or she must learn to articulate the specific subject knowledge with pedagogical knowledge (45).

Commenting on teaching and learning in undergraduate courses, Tardif (2000) asserts that for the teacher to change his/her way of teaching, he/she must, as a student also learn in different ways because “much of what teachers know about teaching, about the roles of teachers and about how to teach comes from their life history, and especially their history of school life” (2000, 13).

The teacher as intellectual transformer

There is a consensus among all of the mentioned authors that a gap exists between what is taught in undergraduate courses and the reality of daily school life. Giroux’s concept of the teacher as an intellectual transformer who, besides reproducing, also produces knowledge, may provide a suitable theoretical basis to understand this gap (1997). The school is seen by Giroux as a democratic public sphere in which teachers have a particular social and political function. The material conditions will form the basis for them to demarcate or strengthen their practices as intellectuals.

[...] Teachers as intellectuals will need to reconsider and possibly change the fundamental nature of the conditions in which they work. That is, teachers must be able to shape the ways in which time, space, activity and knowledge are organised every day in schools. More specifically, in order to act as intellectuals, teachers must create the ideology and structural conditions necessary for writing, searching and working with each other in the production of curricula and distribution of power. Ultimately, teachers need to develop a discourse and set of assumptions that allow them to act more specifically as transformative intellectuals. (Giroux 1997, 29)

In order to contribute to a new discourse on the nature of schooling, Giroux proposes a reflection on factors that enable us to reveal new possibilities of thinking and organising

school experiences. One such factor is “rationality”, that, according to him, has a double meaning:

First, it refers to a set of assumptions and practices that enable people to understand and shape their own experiences and those of others. Secondly, it refers to the interests that define and qualify the way we structure and employ the problems faced in lived experience. (Giroux 1997, 35)

The author emphasises that the critical construction of “rationality” can also be applied to teaching materials. In the specific case of this paper, this idea will serve to help understand the reasons why teachers often strictly follow a textbook, or use them occasionally, or just ignore them.

According to Giroux (1997), materials bring with them a set of assumptions about the world, about certain subjects and interests. Often these materials reduce the teacher to a mere executor of tasks, taking from them the power to decide what should be taught to the students, since the decisions have already been made in advance and are part of the guidelines for use of the material. He goes on:

The materials control the decisions of teachers, and as a result, they do not need to exercise their logical judgment. Thus, teachers are reduced to the role of obedient technicians running the precepts of the curriculum. (35)

To understand the factors that affect the use that high school teachers make of high school physics textbooks and the relationship that can be established with their initial training, some of the propositions of teacher training educators to be developed in physics degree courses were investigated, and we attempted to interpret their understandings concerning the preparation of future teachers to assess, select and use textbooks provided by government programs.

Methodological procedures

The research was conducted at universities and federal institutes of scientific and technological education in southern Brazil that offer degree courses in physics. In the first stage the syllabuses of undergraduate programs in physics were analysed, in order to check whether the development of analyses and discussions of textbooks that prospective teachers would use in high school figured in the programs. The initial information was obtained from the webpages of the institutions.

In the second stage, a questionnaire was sent to coordinators of undergraduate courses in physics from each institution, to seek information about the course and meet the teachers who were responsible for teaching classes in courses whose syllabuses anticipated activities with high school physics textbooks.

In the third stage, a questionnaire was sent to teachers previously indicated by the coordinators which aimed to seek information on how the degree students were instructed to work with high school physics textbooks.

Strategies used to contact the coordinators and teachers

Based on the results obtained in the analysis of syllabuses of disciplines and considering that “contextualisation should be considered one of the main requirements, and even the ‘backdrop’ to ensure the relevance of the results to be disseminated and preferably socialised” (Franco 2003, 24), the questionnaires for the course coordinators were designed to obtain data that could substantiate and extend the analysis and provide support for the following stages of the research.

The questionnaire sent to the coordinators was created with the intention of ascertaining the history and context that gave rise to the undergraduate degrees in physics for each institution, to characterise the respondent subjects and obtain the names and contacts of their teachers who teach and/or develop research that includes analysis and/or discussions of teaching resources.

With the information provided by coordinators, a new questionnaire was created to be sent to the teachers indicated by them. The main objectives of this new instrument was to characterise the survey respondent subjects and obtain information on how discussions and guidelines related to physics high school textbook use are negotiated with students.

Both questionnaires were edited into online forms and participants were contacted via email and given a link so that the coordinator or teacher could fill in their answers online.

Of twenty-nine coordinators of physics courses who were invited to answer the questionnaire, only fifteen of them returned completed questionnaires. These coordinators indicated thirty-nine teachers who they believed probably held discussions and/or provided guidance to their students about high school physics textbooks during their classes. These thirty-nine teachers were contacted and asked to answer the specific questionnaire for teachers, and just over 60%, or twenty-four, responded.

The textbook in physics courses

Of the twenty-four respondents, twenty-two affirmed that they addressed the issue of physics textbooks in their classes. On average, they stated that this topic was dealt with for around ten hours in each subject. Seventy-two percent of teachers felt that the amount of hours dedicated to discussion and guidance on high school physics textbooks was sufficient, while the other 28% felt that it was not. In the questionnaire, teachers were asked to indicate the topics covered during class and those whose objectives are to promote discussions and analyses of physics textbooks used in high school. The topics given were organised according to the categories created by Leite, Garcia and Rocha (2011) and are summarised in Table 1.

Table 1. Topics taught by teachers of physics teacher training courses

Category	Frequency
Content	12
Language	7
Methodology	12
Public Policy	2
Public Policy	5
Others	6

Teachers were also asked if they believe that the guidance provided to their students, future teachers, during the degree in physics is sufficient to enable them to evaluate, select and use textbooks provided by government programs safely, and 70% reported that it was not, while 30% believed it was.

Those who claimed that the guidance student teachers receive during their undergraduate years is sufficient general justified their position by stating that prospective teachers must also possess a greater knowledge of physical concepts, to deepen the study of alternative conceptions of students and learning theories, as well as understand the visions of science that often permeate the works subliminally.

According to these teacher trainers, students will only develop this sense of analysis when, as teachers, they compare books to prepare their lessons. In this sense, one must take into account that in class many of them will replicate the way their teachers use textbooks, and it is desirable, in accordance with the theoretical basis of this work, that teachers give examples of the use of textbooks in their classes.

Some teachers also argued that the time devoted to guidelines and/or discussions is sufficient because what the undergraduate students should analyse is the scientific production that gave rise to the assessment parameters of PNLD and not merely the textbooks.

On the other hand, teachers who indicated that prospective teachers were not given enough guidance in terms of textbook use felt that there is not enough time to deepen the analysis of the books. They insist that crucial questions for each subject must be submitted to prospective teachers, not only undertaking an analysis of textbooks, but encouraging them to remain critical, self-critical and in constant training.

Therefore, our analysis indicates that teacher trainers expect the students from physics teachers' courses to act as transformative intellectuals once they start teaching. This finding is in accordance with Giroux's definitions (1997), which presuppose that the students analyse and create the necessary ideologies and structural conditions to overcome the obstacles encountered in their daily activities.

Teacher trainers believe that the reduced loading of the specific disciplines in undergraduate degrees makes it impossible to deepen discussions about such an important issue. In addition, they indicated that many disciplines that should be devoted to providing guidance on textbooks sometimes lead students to read article after article, leaving aside the handling of books and their analysis.

Among the answers, the ironic view that textbooks end up being forgotten in undergraduate courses because they are an object of school culture that is so ubiquitous in classrooms also appeared; teacher trainers do not realise that is necessary to devote more attention to optimising their use, a situation that is similar to what happens with the new information technologies. Moreover, the almost complete disregard of the use of textbooks and insistence on a different perspective in teaching physics has little relevance to the teaching practice that student teachers will develop at school, given the highly conservative context of most of them, combined with the predominantly banking and content-based training that the university provides.

This result indicates the existence of a gap between what is being taught in the physics teacher training courses and the actual practice of teachers, which is also seen in the issues

regarding textbooks. This suggests that analyses on this subject should be continued and transformed into actions which would effectively reduce this gap.

Final thoughts

In the justifications presented by teacher trainers, both those who believe that the guidelines and/or discussions provided during graduation are sufficient, and those who believe they are insufficient, the conception of the teacher as an intellectual transformer is clearly invoked, i.e., the impression left by them provides evidence that they believe that degree students, future teachers, must consider themselves to be transformative intellectuals and in exercising their role should take their own initiative to deepen their understandings with regard to the ways textbooks can be used with high school students. We see a further investigation conducted in schools to verify if high school teachers do effectively take on the mantle of transformative intellectuals as the next step in this process.

Moreover, it became clear in the teachers' reports that the daily counterexamples given in most subjects of undergraduate teaching courses undermine all the work done in those few subjects which are concerned with giving examples to future teachers about the attitude that teachers should assume toward textbooks.

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Are student-teachers able to select appropriate illustrations for a given learning goal?

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Abstract

This paper presents the results of a small investigation on pre-service teachers' assessments of illustrations in learning materials in order to examine to what extent student-teachers from different countries are able to assess the appropriateness of illustrations in learning materials used in science education. The investigation aimed to address the overarching question of whether or not pre-service teachers are sufficiently equipped at the end of their course of study to be able to recognise the quality of learning materials, and if they know how to evaluate and apply learning materials appropriately in order to support learning processes.

Based on the results it can be concluded that (pre-service) teachers who participated in the survey were insufficient in their ability to select appropriate illustrations in learning materials. Differences in performance were also found between student teachers of the various countries examined. However, no relationship was detected between the degree of ability to select appropriate illustrations and the quality of education as measured by the PISA test.

It is possible that several factors that might have influenced the results and it is also conjectured that other factors could have been taken into consideration in the study to ensure a more comprehensive treatment of the question.

Keywords: teacher education, learning materials, learning processes, learning goals, illustrations, multimedia learning, PISA test, science education

Introduction¹

Teacher education is aimed at making pre-service teachers capable of giving good education. In order to achieve that goal a variety of skills are taught. One of these skills is the selection and appropriate use of qualitative, good learning materials, because effective learning materials can contribute to students' learning and thus good education. However, when selecting new textbooks, teachers often prioritise aspects that make their task easier over aspects having to do with helping their students to learn. Could it be that teacher training institutes do not prepare pre-service teachers enough in terms of recognising the quality of

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learning materials with a view to supporting learning processes? What do pre-service teachers know at the end of their course of study about the quality of learning and how learning materials have to be evaluated or applied appropriately in order to support learning?

In order to study this, we conducted a small investigation about what pre-service teachers know about the quality of illustrations, given specific learning goals. In order to assess the effectiveness of learning materials, CLU (the Centre for Textbook Studies) developed an instrument called a Measurement Instrument of Learning-materials' Quality (MILQ). One aspect of the MILQ, that of illustrations in learning materials, is the primary focus of this study. Research showed that illustrations are better remembered compared to textual information (Levin & Mayer 1993), which implies that illustrations are an important means of instruction and can enhance student learning. Hence, the CLU is interested to find out whether the extent to which teachers are able to select appropriate illustrations in these subject areas is related to results of the Programme for International Student Assessment (PISA). The quality of education can be measured with PISA, which is an international test conducted on fifteen year-old students from different countries.

After presenting a theoretical framework, we describe the method chosen, the results are presented and conclusions are drawn. The article concludes with a discussion of the limitations of the study.

Theory

According to Reints (2008), learning materials are instrumental aids within the process of teaching and learning, but should be seen to be in close relationship with the usage of the teacher or student. In this study, learning materials are defined by their purpose in facilitating learning. In learning materials, both textual and visual information is used to transfer information. Research has demonstrated that an integration of textual and visual information is optimal for the learning process (Mayer & Sims 1994). Furthermore, combining multiple sources of information is described as multimedia learning. Several effects apply to this kind of learning and the two relevant effects for this study are described (Mayer, 2003): the *multimedia effect* in which students learn more when words and illustrations are combined compared to words alone and the *spatial contiguity effect* which states that students learn better when printed words are closer to the corresponding illustration. Moreover, literature distinguished different functions of illustrations (Clark & Lyons 2011): *decoration* (used to motivate and attract the learner), *representation* (a realistic image of an object, used to learn new concepts (Wu 2011), *mnemonic* (used to recall and remember information), *organisation* (used for relationships between content, and used to learn conceptual relationships), and *interpretation* (used for complex concepts, mostly graphic illustrations).

To study the relationship between the selection of illustrations and the quality of education three research questions were formulated. First of all:

1. *To what extent are (pre-service) teachers from different countries able to assess the appropriateness of illustrations in learning materials used in the natural sciences?*

Research has shown that teachers do not think about the education-psychological background of illustrations, but choose illustrations that are attractive (Snoek 2003). Therefore, it is expected that not all participants will be able to answer many items correctly. Second:

2. *Are there differences in the extent to which (pre-service) teachers from different countries are able to assess the appropriateness of illustrations in learning materials?*

Based on differences in teacher education with respect to teaching and knowledge about illustrations in learning materials, it is expected that there will be differences between participants from different countries. Third:

3. *Is there a relationship between the average score of countries in the survey and the PISA results?*

It is hypothesised that participants from countries with a high score on the PISA test, will be more able to assess the appropriateness of illustrations in learning materials and score relatively highly on the survey.

Method

A pilot study was conducted and served as a test for the actual survey. Participants were selected based on their (finished) teacher education for primary or secondary school and contacted by means of personal contacts of the researchers. The pilot study had fifteen (female) participants with an average age of 28 years ($M = 28.36$, $SD = 10.56$). The survey contained 135 participants with an average age of 26 years ($M = 26.39$, $SD = 9.33$). The instrument used in the pilot study consisted of three parts and all questions were formulated in English. The first part contained general questions about the participants (age, gender, country of origin and country of study). The second part asked questions about the participants' studies (length, prior education and the degree to which they are educated about the quality and assessment of learning materials). The third part contained 14 items with illustrations. The 14 items were designed according to the functions of illustrations (Clark & Lysons 2011) and each function was represented by two or three items. The reliability of the instruments was good, both with Cronbach's alpha $\alpha = .91$. Content validity was checked by an expert and grounded in the literature. The participant was asked to select the illustration that best fit the learning goal. Based on the results of the pilot study, the norm for sufficient and insufficient was set at 80%, which corresponded to ten or more correct questions. Feedback on the pilot study suggested simplifying the English questions and removing section two of the test. These suggestions were taken into account.

In this study, the scores of participants from different countries who participated in the survey are compared. Given that this study examines the correlation between average scores of participants from one country and scores on PISA of different countries, an ANCOVA was performed (Field 2009). Furthermore, PISA scores are used to explain within-group variance.

Results

Data were collected from 143 participants from nine different countries: Finland, Hungary, the Netherlands, Portugal, South Korea, Austria, Belgium, Estonia and Iceland.

Table 1. Frequency table with number of correct items and number of participants

Number of correct items	Number of participants	Percentage (%)	Cumulative percentage (%)
0	27	18.9	18.9
1	0	0.0	18.9
2	0	0.0	18.9
3	0	0.0	18.9
4	0	0.0	18.9
5	1	0.7	19.6
6	1	0.7	20.3
7	2	1.7	21.7
8	16	11.2	32.9
9	13	9.1	42.0
10	27	18.9	60.8
11	28	19.6	80.4
12	16	11.2	91.6
13	8	5.6	97.2
14	4	2.8	100.0
Total	143	100.0	100.0

To examine to what extent student-teachers from different countries are able to assess the appropriateness of illustrations in learning materials used in science education, a frequency table is given (see Table 1). The average score of participants is $M = 8.39$ ($SD = 4.36$), which is below the norm of ten correct items.

Before investigating differences between (pre-service) teachers from different countries, participants from countries with a response below $N = 4$ were removed (Austria, Portugal, Belgium, Iceland, Hungary and Finland). The remaining countries ($N = 125$) were analysed: Estonia ($N = 33$, $M = 9.15$, $SD = 2.81$), the Netherlands ($N = 82$, $M = 9.63$, $SD = 3.73$) and

South Korea ($N = 10$, $M = 4.60$, $SD = 4.09$). As can be seen from Table 2, differences between the countries existed and appeared significant, $F(2, 124) = 8.66$, $p < .001$.

Table 2. Average score per country and PISA results

Country	N survey	Average number of items correct	Score on PISA test in 2009
Estonia	33	$M = 9.15$ $SD = 2.81$	$M = 501$
The Netherlands	82	$M = 9.63$ $SD = 3.73$	$M = 508$
South Korea	10	$M = 4.60$ $SD = 4.09$	$M = 539$
Total	125	$M = 8.47$ $SD = 4.30$	$M = 493$

To study the relationship between average test score of countries and the PISA results, mean scores were compared. The average PISA score in 2009 was $M = 493$ and was based on assessment of reading. All countries scored above average (see Table 2). An ANCOVA was performed to explain within-group variance, however results appeared non-significant ($p = .25$).

Conclusion

Based on the results it can be concluded that (pre-service) teachers who participated in the survey were insufficient in their ability to select appropriate illustrations in learning materials and the first hypothesis that not all participants are able to answer ten items correctly should be accepted. A possible explanation is that 18.9% of the participants answered all items incorrectly, which has an influence on the mean score. Regarding the second research question, in terms of average scores, the results of participants from the Netherlands was the highest ($M = 9.63$) followed by Estonia ($M = 9.15$) and South Korea ($M = 4.60$), respectively. Consequently, the hypothesis that there are differences between countries can be accepted. The last research question concerned the relationship between survey scores and PISA results. South Korea scored best on the PISA test ($M = 539$) and the lowest on the survey. The Netherlands obtained the second place on the PISA test ($M = 508$) and first on the survey. Estonia had the second-highest score on the survey, but the lowest score from these countries on the PISA test ($M = 501$). Therefore, it can be concluded that there is no

relationship between the degree of ability to select appropriate illustrations and the quality of education as measured by the PISA test ($p < .25$). Therefore, the last hypothesis is rejected.

Discussion

In this study several factors might have influenced the results. First of all, in the pilot study participants indicated that the English used was too advanced, which affected the results of the study. Moreover, the number of items was rather low, since every type of illustration was represented by only two or three items. This might be insufficient to ensure content validity. Furthermore, 18.9% of the participants had a score of zero. It could be the case that these values are not identified as missing values, which resulted in a lower mean score, especially for South Korea. Another point of criticism concerns the norm set for the survey, which was based on the pilot study. Participants in the pilot study could have had more prior knowledge compared to participants in the survey which resulted in a higher average and a norm too high for the survey. In addition, the study should have paid more attention to differences between countries with respect to teacher education and its content, and other factors that might be of influence. The last point concerns the PISA test. Although scores on the PISA test are considered a measurement of the quality of a country, questions are raised about the limitations of using only this type of data. To ensure a full conception of the quality of education more sources of data should be combined.

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WORKSHOP 4
LEARNING FROM TEXT MATERIALS
FOR DIFFERENT PURPOSES

How can the development of digital learning environments make a difference for differentiation in teaching? – An intervention study

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Abstract

Digital learning materials have again raised the question of how teaching can be differentiated so every child is challenged in an appropriate way without falling back to the individualisation of learning of the 1970s. Today diversity in ability, interest and background in learning groups has to be seen as a condition. On the other hand, the question is raised because digitalisation of learning materials seems to have an unfulfilled potential in this area. In order to find connections between the use of digital learning materials and the differentiation of teaching, a two-year national intervention study has been launched in Danish primary and lower-secondary school. This paper presents the two pillars of this new type of study. On the one hand, there is a theory-based intervention design with a long-term, spiral progressive and multi-dimensional approach. On the other hand, the intervention is framed by measuring the pupils 21st century competences, their productions and performances, as well as the school and learning context. The concept of ‘effect’ is based on causal complexity. It is essential to identify an interventional meso-level that makes the intervention effective and generalisable without being indifferent to contexts. The intervention consists of a highly self-instructive ‘learning material’ for the professional in schools and the transition is facilitated by blended learning-cooperation with regional educational consultants. During the presentation of the ongoing study the central design aspects and research methodologies are discussed, the overall questions being: how can interventions be designed with long-term effects, with the possibility of being scaled up and without being dependent on the research group?

Keywords: intervention study, digital learning resources, didactic design, differentiated teaching and learning, research design and methodology

Introduction

In this paper I will present and discuss the intervention design of the national development and research project, “Inclusion and differentiation in digital learning environments”. The purpose of the study in focus is to “develop and test a generalisable design for digital learning environments that has a documented effect on increased inclusion and differentiated teaching” (quote from the research application). A team of researchers and consultants is developing a theory-based intervention design that will most likely develop ICT-based differentiated teaching and learning. The intervention will be carried out from January 2014 to June 2015 by a team of consultants, ensuring that the intervention stays the same and can

be well adapted to the contexts of the six chosen schools. In the schools the intervention will be carried out with the 2nd, 4th and 5th form levels, that will subsequently become 3rd, 5th and 6th form levels. The research connected to this intervention is grouped into a quantitative and a qualitative approach, each with two types of studies. The quantitative research consists of a measurement of the pupils' development of 21st century skills and of a measurement of the school as the context for the intervention. The qualitative approach is carried out as research across the two other parallel intervention projects with comparative aspects as well as research specific to the intervention project on differentiated teaching with ICT. Both approaches are meant to complement each other. While the quantitative research documents changes in competencies and contexts, the qualitative studies seek mainly to find possible explanations for the changes and supplementary results.

The focus in this paper is to present and discuss the intervention design, the detailed research design being still in progress.

The background

The study presented here is part of the Danish National Strategy for the Digitisation of Public Welfare between 2013-20 that includes more than sixty initiatives within twelve areas. In the area of education there are, among others, the following objectives for primary and lower-secondary school (Folkeskole), a united comprehensive school, with no possibility of failing, no grades up to 8th form level and a final leaving exam in 9th form level: the daily use of digital learning materials and the integrated use of digital tools for learning (Danish Government 2013). To meet these objectives provision has been made for a range of subsidies (67 million Euro) for schools and accompanied efforts to secure high wifi-capacity, computer access for all students and other technical solutions and support. Nevertheless, the technological issue is not a big focus since the authorities have carried out several action plans for the digitisation of schools over the last 15 years and Danish students themselves are quite well-equipped and active IT-users (Haddon, Livingstone & network, 2012). The policy goal is the normalisation of the use of digital possibilities. That means integrating them in the pedagogy and the daily routines of schools. In order to avoid a situation where traditional schooling goes on with new digital means and gain a more structured and systematic knowledge about the effects of pedagogical interventions with ICT, the national and common local authorities offered four development and research projects called "Demonstration schools" (Demonstrations-skoleforsøg). These should offer an exemplary way to demonstrate the potential for high 'academic' achievement with ICT-based teaching and learning designs and document the possibility for later scaling up. Either these schools are already ITC-frontrunners or they are striving to make a fast digital u-turn. The schools were chosen by the national and common local authorities.

A project that acts within the field of educational policy has to be aware of the setting, which has consequences for the implementation of changes in schools and for the research on many levels. On a conceptual level, I will mention two clashes. Firstly, the mandate of the authorities seems to have in mind a certain concept of 'effect' and evidence, including expectations about increased 'academic' achievement. In these cases, the project adopts only the overall claim that development projects need to prove their interventions by systematic means in order to identify relevant changes. However, the concept of generalisable knowledge about standardised interventions has its limits. Secondly, the mandate includes policy interests towards a national reform of the Folkeskole, including conflicts with the teachers' union on new standards for leadership and time management. The expectation in the

mandate is that ICT will “free up time for more teaching” (Description of the task). This intention is both unclear and controversial. From the point of view of research this intention is understood as a question of distribution of teacher time in relation to learning relevant activities.

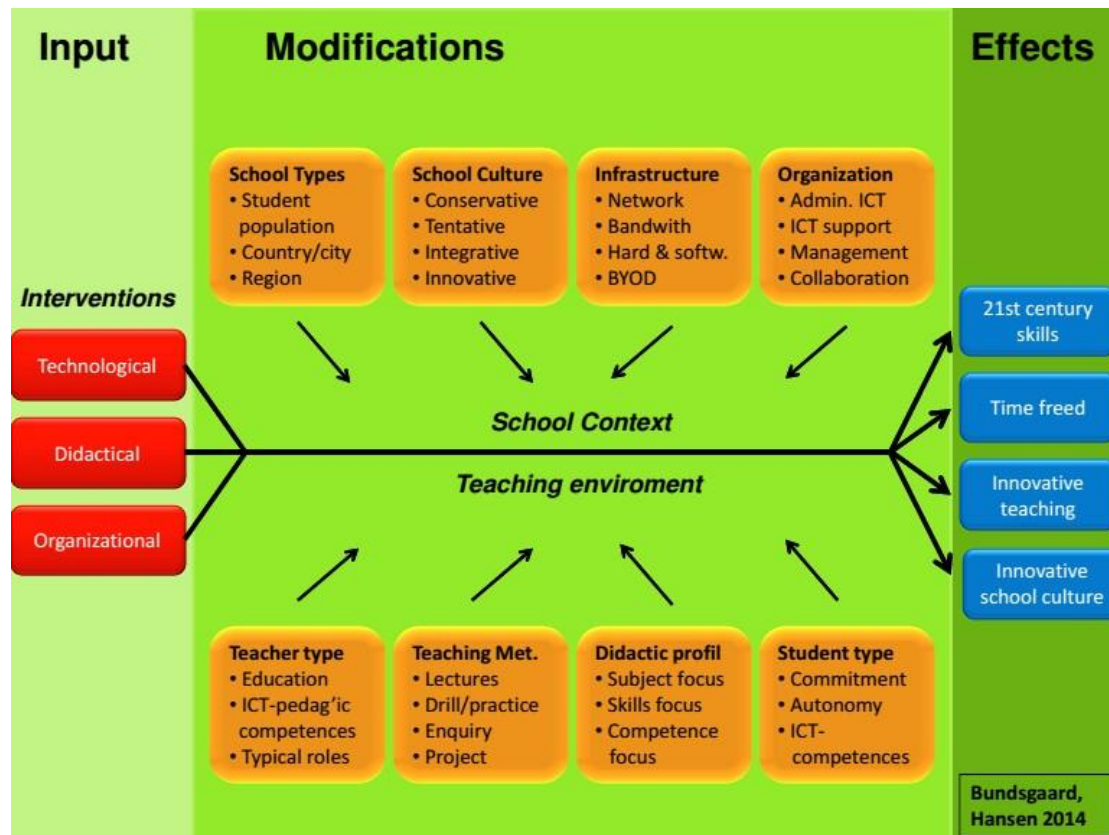
It is necessary to mention that in Denmark there is no authority that approves, chooses or prescribes the teaching materials for schools. By law teachers are free to choose the teaching methods and materials that are necessary from a professional perspective, as long as they comply with the written purpose for schooling and the pedagogical goals for different subjects and ages (curriculum). The production of teaching and learning materials is a free market, where the question of a material’s quality is only one issue in the buying and selling process. Not only traditional publishers, but also private companies, NGOs and other players on the market want to produce teaching and learning materials for the schools.

A new type of intervention study

In the Danish context there haven’t been many large-scale intervention studies, the tradition has been rather to undertake case studies, action research, grounded theory and development projects with a high level of cooperation between the researchers and the practitioners. These studies have difficulties in documenting results and effects in relation to a well-defined intervention. In order to establish a new way of conducting research and create a large-scale Danish study, a strong consortium was established consisting of six university colleges with teacher education (UCSyd, UCL, VIA, UCC, UCSj and Metropol), the Department of Education of the University of Århus and the Alexandra Institute. The consortium was granted three of the four demonstration school projects, which made it possible to develop common theoretical and methodological groundwork for the three different intervention projects that all together involve 16 geographically-spread schools. This is a unique situation in Denmark, because the three different intervention projects will apply the same instruments for measuring changes in the pupils’ competences and in the school context. The setup provides an opportunity to compare various contexts, modifiers and effects across the three different interventions.

The quantitative approach of the study consists of two parts. The first is a student competency test. The measurement of the pupils’ competencies is not conceived as a distilled version of the scientific disciplines and does not have as its aim to test so-called academic achievement. This concept of learning achievement has very little to do with the knowledge or skills needed for students’ present and future life, and engenders an unsolved transfer problem between school knowledge and its application in everyday life. Therefore, a specially-designed and standardised online test of “21st century skills” was developed with items that put pupils in typical life situations where they need to search and filter information, collaborate, organise, innovate and critically discuss matters of concern (Binkley et al. 2012, Johnson 2009). A system of rotation in the test design makes it possible to calibrate a standard while other groups function as control groups. This test was inspired by the International Computer and Information Literacy Study (ICILS) where more authentic contexts such as “at home, at school, in the workplace and in the community” play a role (Fraillon & Ainley 2010, 8) and the software was developed by the Australian enterprise SONET. In addition to this special competence test, the pupils’ achievements will be related to the results of the mandatory national tests.

Figure 1. The overall design of the intervention study (Hansen & Bundsgaard 2014)



The other part of the quantitative approach was to develop a measurement of the school context through standardised online surveys of the pupils, the teachers, the school-based ICT consultants and the leadership, through highly standardised performance ratings of observed teaching of 12 classes in each school over a whole day and through ratings of the performance of systematically collected student products. Such performance-based assessments was inspired by authentic assessment (Greenstein 2012) and Learning Activities Student Work (LASW) (Shear, Hafter, Miller & Trinidad 2011), and has been used by TIMSS 1995. The results of the surveys, of the observation of teaching and of the criterion-based assessment of the pupils' work together form a specific school context that consist of two types of modifiers. On the one hand, the school context, understood as: the socio-economic level of the school, the school culture, the school's infrastructure and the school's internal organisation. On the other hand, there will be a learning context that is differentiated into: types of teachers, a classification of teaching methods, the concept of the purpose of the school and types of pupils (Hansen & Bundsgaard 2013). A lot of items that directly concern this study are associated with these overall modifiers. For example, how do teachers differentiate their teaching? How do they use ICT? How do they think about their pupils? And so forth.

Within the limits of this paper we will content ourselves with a presentation of the design for the three parallel but different intervention projects. We will now turn our attention to our main focus, i.e. the intervention design for ICT-based differentiated teaching and learning. Although the three intervention projects share some of the same program theory of change,

their interventions are quite different. Here we present the interventional design of the study in question as though it only applies to it.

The intervention design

Basically, the intervention consists of *a collection of materials* that are made available to the six schools and the *work of a team of regional educational consultants* from the Educational Resource Centre within the university colleges. Before elaborating on this, the main general characteristics of the intervention design will be presented.

Per Dalin's review of school development projects points out strongly that "a lot of reforms either remain unproven, strongly change during the process or are simply counteracted" (Dalin 1994, 215, my translation). The intervention in question seeks to counter these three challenges.

Firstly, and as mentioned above, the intervention is framed by an effect study across the three intervention projects so that each serves as a sort of control group for the others.

Secondly, the intervention was fully designed and developed in advance, and unlike the iterations of design-based research, not changed during the process. To monitor the intervention process in relation to the intervention design, as well as to secure the uniformity of the intervention across the six schools, regular meetings are held with the regional consultants in action and the design group. In contrast to action research, the research group itself does not interfere directly in the process and does not have interventional contact with the schools. This arm's length principle between intervention and research is also seen as an advantage for uncovering blind spots.

Thirdly, in order to stabilise interfering activities and influences several precautions were established in the application process and when entering into contracts with the schools. The schools had to declare and document their readiness in relation to the projects intentions, their commitment and support from the local authorities and the pedagogical professionals of the school. The contractual process included mutual clarification of expectations, working resources and the participating professionals. Another aspect relevant within the Danish context is the widespread tradition for a progressive movement from a child-centred to a subject-centred pedagogy. It is common sense that Danish teachers are skeptical of pedagogical theory and interventions that challenge their professionalism. The complexity of possible counteracting influences appears on several levels and in various ways and cannot be dealt with in this paper.

A multi-dimensional approach

We call the intervention a multi-dimensional approach (Hirsch). There is enough evidence to claim that the predominant, simple and narrow interventions, like for example technological-only interventions, do not have the intended effects in pedagogical settings. Recent examples are schools buying technological devices (e.g. iPads, IWB) for several classes or the whole school with some general visions but no theoretical foundation, or when authorities carry out rapid changes to cloud-based access without supplementary education for the professionals. In these cases the technological intervention steers the pedagogy and the organisational reactions (e.g. Carlsen, Christiansen, Gissel, Graf & Slot, 2013). It is not infrequent that digital teaching modes are even more traditional than non-digital forms (e.g. Khan academy).

Teaching with interactive whiteboards can easily regress to old-fashioned blackboard teaching. Also, didactic interventions are likely to neglect the school context and do not facilitate broader changes in the long run. Generally, didactic interventions are bound to a tradition that understates the importance of educational media, textbooks and therefore digital media (Graf 2009).

In recent years there have been numerous initiatives from an organisational point of view. For example, requests for local evaluations of schools, teaching and learning, educational school plans, student plans (Krejsler 2009), new leadership and new school structures in connection with the merger of municipalities. The actual type of monitoring and evaluations of schools seem to encourage structural initiatives from a policy point of view. The promise to solve pedagogical issues with new organisations, structures and control mechanisms only, is likely to shoot past the core of the pedagogical challenges. Our multi-dimensional approach defines three interventional dimensions that are intertwined and form the intervention as a whole (see Figure 2).

Figure 2. Three interventional dimensions.



The didactic dimension aims to change the teachers' reflective teaching practice in various ways. In accordance with the purpose of the intervention, this concerns differentiated teaching in digital learning environments. Secondly, there is a technological dimension that introduces and/or maintains IT-based modes of differentiated teaching. The third dimension incorporates organisational factors, which actively involves the school-based pedagogical ICT consultants and the school's leadership in scaffolding their innovative reasoning and acting in order to support, facilitate and sustainably carry on the intentions of the intervention.

A long-term spiral progressive approach

For an intervention-based development it is vital not to overwhelm the schools and their professionals for several reasons. In the last fifteen years there has been a flood of initiatives from the national and local authorities as well as research and development institutions on educational policy issues. Also, consultants and other private agencies mingle in these tricky waters by offering and endorsing their idiosyncratic pedagogical concepts. In the Danish situation, the conflict between the authorities and teachers' union mentioned above is a

second factor. A third reason is the public debate about schools and teachers that maligns the latter's professionalism and pushes them into a defensive posture.

While these tendencies create a difficult context for the elaboration of new interventions at the moment, there are more educational reasons to adopt a long-term spiral progression. The long-term perspective is often connected to questions of money and is a rare phenomenon. In this study we have at least one and a half years to achieve the goals of the intervention project. Given this timespan, it will be possible to design the process in progressive phases, from the introduction of small changes with simple technology and tools connected to short-term didactic objectives and aiming at the long-term goals while the changes are adopted and supported by organisational adjustments. Because every introduced phase will be facilitated, we conceive of the process as an 'add-on', or even better, a spiral progression, where the new digital tools, the planning and evaluation of the courses and the organisational activities twist around the subsequently more and more qualified question of differentiated teaching and learning for all pupils in order to socially and 'academically' integrate them. Figure 3 briefly describes these four phases.

Figure 3. Overview of the spiral progression

Spring 2014	Autumn 2014	Spring 2015
		Phase 4
		Developing complex and differentiated teaching and learning courses in an environment of digital tools. Facilitating the teachers’ own development of courses and new tools. Consolidating an innovative school structure and collaboration.
		Phase 3
		Developing differentiated and project-oriented courses with focus on the pupils’ digital process, product and content tools. Innovative collaboration and the challenge of scaling up within the schools
	Phase 2	
	Developing differentiated teaching and learning courses with a focus on process-oriented use of Learning Management Systems (LMS) and multimodal production tools. Collaboration, knowledge sharing and decision taking in an innovative school.	
Phase 1		
Developing qualified teaching and learning courses with differentiated use of basic technologies for reading and writing for all pupils and in all subjects. Introducing the use of a new online barometer for systematic pupil feedback to the teacher. Establishing and/or activating the systematic and didactically-oriented collaboration of leaders, local consultants and teachers in order to facilitate adherence to the intentions of the intervention.		

Theory-based approach

The intervention design and the intervention materials are grounded in various theories and research. First of all, the didactic field is structured by a new didactic model (Graf 2009, 2012b, 2013). One advantage of the model is that it takes the intimate interrelation between *intention/content*, *methods* and *media* (impression/expression) seriously and in this way rehabilitates the question of teaching and learning materials from the general outsider position in didactic theory and research. A second advantage can be seen in the important but *subordinate* position of the question of technology. Technology has always been a part of teaching and learning even when Ancient Greeks drew with sticks in the sand, when Nicolas von Cues used group work and a painting to show the invisible God in the 15th century, when Comenius took advantage of printing technology to change the teacher-centred oral tradition to a more pupil-centred Autopsia, in the use of radio and television, in the language labs in the 1950s, and now as digital technologies are in focus (Graf 2012a). The current technological enthusiasm shadows this fact and hypostatizes the digital to something self-evident. It is not the technology itself that is important but its use, and especially the kind of technology used and the ways technologies are combined in relation to what is important to perceive and notice within the myriads of information. The third advantage of the model is that it highlights the very basic structure of the didactic field.

For the use of technologies for reading and writing (e.g. AppWriter, CD-ord, IntoWords) there are several supports: for the connection of writing and reading the reports of the International Reading Association (2011) and the National Institute of Child Health and Human Development (2011), Genlott and Grönlund (2013), Graham and Herbert (2010); for the integration of technology in a compensating and differentiated way, Jensen and Engmose (2012 and 2011), and Bladt (2008).

For the use of educational technology, in general, research carried out in connection with the National Center for Learning Design is relevant (Bundsgaard & Hansen 2011, Hansen & Bundsgaard 2013).

For improving pupil-to-teacher feedback the project developed an online barometer with several sets of a few central questions on: the use of technology, the pupils' feelings about integration and their perception of 'academic' challenges. Pupils are to answer these questions every day during the period of the differentiated course. Support for this method comes from the Learning Rating Scale (Nissen 2011) and research on the importance of feedback (Hattie & Timperley 2013).

For the conceptualisation of differentiated teaching and inclusion, a variety of works served as inspiration and resources: Alenkær (2012), Molbæk & Tetler (2012), Egelund (2010), Tomlinson (2005/2001), Tomlinson & Strickland (2005), Binderup, Jørgensen, Nørregaard Rasmussen, & Vincent Andersen (2013).

All these aspects and issues are worthy of a separate paper and documentation. Here, we will simply provide some examples since we feel the development of the intervention design to be more important than the details.

Self-instructional scaffolding materials

Groups of researchers developed the intervention design and, supported by the regional educational consultants, the *materials of the intervention* as well as the *methodological*

design for the consultants' work with the schools and their professionals were developed and produced. The interventional materials are provided through a website (demonstrationsskoler.dk/undervisningsdifferentiering) and consist of the following topics: descriptions, reflection models, guidelines, examples, technological guidelines, templates, digital tools and other information like links and news. There are *descriptions* for each dimension of the intervention that explain, argue and support the specific focus of the phase. There are *models* for basic didactic and organisational categories as well as a model that conceptualises differentiation in teaching. These models are tools for reflections and provide a common professional language for central phenomena. The *guidelines* give step-by-step instructions for the teachers, the local consultants, the leadership and the different professional teams at the school. For each phase and focus there are teaching examples for differentiated teaching with technology and examples of how the teams can collaborate. The *technical guidelines* are conceived as educating instructions and are connected to the specific digital tools in each phase.

Figure 4. An excerpt of the planning template.

Skriv i de frie felter		Vejledning til skabelonen
Klasse, fag og lærere	Klik her for at angive tekst.	fx Om at måle tyngdekraften
Overskrift for forløbet	Klik her for at angive tekst.	
Beskriv den centrale idé for forløbet Klik her for at angive tekst.		Naturligvis er mange ting på spil i undervisningen, men det er væsentligt, at identificere forløbets faglige kerne eller pointe, som alle elever forventes at tilegne sig. Forløbets målsætning og indhold skal blive tydelig. <i>Eksempel</i> Eleverne skal lære om tyngdekraften ved først selv at eksperimentere og opdage sammenhængen mellem tid og hastighed for faldende objekter. Undervejs introduceres til Galileis første eksperiment om faldloven, som lagde en væsentlig grundsten for videnskabelig og samfundsmæssig udvikling. Det afgørende er, at hvert skridt i elevernes eksperimenter diskuteres i fællesskabet, fordi det gælder om at erfare grundlaget i fysikkens metode. <i>Konsulentkommentar</i> Klik her for at angive tekst.
Inddel dit forløb som minimum i følgende tre faser og beskriv kort det centrale i hver		Ligesom et stykke musik- eller teaterstykke udgør et undervisningsforløb en helhed. Den har en begyndelse (eksposition, 1. akt), en midte med x antal sløjfer (variationer af temaet, akter) og en afslutning (finale, sidste akt). Ligesom den første tone i et stykke musik er en god fælles begyndelse/åbning væsentlig for elevernes stemthed og tilpas udfordrende opfattelse af det nye, de
Åbning/eksposition	Gennemførelse	
Klik her for at angive tekst.	Klik her for at angive tekst.	
	Afslutning/finale	
	Klik her for at angive tekst.	

We will now describe the *templates* as examples of a concrete material in a little more depth. The templates are meant to guide the teachers' planning and evaluation of teaching and learning with specific questions related to the focus of the phase. It is still a difficult matter to develop scaffolding schemes for the planning of teaching in the continental didactic tradition of the reflective practitioner (Westbury, Hopmann & Riquarts 1999/2000). On the one hand, there is the rigid approach with minute planning and with highly structured questions on the teaching methods. This leaves very limited space for self-critical, didactic reflections and can lead to a recipe-like understanding of the art of teaching. On the other hand, there is the very open space or scheme with broad didactic categories from a model. Here the teacher is somehow left alone and if the teacher doesn't think of the critical questions on his/her own, the planning remains imprecise or unqualified. The templates developed attempt to strike a balance between open space in the left column and qualifying guidelines and questions in the right column (Figure 4).

For example, in the first phase teachers are requested to identify the comprehensive core of the teaching by writing in prose. Directly or indirectly, this will point out how the teachers set goals and shape the learning content. This intentional core of the content is important in order to be able to differentiate in appropriate ways. The second question is about the time structure of the teaching process, in three basic and important parts: the exposure of the core challenge of the learning process that has to foster all the pupils' *interest* for the acquisition of understanding, skills and motives. In analogy to a symphonic composition, the second part is the "Durchführung", where the (melodic) themes are carried out and varied. In this period, the proactive design of differentiated activities is at stake, without losing the core of the course. The third and final part is often neglected in Danish teaching. The meta-studies of Hattie (2013) point out that this final part is vital to the pupils' learning. Here the learning results of all pupils should be evaluated and acknowledged adequately. These three steps common to all pupils, to the differentiated activities around a core and the common wrap-up at the end, represent a concept of differentiated teaching that does not lead to simple individualisation. Here we provide our definition:

Differentiation is a didactic principle for the planning, carrying out and evaluation of teaching, where the teacher proactively scaffolds the learning activities and materials, in relation to the heterogeneity of the group of pupils and in order that every individual and the group learns the common core of the content.

For the progression from phase to phase this means that the teachers' tasks are more and more about framing than presenting content and the pupils' work becomes more and more self-determined.

The next questions in the template will lead the teacher through reflections on how to use the technological possibilities for both the 'weak' and 'strong' pupils, and how to elaborate on the different parts of the course. While the template for phase 1 is quite simple and has broad categories, the succeeding templates will be more challenging and request more precision relevant to the phase. The background for the progression of the templates is the didactic model mentioned above.

The materials presented above form, in their variety and cohesion, a kind of scaffolding 'teaching and learning material' for the supplementary education of the schools' professionals.

The methodological design of the external consultants

It is a well-known fact that interventions often die shortly after the external partners have left the scene. How should we deal with this challenge? Firstly, the design prohibits the researchers from carrying out the intervention, i.e. the supplementary education of the schools' professionals. This is not only expensive but also critical because they never come back. Secondly, the supplementary education by external consultants has to be minimal and mainly scaffold the introduction, the carrying through and the handover of the intervention. The consultants' efforts aim at facilitating and qualifying the work of the professional in relation to the self-instructive interventional material.

Although the intervention will come to an end there are strategic reasons behind the choice of external consultants from the regional Educational Resource Centres. Firstly, it is the general

task of these consultants to work as intermediaries between the research and innovation teams on one hand and the practitioners on the other. Secondly, these centres provide all the available educational materials and media in a specialised library, and offer courses and school-based supplementary education in relation to the resources. Thirdly, the relationship between the schools and the consultants from these centres could facilitate an even longer and strategic collaboration. And fourth, this project envisages a closer collaboration between researchers and regional consultants in the future.

The team of nine consultants for six schools has been divided into two sub-teams, each one covering three schools competence-wise. Together they cover different subjects, didactic ICT competencies, general competencies in relation to teaching and learning resources and experiences with school development. The sub-teams work closely together and the whole team has the function of ensuring the uniformity of the intervention across the six schools.

The overall methodological design of the supplementary education is based on blended learning. This means the teachers are meant to communicate and collaborate with the consultants between the few face-to-face meetings via email, databases and different kinds of online meetings. The work in between a face-to-face meeting can for example be critical in acknowledging feedback on the preparation drafts of the teachers. This is the purpose of the other blank spaces in the templates; they are for the comments of the consultants.

A qualitative study of the intervention process

The entire intervention design is in itself a complex matter. It is vital not to isolate the three dimensions into separate elements, but to think of them as intimately intertwined aspects of the same intervention. This is not easy because already the ways of talking about the intervention during the design process revealed tendencies to favour one side, for example when people say “the first phase is all about reading/writing-technology”. This is not only the case when teams of researchers and consultants discuss and develop the concrete materials, but will also be the case when the intervention and its materials are presented, understood and applied by the various professionals in the schools. One of the partial studies will track this process in order to gain knowledge about the relation between intervention design and intervention practice. The process of carrying through the intervention is stretched out between the intervention design, the interventional materials, the interventional work of the consultants and the schools’ practice in relation to the last two. This forms a complex field of relations that have to be differentiated in order to identify the potential for generalisation and scaling-up of the intervention. Figure 5 represents a first analytical model for this purpose.

Figure 5. The complex fields of relations of interpretations during the intervention practice

			Intervention design				
			intended intention/ content	intended methodology	intended media/ material		
Intervention practice	Intervention material	actualised intention/ content	The complex field of relations of interpretations			actualised intention/ content	Practice of consultants
		actualised				actualised	

		method				method		
		actualised material/ expression				actualised material/ expression		
			realised intention/ content	realised method	realised material/ expression			
			The schools' practice					

If we want to analyse the process during the intervention, data is differentiated according to whether we are talking about the intentional design, the interpretation of the design through the concrete materials, the interpretation of the design and the materials through the consultants' practice, and the interpretation of the different professional groups of the schools.

Conclusion

Unfortunately we don't have any results from the larger study while the measuring and intervention is still going on. In this paper the intention was to present the research design of the intervention study and the intervention design in order to make it public and available for methodological discussion. Both the research and intervention design is very complex and many questions deserve a more extended discussion. Apart from the overall 'effect' question, a range of qualitative research projects will be carried out within and across the three intervention projects. These will focus on distributed leadership, the teachers' practices, the relation between tasks and the pupils' performance/productions and the intervention practice.

For the moment, my hope is that the design can be qualified by scientific discourse and eventually lead to further inspiration on how ICT-based teaching and learning designs can contribute to effective differentiation of all groups of pupils within comprehensive schooling.

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Learning-style characteristics of digital learning materials and the effect on learning of boys and girls

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Abstract

This paper examines the effect of learning-style characteristics of digital learning materials on the learning of boys and girls. In the Netherlands, and in other countries as well, we see that girls outperform boys. How could this happen and what is the role of learning materials in this respect? Is it plausible that learning styles in relation to learning materials are responsible for the lower performance of boys? Literature denotes the existence of different learning styles for boys and girls.

We found that it is difficult to examine if boys perform better on so-called ‘boyish assignments’ because there was an insufficient number of typical boyish assignments. Although the results between boys and girls are different in the way that was expected, the differences are not significant. An important conclusion was that there were less boyish assignments in the digital material we examined and, in the cases where boyish assignments are present, they will be made more girlish by the teacher.

Future research should take these critical notes into account and proceed in investigating learning-style characteristics in digital learning materials with respect to differences between boyish and girlish assignments. An important question to answer is if there are variables which are responsible for the lack of significant differences.

Key words: textbooks, digital learning materials, learning styles, learning preferences, outperformance of boys

Research problem

In educational practice it has been noted that, increasingly, boys are performing less well compared to girls. Boys are also more frequently represented in lower secondary education, but many drop out without attaining a qualification and are kept down a class more frequently compared to girls. According to Driessen and Van Langen (2010), boys move down to lower education more often than girls and exhibit more inappropriate behaviour. These differences between girls and boys are found across Europe (Eurydice 2009). Explanations for these differences can be found in the way boys and girls learn. The literature denotes the existence of different learning styles for boys and girls (Severiens & Ten Dam 1997, Kommer 2006). The idea has been put forward that in current secondary education, learning styles better suited to girls are more common. For instance, using a step-by-step approach is more suited for girls and a trial-and-error approach is more suited for boys. To tackle this problem some

schools have adapted learning material more appropriate for boys, without compromising on learning styles for girls. This new type of learning material should make digital adaptive education possible.

This study examines the effectiveness of digital learning materials that differ in learning style characteristics, focusing on learning styles for boys and girls. The research question is: *What is the effect of learning-style characteristics in digital learning materials on the learning of boys and girls?*

In what follows, we present a theoretical framework. Subsequently, the method is described, the results are presented and conclusions are drawn. The paper concludes with a discussion of the limitations of the study.

Theoretical framework

Differences between girls and boys in performance and learning

In several publications there is an ongoing debate about the differences in performance between boys and girls. Research has shown that there are indeed differences in the way in which boys and girls learn and perform.

Table 1. Differences in performing and learning between boys and girls.

Girls	Boys
Literate	Spatial-mathematical
Collaborative	Working on their own
Emphasis on cooperation	Emphasis on competition
Step-by-step	Experimenting
Longer time span	Shorter time span
Girls	Boys
Have a keener eye for details	Have a keener eye for the whole
Naturalistic and realistic visuals	Abstract and graphic visuals
Superficial learning	Deeper learning
Reproductive learning	Diffuse learning style

First of all, girls perform better on tasks that emphasise language, cooperation, step-by-step procedures, a longer attention-span, an eye for detail and realistic illustrations, more surface learning and often adopt more of a reproduction-oriented learning style (Severiens 1997, Gurian & Stevens 2004, Van Bavel, Van Middelaar & Scherpenzeel 2005, Milgram 2007). In contrast, boys focus more on spatial-mathematical aspects, individual work, competition, experimenting, have a shorter attention-span, more often take an undirected learning approach, have more of an eye for abstraction and totality, and use in-depth learning more (Severiens 1997, Gurian & Stevens 2004, Van Bavel, Van Middelaar & Scherpenzeel 2005, Milgram 2007). These differences in performance and learning are summarised in Table 1.

Learning styles

Since several studies have demonstrated differences between learning styles of boys and girls, it is important to establish the definition of a learning style. A learning style is a preferred way of learning of an individual, or put differently: the characteristics that refer to the way individuals process information and start with the learning task (Morrison, Ross, Kalman & Kemp 2011). In this study, four learning styles are distinguished (Vermunt 1992): undirected, reproduction directed, meaningful directed and application directed. See Table 2.

Table 2. Learning styles according to Vermunt (1992).

Learning style	Pupils
Undirected	are not aware of their preference for certain learner activities
Reproduction directed	have a preference for memorising and repeating
Meaningful directed	prefer to establish relationships
Application directed	need practice-oriented assignments

Characteristics of learning styles can be represented in learning materials. In education, learning materials fulfil an important function by supporting the learning process of students. More and more teachers are using digital learning materials (Ten Brummelhuis & Van Amerongen 2010). In addition, Reints and Wilkens (2012) identified nine functions of learning materials divided into three areas: *content*, *pedagogical approach*, and *design and presentation*. These functions form the foundation of the Measurement Instrument Learning materials Quality (MILQ), which is used to establish the learning-style characteristics of learning materials.

Learning goals according to the taxonomy of Bloom

Some differences in Table 1 refer to special differences in learning goals that have to be reached in education. A step-by-step strategy, superficial learning and reproductive learning appear to be more useful when working towards ‘lower’ cognitive learning goals according to the taxonomy of Bloom. While experimenting, deeper learning is more useful when working towards ‘higher’ cognitive learning goals.

Research questions

Based on the theoretical framework, three research questions were formulated:

- *Do boys and girls perform differently on a test, after doing assignments in digital material which supports mainly learning-style characteristics for boys?*
- *Do boys and girls perform differently on a test, after doing assignments in digital material which supports mainly learning-style characteristics for girls?*
- *Do boys perform better on Bloom's higher cognitive levels and girls on lower cognitive levels?*

Methodology

In the study 140 students from the 4th grade (16 years old) of secondary education participated. We chose this age group since the literature indicates that differences between boys and girls are the largest in the upper half of secondary education (Eurydice 2009). The subject of biology was chosen due to the presence of both language and mathematical aspects in this subject area, which enables the use of step-by-step and experimental assignments. The digital assignment-based textbook, '10 voor Biologie', was selected.

Two themes were selected and these were addressed during the period of collecting data.

For each theme, three 'boyish' and three 'girlish' assignments were selected. In total, there were four assignment cycles: two per theme. For every cycle there was a pre-test and a post-test. All tests contained questions with three of Bloom's cognitive levels: remembering, understanding and applying.

We adopted a quasi-experimental design, which can be represented as follows:

X1 - O1 - X2

Y1 - O2 - Y2

Which means:

X1 = pre-test before making boyish assignments

Y1 = pre-test before making girlish assignments

O1 = making boyish assignments

O2 = making girlish assignments

X2 = post-test after making boyish assignments

Y2 = post-test after making girlish assignments

To see if there are discrepancies between how learning materials are intended to be used and actually are used by teachers, classroom observations were made and a questionnaire was

given to teachers. It could be the case that teachers paid too much attention to girlish or boyish learning-style characteristics or even reinforced those characteristics.

Based on a literature study, the Index of Inclusiveness of Heemskerk (2008), the Inventory Learning Styles of Vermunt (1990) and the MILQ (Reints & Wilkens 2012), an instrument was developed in order to identify boyish and girlish assignments. The instrument was tested with respect to reliability and inter-rater reliability, and modified accordingly. The final instrument contains 56 items with 23 boyish and 33 girlish questions, and is divided into four categories: *Identification*, *Concreteness*, *Uncertainty reduction* and *In-depth learning*. To measure the discrepancies in intended usage and actual usage, three instruments were developed: self-reports, observation forms and interview schemas. In addition, questionnaires were administered about students' motivation and learning preferences.

Eight of the 21 schools that were approached to participate in the study responded positively and were asked to indicate in which theme they were engaged. Based on the responses, the themes *Doping* and *Behaviour* were selected. Assignments were analysed by two researchers independently. Only assignments with Kappa $\geq .40$ were selected. Before data collection took place, instructions were given to all participating teachers to ensure that external factors remained constant between different classes. During the study, four of the nine teachers withdrew. The teachers assessed all assignments by means of an answer book. Test scores were processed using SPSS and analysed with multilevel techniques. Pre-test scores served as a covariate. Analyses were conducted on the overall scores, three levels of Bloom's taxonomy, theme, school and class. Also, differences between boys and girls regarding their learning preferences were investigated using independent *t*-tests. Qualitative analysis and data were used to study discrepancies.

Results

In the section that follows the results are presented. Multi-level analyses (MLA) by means of SPSS were conducted. A significance level of .05 was applied (see Tables 4 – 13).

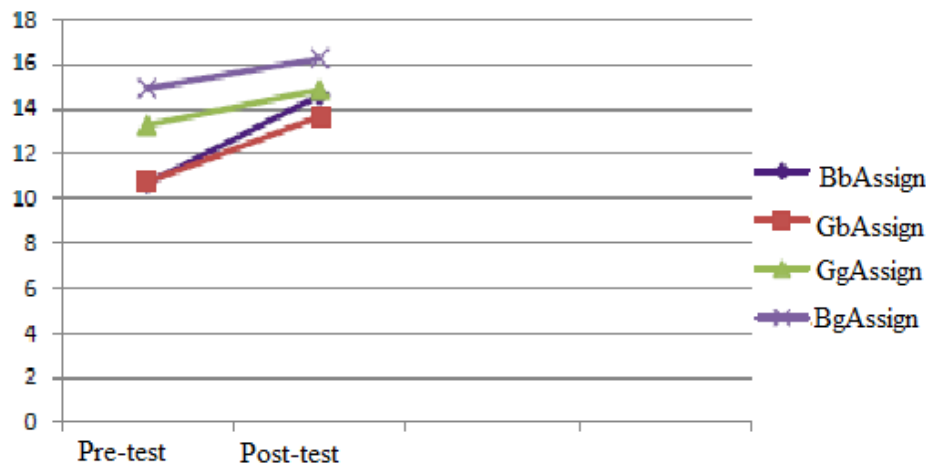
Prior to multilevel analysis, pre- and post-test scores were analysed to investigate whether learning occurred. Table 3 presents the scores of girls and boys before and after making boyish and girlish assignments.

Table 3. Estimates for random intercept of learning results after boyish and girlish assignments.

	Gender	N	<i>M</i>	<i>SD</i>
Pre-test boyish assignments	girl	71	10.73	5.81
	boy	66	10.67	7.20
Post-test boyish assignments	girl	73	13.66	5.86
	boy	67	14.61	6.37
Pre-test girlish assignments	girl	65	13.27	5.42
	boy	58	14.91	5.95
Post-test girlish assignments	girl	71	14.85	6.02
	boy	66	16.25	6.16

As can be seen in Table 3 and Figure 1, all participants learned, since the scores of the post-test are higher compared to those on the pre-test. The boys scored overall higher than the girls and learned more compared to the girls on the boyish assignments. As for the girlish assignments, the girls learned more than the boys.

Figure 1. Differences in pre- and post-test score of boys and girls after completing boyish and girlish assignments.



BbAssign = Boys scores on boyish assignments

GbAssign = Girls scores on boyish assignments

GgAssign = Girls scores on girlish assignments

BgAssign = Boys scores girlish assignments

To see whether these differences appear significant, multilevel analysis and ANCOVA's were performed (see Tables 4 – 13).

Boyish assignments

Table 4 shows the estimated model parameters of the model in which the total learning results between boys and girls are compared on the boyish assignments. When studying the overall learning of participants, the results indicate that girls have a lower regression coefficient compared to boys ($\beta = -.71$). This means that boys learned more from the boyish assignments than girls. However, this difference was not significant.

The pre-test was a significant predictor of post-test scores, $p < .001$. The multilevel model with random intercepts resulted in a positive significant change in $-2\log\text{-likelihood}$ ($\Delta\text{-}2\text{LL}(4) = 12.34$), indicating that differences between classes exist. The model explains a total of 5% of the variance on the group level and 18% on the individual level.

Second, the scores on the post-test are disaggregated according to the three levels of Bloom: *Remembering*, *Understanding* and *Applying*. Table 5 shows the estimated model parameters of the model in which the total learning results (broken down into Bloom's levels) between boys and girls are compared after completing the boyish assignments.

Table 4. Estimates for random intercept of learning results on boyish assignments.

MLA	β	SE
b ₀ = Intercept	14.86	1.01
b ₁ = Gender(=1)	-.71	.76
b ₁ = Gender (=2)	0.00	
b ₂ = Pre-test	.43**	.08
<i>Variance</i>		
Individual level	18.00	
Group level	5.04	
-2 log-likelihood	780.35	
Change log		
(df)	12.34 (4)**	

* $p < .05$ ** $p < .01$.

Note. Gender (boy = reference group); 1= girls, 2 = boys

Analyses showed a significant effect of the pre-test on post-test scores, $p < .01$. For all levels girls scored lower than boys, respectively $\beta = -.17$, $\beta = -.13$ and $\beta = -.26$ (with boys serving as a reference group). However these differences did not appear significant. Changes in -2 log-likelihood of the three models were significant, respectively $\Delta-2LL(4) = 18.74$, $\Delta-2LL(4) = 39.98$ and $\Delta-2LL(4) = 21.98$ (see Table 5).

Third, results of the themes *Doping* and *Behaviour* were analysed by performing an ANCOVA. Girls scored on average lower than boys when completing boyish assignments, however the difference was not statistically significant. See Table 6 and Table 7.

Subsequently, an ANCOVA was performed to investigate whether differences between learning outcomes existed between schools. The dummy variable school C was significant, $F(1, 134) = 20.30$, $p < .05$, meaning that in school C boys' post-test scores were significantly lower than in school A ($\beta = -4.42$). Finally, results from an ANCOVA showed that the dummy variable class C2 was significant, $F(1, 134) = 20.15$, $p < .05$. This indicated that in class C2 boys scored significantly lower on the post-test compared to those of class A1 on boyish assignments, ($\beta = -7.04$).

Table 5. Estimates for random intercept of learning result (broken down in levels of Bloom) on boyish assignments.

MLA	Remembering		Understanding		Applying	
	β	SE	β	SE	β	SE
b ₀ = Intercept	5.47	0.46	4.71	0.56	4.71	.48
b ₁ = Gender (=1)	-.17	0.31	-.13	0.30	-.26	.35
b ₁ = Gender (=2)	0.00	0.00	0.00	0.00	0.00	0.00
b ₂ = Pre-test	0.27**	0.08	0.28**	0.08	0.38**	.08
<i>Variance</i>						
Individual level		2.95		2.81		3.77
Group level		1.11		1.83		1.15
-2 log-likelihood		539.66		536.67		571.42
Change log						
(df)		18.74 (4)**		39.98 (4)**		21,98 (4)**

* $p < .05$ ** $p < .01$.

Note. Gender (boy = reference group); 1= girls, 2 = boys

Table 6. Estimates for random intercept of learning result, on the theme Doping, on boyish assignments.

ANCOVA	β	SE
b ₀ = Intercept	5.52	.24
b ₁ = Gender (=1)	-.47	.34
b ₁ = Gender (=2)	0.00	0.00
b ₂ = Pre-test	0.47**	.07
-2 log-likelihood	558,398	

* $p < .05$ ** $p < .01$.

Note. Gender (boy = reference group); 1= girls, 2 = boys

Table 7. Estimates for random intercept of learning result, of the theme 'Behaviour', on boyish assignments.

ANCOVA	β	SE
b ₀ = Intercept	9.70	.51
b ₁ = Gender(=1)	-.19	.37
b ₁ = Gender (=2)	0.00	0.00
b ₂ = Pre-test	.31**	.07
<i>Variance</i>		
Individual level	3.50	
Group level	1.13	
-2 log-likelihood	453.00	
Change log (df)	25.82 (4)**	

* $p < .05$ ** $p < .01$.

Note. Gender (boy = reference group); 1= girls, 2 = boys

Table 8. Estimates for random intercept of learning result (by schools) on boyish assignments.

ANCOVA	β	SE
b ₀ = Intercept	16.55	.82
b ₁ = Gender (=1)	-.96	.77
b ₁ = Gender (=2)	0.00	0.00
b ₂ = Pre-test	.51**	.07
b ₃ = School B	-1.63	1.18
b ₄ = School C	-4.42**	.98
b ₅ = School D	-.86	1.25

b ₆ = School E	.40	1.62
<i>Variance</i>		
Individual level	18.47	
-2 log-likelihood	771.03	

* $p < .05$ ** $p < .01$.

Note. Gender (boy = reference group); 1= girls, 2 = boys; school B (school A = reference group); school E (school A = reference group); school D (school A = reference group); school E (school A = reference group).

Girlish assignments

First, the overall learning results indicate that girls have a lower regression coefficient compared to boys ($\beta = -.36$). This means that boys learned more from girlish assignments than girls. However, this difference was not significant.

Table 9. Estimates for random intercept of learning results on girlish assignments.

MLA	β	SE
b ₀ = Intercept	16.38	1.02
b ₁ = Gender (=1)	-.36	0.77
b ₁ = Gender (=2)	0.00	
b ₂ = Pre-test	.55**	0.08
<i>Variance</i>		
Individual level	17.06	
Group level	5.09	
-2 log-likelihood	704.84	
Change log	13.08	
(df)	(4)**	

* $p < .05$ ** $p < .01$.

Note. Gender (boy = reference group); 1= girls, 2 = boys

The pre-test was a significant predictor of post-test scores, $p < .001$. The multilevel model with random intercepts resulted in a positive significant change in $-2\log\text{-likelihood}$ ($\Delta\text{-}2\text{LL}(4) = 13.08$), indicating that differences between classes exist. The model explains a total of 5% of the variance on the group level and 17% on the individual level.

Second, the scores on the post-test were disaggregated according to the three levels of Bloom: *Remembering*, *Understanding* and *Applying*. Analyses showed a significant effect of the pre-test on post-test scores, $p < .01$. For the levels *Remembering* and *Understanding* girls scored lower than boys, respectively $\beta = -.04$, $\beta = -.51$ and $\beta = -.34$ (with boys serving as a reference group). However these differences did not appear significant. For *Applying* the girls scored higher than the boys ($\beta = 0.08$), although not significantly. Changes in -2Log-likelihood of the three models were significant: respectively, $\Delta\text{-}2\text{LL}(4) = 4.48$, $\Delta\text{-}2\text{LL}(4) = 25.79$ and $\Delta\text{-}2\text{LL}(4) = 19.29$. See Table 10.

Table 10 Estimates for random intercept of learning result (according to the levels of Bloom) on girlish assignments.

MLA	Remembering		Understanding		Applying	
	β	SE	β	SE	β	SE
$b_0 = \text{Intercept}$	7.43	.46	4.41	.41	4.61	.49
$b_1 = \text{Gender (=1)}$	-.04	.44	-.51	.28	.08	.34
$b_1 = \text{Gender (=2)}$	0.00		0.00		0.00	
$b_2 = \text{Pre-test}$.34**	.08	.33**	.07	.36**	.09
<i>Variance</i>						
Individual level	5.63		2.18		3.32	
Group level	.75		.90		1.26	
-2 log-likelihood	565.31		455.65		506.75	
Change log	4.48		25.79		19.29	
(df)	(4)*		(4)**		(4)**	

* $p < .05$ ** $p < .01$.

Note. Gender (boy = reference group); 1 = girls, 2 = boys

Third, the results of the themes *Doping* and *Behaviour* were analysed by performing an ANCOVA. For *Doping*, the girls' average score was lower than the boys for the girlish assignments, however the difference was not significant. For *Behaviour*, the girls' score was higher compared to the boys, but this did not appear to be significant. See Tables 11 and 12.

Table 11 Estimates for random intercept of learning result, on the theme of Doping, on girlish assignments.

ANCOVA	β	SE
b ₀ = Intercept	9.48	.39
b ₁ = Gender(=1)	-.28	.54
b ₁ = Gender (=2)	0.00	
b ₂ = Pre-test	.50**	.10

Variance

Individual level 6.61

-2 log-likelihood 453.79

* $p < .05$ ** $p < .01$. Note. Gender (boy = reference group); 1= girls, 2 = boys

Table 12 Estimates for random intercept of learning result, on the theme of Behaviour, on boyish assignments.

ANCOVA	β	SE
b ₀ = Intercept	10.50	.72
b ₁ = Gender (=1)	.29	.46
b ₁ = Gender (=2)	0	0
b ₂ = Pre-test	.15	.10

Variance

Individual level 4.49

Group level 2.46

-2 log-likelihood 403.79

Change log
(df) 28.76
(4)**

* $p < .05$ ** $p < .01$. Note. Gender (boy = reference group); 1= girls, 2 = boys

Subsequently, an ANCOVA was performed to investigate whether differences in learning outcomes existed between schools. None of the schools were significantly different from the reference group (School A), $p > .05$. Finally, results from an ANCOVA showed that the dummy variable class C2 was significant, $F(1, 122) = 37.34$, $p < .01$, indicating that in class C2 girls scored significantly lower on the post-test compared to those in class A1 on girlish assignments, ($\beta = -6.17$).

Table 13. Estimates for random intercept of learning result (by schools) on girlish assignments.

ANCOVA	β	SE
b ₀ = Intercept	16.55	1.46
b ₁ = Gender (=1)	-.34	.77
b ₁ = Gender (=2)	0	
b ₂ = Pre-test	.53**	.08
b ₃ = School B	-1.78	2.57
b ₄ = School C	-1.37	2.00
b ₅ = School D	-.05	2.46
b ₆ = School E	3.79	2.64
<i>Variance</i>		
Individual level	16.94	
Group level	3.05	
-2 log-likelihood	701,210	
Change log (df)	10.85 (9)**	

* $p < .05$ ** $p < .01$.

Other results

Above we examined if digital material of different learning style characteristics, in terms of boyish and girlish assignments, have an effect on learning outcomes. No significant relationship was found. In contrast, significant differences existed between boys and girls in their learning preferences. Girls made significantly more frequent use of *Memorising* compared to boys. In addition, boys scored significantly higher on *Critical processing* than girls. With respect to preferences in assignments, results denote that, overall, girls enjoy assignments more than boys, except for doing experiments, which is equally rated. However, these differences are not significant. Observations showed that there were discrepancies in executing the assignments. Girlish assignments were more often executed properly than

boyish assignments. Also, with boyish assignments, additional content was provided by the teachers more frequently compared with girlish assignments. In other words: teachers tended to modify the boyish assignments so that they became more girlish.

Conclusion and discussion

The first research question concerning whether boys and girls perform differently on a test based on digital learning material which supports mainly learning-style characteristics for boys, cannot be answered. The reason for this is that there was an insufficient number of typical boyish assignments in the digital textbook, *10 voor Biologie*. Results regarding the second research question, whether boys and girls perform differently on a test based on digital learning material, which supports mainly learning-style characteristics for girls, indicated that there are no significant differences. The third research question, whether boys perform better on Bloom's high cognitive levels and girls on lower cognitive levels, was also not confirmed.

Explanations for these findings can, in the first place, be found in some research conditions: it could be the case that the difference between boyish and girlish assignments was not distinct enough, or the test and assessment procedures might be invalid due to a lack of systematic investigation. In addition, differences in time spent on the themes, weighting of the test, delays in deadlines, and discrepancies in execution and motivation might be of influence. Future research should take these critical notes into account and proceed in investigating learning-style characteristics in digital learning materials with respect to differences between boyish and girlish assignments.

Also the question might be raised whether learning-style characteristics of boys and girls are as fixed as the literature indicates. Research on learning styles of pupils generally indicates that learning styles are not as fixed as the literature on differences between boys and girls indicates (Coffield et al. 2004, Vermunt 1992). Motivation and environment also are important. In a follow-up study of our research project, Van Kats et al. (2013) found that girls like all kinds of assignments more than boys do, while both boys and girls like the most boyish assignments most. So it seems that differences in learning results in schools have more or as much to do with characteristics of the school system than with assignments only. Some researchers speak about differences in brain development, where boys are genetically more active and impulsively-oriented (Epstein et al. 1998). Teachers in our research also indicated that girls are far better at planning and organising their learning process. Epstein et al. (1998) also see a development where values such as competitiveness are less valued in our current society and in schools. If we combine these theoretical reflections with the findings of Van Kats et al. (2013) that boys and girls both like the most boyish assignments most, then the conclusion must be that in our schools we need more assignments with which boys can identify themselves, where there are more possibilities for executing experimental assignments, where there are also instructions with more 'uncertainties' and less step-by-step procedures, and where there is more attention to in-depth learning.

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Resources for low-skilled adult immigrants' language training and their uses: Some contradictions at work

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Abstract

This article presents an exploratory work dealing with resources for the training of adult migrants, seeking to determine: How to characterise these resources? Which uses do the trainers develop? What needs in terms of developments can be identified?

Based on the theory of expansive learning and, particularly, on the concept of *contradictions*, this exploratory study brings to light some difficulties in designing and pooling educational resources. The observations of the practices of five trainers highlight their specific support needs according to their experience trajectories. I analysed in particular a double bind concerning learners and resources, caused by layouts that do not take account of the specificities of adults who have little knowledge of reading and writing.

Key words: educational resources, migrants' language training, France, contradictions, activity theory.

Context

France occupies the fifth place, among the 28 European countries, in regard to the number of non-national residents on its territory (Eurostat 2012). Data from 2012 indicates that 40% of the new migrants have never been to school or have only received primary education (Domergue 2012). Many of those residing in France for longer periods were in the same situation before settling in France (Bachelay 2013). Moreover, zero illiteracy in the world has not been achieved; the literacy rate is currently close to 76% (ONU 2008).

Since the end of the 1990s, the European Union has encouraged the governments of its member countries to develop and harmonise migrant integration policies: for example, the Amsterdam Treaty, signed in 1997, forecast the community management of migration policies (Castagnos-Sen 2002). A comparative study (Vincent 2005) analysed language training provided by ten European countries for migrant integration: it showed that all of these countries have developed training devices which are frequently (7/10) mandatory, especially for new migrants.

In France, a scientific project called MALIN aiming at identifying educational resources used for migrants' language training, was funded for four years (2008-2012) by different institutions (local, national and european). Articles linked to this project have highlighted several important facts, such as the lack of interest of publishers in this public throughout the

history of literacy practices (Bergère 2009), thus the construction of educational materials took place mainly in associations and they were disseminated within a limited circle (Bergère & Deslandes 2007).

When the project ceased to be funded, the team in charge had succeeded in identifying 1,890 educational resources, edited between 1953 and 2009. This represents a consistent corpus that could lead to many research programs. However, the resources were not all designed to correspond specifically to low-skilled adult immigrants' needs (Bergère 2009): a point generally admitted is that trainers make use of diverse resources and a specificity of MALIN's project was to avoid being prescriptive but to be descriptive, so there was no selection made on material declared as being used.

Private publishers of educational resources for teaching and learning French as a foreign language have been attracted by the wave of reform triggered by European influence in France (Bergère & Deslandes 2007). During the last decade, they have all edited almost one textbook specifically concerning migrants' language training (Barthe & Chovelon 2004, Benoit-Abdelkader, Thiébaud & Croix-Rouge française 2005, Bonin-Sauve 2010, Iglesias & Verdier 2012, Reboul, Boulinguez & Fouquet 2013). But it appears that they tend to reproduce the traditional Western model of textbooks constructed for educated people.

The distance between didactic analyses and training practices

Little academic research has been conducted on the study of literacy practices concerning adult migrants (Etienne 2004a, Bergère & Deslandes 2007, Adami 2009a). However, a few papers deal with educational resources. I analyse here five of them because they present some interesting contrasts linking trainer practices to educational resources.

Adami (2009b) begins with a strong affirmation: "Trainers have long exploited this state of affairs, and authentic documents form part of their teaching practices since learners are constantly exposed to them out of class" (1)⁴. But, later, he admits, "pedagogical practices and habits in adult education for integration are contrasted" (6). In fact, the entire article develops, from the example of the identity administrative form, what didactic transpositions are currently in use:

What is striking is that very often, this type of form that can be found anywhere, in abundance and in all forms in reality, is reproduced for the purposes of the educational cause. The proposed practice document has simply "name", "first name" and "address" written, with a line of points in front of each word carefully placed one below the other, where it is necessary to write the "answer". This type of "simplified" form cannot of course be found anywhere in reality and learners will never find it anywhere other than in training. (7)

Although this article presents didactic proposals adjusted to the specific needs of trainers, it does not manage to conceal an important tension related to the establishment and the

⁴ This and subsequent translations were made by the author.

recognition of this professional body. Bergère (2008) described, for example, tensions between trainers of different generations, which hinder skills and knowledge transmission:

- The “old” trainers often place their practices in a militant ideological framework that they do not recognise in the discourses of “new” trainers,
- The working conditions have changed: the “old” trainers are usually employed full-time, while the “new” are usually employed part-time and they circulate at a high rate between the structures, which does not encourage the “old” to invest time in the transmission of their know-how,
- Even if the “new” trainers have difficulties in training situations, they are legitimised by their diploma in teaching French as a foreign language, while “old” trainers, even if they are more comfortable, do not feel legitimised.

Putting these two articles in perspective, we may assume that the use of authentic materials is not necessarily integrated into training practices and that their use can be problematic for trainers, especially if they are isolated and constrained by precarious contracts.

On the subject of educational resources specifically designed to meet migrants’ needs, Bergère and Deslandes (2007) analysed the lack of consideration given by didacticians of French for foreigners in the provision of tools for immigrant trainings. The authors associated it with the old adage “*qui peut le plus peut le moins*” (“he who can do more can do less”): this lack of consideration could be due to the idea that if a trainer has the tools to create didactical sequences for an educated public, he or she is able to train learners with less or no education. However, in addition to the cultural and linguistic decentration, which allows trainers to support people in developing their communicative skills, training of migrants with little or no prior schooling requires a decentration from school habits, which is difficult for trainers who have spent a long time being schooled to accomplish (Adami 2009a 74-75). Specific tools for the formation of these learners seem just as necessary as providing training to trainers with the conditions for the appropriation of a relevant posture.

Leclercq (2011) established an historical description of the construction of educational resources, tending to promote a growing didactic frame:

Teaching the language of the host country remained deeply marked by its initial roots in humanistic and charitable values. The particular role played by associative networks, commitment and the almost militant involvement of some participants, the adherence of many trainers to the ideals of Continuing Education reflect this specificity. This has participated in the creation of many tensions between opposite models of educational interventions, which is marked by a strong general tendency to deepen the structuration, the frame, and the professionalisation of the field. (34)

But Vandermeulen (2012) showed in 2011, that training practices tend to reproduce “traditional” practices centred on linguistic knowledge, or based on communicative goals which differ from an action-oriented approach promoted for the last decade in Europe (Unité des Politiques Linguistiques 2001). Putting this into perspective, these two studies indicate some divergence between didactic publications and training practices. An important need in terms of the analytical observations of those practices is thus made apparent.

Considering the resources in terms of how they are used in training and based particularly on the concept of “internal contradictions as the driving force of change and development in activity systems” (Engeström 1987, 6), this exploratory study questions the use of educational resources in language training for low-skilled migrants: How can we characterise these resources? Which types of uses do the trainers develop? What needs in terms of developments can be identified?

General framework, methods and data collected

My PhD research questions trainers’ instrumented practices. The concepts from the different generations of Activity Theory (Engeström 2001) guide the general framework. Here, I mainly use the concept of contradiction defined by Engeström (1987, 98-106). According to this researcher, the first existing contradiction is linked to the division of labour in capitalism: each human activity is simultaneously “independent of and subordinated to the total societal production”, which is also associated to the opposition between use/exchange value. But a contradiction is more than a fixed conflict: “the essential contradiction is the mutual exclusion and simultaneous mutual dependency of use value and exchange value in each commodity”.

Later, Engeström highlights that, through time, all things “become saturated by the dual nature of commodity - they become commodified. The relation between individual actions and collective activity, between specific productions and the total production, is transformed accordingly”. A clear example of “commodification” can be mentioned here: trainers who have a diploma in didactics, specifically in French as a foreign language, are paid less than those who have a diploma to teach in “regular” scholarly contexts, even when they are employed to teach French to adult immigrants (1987, 98-106).

In this article, the concept of contradiction as a source of potential development, is used to analyse some characteristics of educational resources for language training of migrants and their usages in training. The data comes from two exploratory research projects undertaken during my masters degree (Beauné 2011a), and data collected during my PhD research:

- Seventeen telephone interviews with managers of Parisian training centres about their ICT equipment;
- Three focus groups with 25 trainers about their uses of ICT in training;
- Eighteen semi-structured interviews with trainers and managers;
- Seventy hours of participant observation in two Parisian centres with five trainers.

A thematic table was built before each interview. The interviews were conducted in order to follow the evolution of exchanges between the interviewer and the respondents (Jovic 1987, 2). The requirements for the focus groups described by E. Thibeault (2010) could not be achieved because the trainers in the different centres were too few (four) or too numerous (18). However, the advantage of this type of interview is that it allows questions that would not have arisen through individual interviews to emerge and, also, it highlights several aspects of relationships between subjects within specific communities. The data collected during the focus groups appeared to be rich material to be exploited, particularly in regard to the theoretical framework used. Primary content analysis (Bardin 2003) was conducted following the transcription of the interviews.

It should be noted that no systematic analysis of published textbooks has been set out here; analyses concerning materials used during the courses observed will be refined in my thesis. Despite the limitations inherent in any exploratory study, the results that emerge from the analysis of a consistent dataset provide trails to interpret tensions in this specific field of educational practice.

General results

Preliminary studies (2011)

I designed two studies about educational resources for language training of migrants during my masters degree (Beauné 2011a). The first focused on the role of ICT within a corpus of 14 textbooks published between 1995 and 2009. The second focused on digital resources that could be used for the training of migrants with little or no prior schooling in their country of origin.

With the first of these studies, I noted that technology had infiltrated the social and cultural landscape presented by textbooks, but that only one of them (Etienne 2004b) proposed a module integrating ICT explicitly linked to the developments of written skills. Subsequent publications of textbooks are based on visually-poor material, adopting a syllabic and low-contextualised approach to learning to read and write in adulthood. It tends to refute the hypothesis of a significant and sustainable development of didactic elaborations for adult migrants. Taking into account the potential of ICT for learning could appear as a sign of sophistication.

Concerning ICT utilisation in low-skilled migrants' training, I remarked that, as in scholarly contexts, the first trials started around the end of the 1970s. The referential defining the level of skills to reach for low-skilled migrants mentions ICT contributions to the development of written skills (Beacco, de Ferrari & Lhote 2005, 164). The results of a study on email use also showed that they "seem to favour [...] the emergence of orthographic reflections and pragmatic and situational strategies" (Beauné 2011b). The study of digital resources identified online and offline showed that we could not talk about a proliferation of resources for the acquisition and the development of skills by migrants with no or little prior schooling. They are relatively difficult to identify and, currently, they still cater mainly to trainers. However, it is difficult to identify relevant sets of digital resources since they can be very different from each other (sites, encyclopaedias, software, etc.), and also because they renew fairly quickly.

The limited number of learning materials identified online and offline does not allow any prediction about their future expansion. The most interesting observation can be linked to the concept of contradiction, defined above: a lack of developments, similar to those identified for textbooks, has been identified through a syllabic approach to learning to read and write, decontextualised language units, visually-poor or infantilising interfaces, etc.

Analysis of trainers' instrumented practices (2011-2013)

The content analysis of the 17 managers' discourses (from public, private and non-profit organisation centres) tends to show that their ICT equipment consists of, on average, one information technology room or one computer per trainer. But it appears, as one publication shows (Dessis 2006), that the majority of users are learners who already know how to read

and write, and they require the use of installed software or word processing programs. Email usage was discussed in two interviews, but only four respondents mentioned how using a computer could help to enhance the faster acquisition of learners' written skills.

Analysing the 70 hours of observations, my first finding was that the use of educational resources is directly determined by the trainers' level of experience; whether they are at the beginning, in the middle or at the end of their career. A trainer, having four years of experience, tends to multiply sources and to maintain research about resources that could be used, including Internet sources. Two trainers in mid-career, with between ten and 16 years of experience, use a more stable corpus of educational resources that they modify. Two trainers close to retirement, or having more than 20 years of experience, tend to use a set of very stabilised resources and they expressed some weariness about the developments in resources, which are described as less adequate to address the needs of the less qualified learners and/or difficult to identify. This could indicate trainers' need for an adapted support to develop and stabilise new practices.

The second aspect uncovered by my analysis is more specifically linked to paper textbooks. For two trainers, the "ready-to-use" and the "validated" aspects of paper textbooks seem to interfere with their usage of material during training. It appeared that, frequently, the trainers planned an activity based on a quick look to the contents but without any precise reading: the resources they were using surprised the trainers. Specialised training could be productive to guide them in the use of textbooks: to contextualise activities, to give user feedback, to build a critical approach, etc.

One last important aspect in the analysis of observations concerns the difficulties learners face with the documents provided during training. On this point, the following tension was clearly identified: while these learners are considered illiterate, they are often very sensitive to the slightest written signals. An overload of useless information (such as instructions or excessive layouts mixing points, letters, or numbers to associate) or irrelevant locations for information (shifts in the numbering or the pictures associated with specific information, pictures that are too small) reduce the potential understanding of the resources by the trainees. We have, in effect, a double bind: the first one concerning illiterate learners trying to make sense of traditional scholarly layouts; the second one concerning publishers who have to produce a book for illiterate adults.

Discussion and perspectives

First, it should be remembered that this article is based on a large overview of educational resources available currently in France for the training of low-skilled immigrant adults. A systematic analysis may be organised. The analysis of observations, particularly concerning practices developed with computerised resources, will be refined in my thesis.

Despite these limitations, this article indicates that even if the educational resources are numerous, those specifically elaborated for low-skilled migrants appear to be barely visible. An explanation could be linked to the fact that we are in a period of transition caused by the latest reforms of public policies on migrant integration, which are impacting training systems' management. The analysis has also shown that research on support for trainers could help the evolution of practices in this field of activities. An important contradiction, similar to a double bind situation, has also been highlighted whereby textbooks, which are

supposed to be addressed to illiterate learners, are not considered to be instruments used by specific learners.

It seems that paper textbooks, maybe because they are “familiar”, have disappeared as specific instruments, especially in the face of digital possibilities. But, as my analysis puts forward, the tensions that characterise textbooks are equally present with digital resources. They tend to use a traditional approach to the acquisition and the development of written skills, a linear method, which frequently presents syllables or words outside of any real context of use. Social representations concerning illiterate adults’ needs and abilities have been revealed to be a big issue.

Questions about educational resources are also really important, provided that they consider issues of training practices. To organise a “change laboratory” (Engeström 2011) with editors, trainers and managers would probably help a lot to improve existing materials and practices, especially if we consider that it marries with global development issues where techniques applied in the teaching of adult literacy can be an important lever of social dynamics.

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WORKSHOP 5
TEXTS AND CHANGES,
CHANGES IN TEXTS

Designing learning resources in synchronous learning environments – Some considerations and examples

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Abstract

Computer-mediated communication (CMC) and synchronous learning environments offer new solutions for teachers and students that transcend the singular one-way transmission of content knowledge from teacher to student. CMC makes it possible not only to teach computer-mediated but also to design and create new learning resources targeted to a specific group of learners.

This paper addresses the possibilities of designing learning resources within synchronous learning environments. The empirical basis is a cross-country study involving students and teachers in primary schools in three Nordic countries (Denmark, Sweden and Norway). On the basis of these empirical studies a set of design examples is presented with the purpose of showing how the design fulfills the dual purpose of functioning as a remote, synchronous learning environment and – using the learning materials used and recordings of learning sessions – developing a repository of online asynchronous learning resources.

In the course of developing a design several important restraints of CMC were identified that had significant impact on the design choices made. Among these were the need to design sessions as sequences and identifying trade-offs between design choices such as rights and privileges of participants. Focus is also placed on the importance of multiple channels of communication (seeing, writing, hearing) as a means of understanding.

Keywords: Computer-mediated communication (CMC), Educational design research, design examples, web conferencing platform, synchronous learning environments, personal learning environment, learning resources.

Background

The empirical study discussed in this paper derives from a cross-border project concerning primary schools in Denmark, Sweden and Norway. The aim of the project is the construction of virtual, Nordic classes where students work closely using new technology. Teachers from the three Nordic countries plan, evaluate and teach each other's students in various subjects. This study looked at the subject of history. The teachers set-up synchronous, online learning environments for the students from all three countries using the web-conference platform Adobe Connect (AC). The specific aim for this context is the focus on students' collaboration and the production of digital learning resources in a synchronous learning environment. The article furthermore sets out to discuss the field of education and technology on the basis of

design experiments. I define a learning resource as “*materials or tools being used as the means with learning as the goal*”. There is a certain focus on the aspect of understanding because the students speak their native language and not a common foreign language (like English for example), because Swedish, Norwegian and Danish are, though not altogether alike, in many ways similar. However, the differences in the three languages made it essential for the virtual learning environment to use as many channels of understanding as possible (Spante et al. 2013). In this case seeing (web-cam), hearing (microphone) and writing (chat) were made use of, while producing a learning resource in a synchronous learning environment.

Computer-mediated communication and synchronous learning environments

The scientific literature shows that research regarding synchronous learning environments has been scarce and insufficient (Teng et al. 2012, Hrastinski et al. 2010). As a consequence, there is a need for the development of educational design principles regarding online synchronous teaching and learning.

Synchronous learning environments offer the possibility and the capability of *coupling two or more (learning) contexts* in real time. For this purpose several types of tools have been developed, such as Google hangouts, Skype or Adobe Connect, but the need for educational design principles to follow are crucial. Synchronous learning has “*the potential to support e-learners in the development of learning communities ... help learners to feel like participants rather than isolates*” (Hrastinsky 2008).

Much research has been carried out regarding asynchronous learning environments (Hrastinski et al. 2010, Chen et al. 2006), but there seems to be only little transformation material. It is highly problematic to use this research when it comes to asynchronous learning environments for several reasons. In asynchronous learning environments focus is placed on the beneficial access to education whenever a student wants it and has the time, not when schools are open. Time for reflection is another issue often mentioned as an educational quality regarding asynchronous learning environments (Hrastinsky 2008, Marjanovic 2002). However, as Hrastinsky et al. stress, the problem of feeling left alone or isolated, must not be overlooked. This probably has to do with the absence of immediate feedback from teachers and fellow students – something that is more easily accessed in a synchronous learning environment. That is probably why Marjanovic can show us that some students prefer synchronous learning situations over asynchronous ones (Marjanovic 2002).

Synchronous computer-mediated communication allows educational activities to take place in real time regardless of distance and can in some sense ‘mimic’ traditional classroom teaching. The real-time, computer-mediated interactions can produce a feeling of commonness and belonging (McBrien et al. 2009), however it is crucial to stress that this is only possible via the construction of strong, transparent and ‘good’ (Walker 2006) didactic and educational designs (McBrien et al. 2009, Walker 2006).

According to Wikipedia.org, CMC can be defined as “*communicative transactions that occur through the use of two or more electronic devices*”. This allows communication to take place regardless of geography. Recent research regarding cross-border collaboration in primary schools in Scandinavia with CMC showed a need to use as many ‘channels of communication as are available’ in an attempt to attain cross-border understanding. When it comes to online

education, teaching and learning the need for testing students' understanding in a continuous way using video, speaking and chat at the same time in the communicative synchronous online processes could lead to a new offering of a more broad definition of CMC as follows: *CMC (in education) covers communicative transactions that use as many channels of communication as possible in the attempt to accomplish the educational purpose of CMC, namely mediating understanding among the participants regardless of boundaries in distance.*

I realise that I am implanting the concept of understanding as a key factor in education. However, the communication processes between A and B makes no sense in an educational context unless we talk about A understanding B and B's response being understandable to A (Luhmann 1984).

The platform used for the empirical examples carried out in this article is Adobe Connect (AC). AC is a video-conferencing platform, which allows file-sharing, video and sound communication (including recording of the sessions), chatting, writing and the possibility for designing learning resources and learning environments (using various templates/lay-outs). In that sense AC offers new opportunities for developing digital learning communities (students) and digital teaching communities (teachers) and furthermore designing and distributing learning resources in synchronous learning environments.

Various layouts (templates) can be used as a structuring tool for the coordinated efforts of teachers and students. This allows a platform like AC to function as a learning environment, where a teacher or a group of teachers in advance can set up a course or a smaller teaching sequence in a particular subject. At the same time the platform functions as an organisation of learning resources for the students to utilise in a synchronous as well as an asynchronous way.

According to Beetham (2007, 40) five forms of learning activities in synchronous learning environments can be discerned: (1) working with others, (2) discovering, (3) developing and sharing ideas, (4) solving problems, developing techniques, (5) collecting, gathering, recording, editing. These five learning activities can all be carried out with the Adobe Connect platform. To follow Beetham's definition of a learning activity being "A *specific interaction of learner(s) using specific tools and resources orientated towards specific outcomes,*" AC's offering of chat, video, sound, file sharing and production collaboration is a well-placed example of what Beecham calls a *technology-rich environment* (Beetham 2007).

In this project practitioners and researchers worked closely together to find solutions for teaching and learning in a synchronous environment. This specific kind of cooperation deserves a space of its own since this approach – design-based research – addresses some fundamental problems and issues within the community of educational research.

Design-based research

Design-based research (DBR) is a vast and broad research tradition which signals that research processes are based on (some kind of) design. But what does that really mean? Why is that important and necessary?

In his article on productive design studies, Decker Walker talks about a disappointment with the impact of conventional approaches to research in education:

We have seen no intellectual breakthroughs in research in education comparable to advances in medicine, engineering, and the sciences; nor have we seen any measurable improvement in teaching activities or student learning on a large scale. (Walker 2006, 8).

Traditional educational research – if one can use such an expression – has, according to Walker, “*influenced practice only little*”. The need for more radical solutions is apparent. We believe that DBR offers such solutions when it comes to using research to improve and innovate teaching and learning practices.

The field of DBR – often also labelled “Design Experiments” or “Design Research” – cannot be said to comprise a solid group of researchers bringing along and working within firm and collectively-accepted concepts (Collins 1992, Van Den Akker et al. 2006). DBR consists of various branches and researchers from different milieus trying to develop “*a collective stance on standards would require more consensus on the epistemology of educational research than currently exists within the DBR community*” (Dede 2006, 110). However a few concepts can be highlighted as being present in much DBR.

As pointed out by Walker above, three arguments can be put forward in support of the relevance of DBR (Van den Akker et al. 2006):

1. To increase the relevance of research for educational policy and practice.
2. To develop empirically-grounded theories.
3. To increase the robustness of design practice.

Educational research has often – and deservedly – been criticised for having “a weak link” to practice (Van Den Akker et al. 2006). Results from much educational research never reach an audience outside the research community. Van Den Akker et al., make this point quite clear when they state, attacking conventional educational research,

Those who view educational research as a vehicle to inform improvement tend to take such criticism (that educational research rarely reaches the practitioners it is occupied with) more seriously than those who argue that studies in the field of education should strive for knowledge in and of itself. (Van Den Akker et al. 2006, 4)

When researchers are working on such improvements in close relationship with a specific field itself, solutions which are sustainable over time and which can serve as inspirations for others (design examples) are more likely to be developed or designed. Having these ambitions mentioned above also means that the theory developed is not only closely linked to, but derives from, practice.

Working with design experiments generates important data, which contains theory-generating material. In designing such theories, they are not to be viewed as ‘grand theories’ or ‘true theories’. They are to be viewed as contextual solutions for specific educational, teaching or learning problems. In some cases they contain transformative potential in other, more or less similar contexts. Often, they can serve as inspiration for further development. Last but not least, design practice is difficult and complex work and both the experiences and the knowledge contained in DBR studies has to be described and distributed in order to increase the knowledge of various design processes and possibilities.

The DBR ‘approach’ stresses the importance of generating innovative knowledge through the development and refinement of design. Two researchers describe it as follows: “*if you want to change something, you have to understand it, and if you want to understand something, you have to change it*” (Gravemeijer & Cobb 2006, 17). This approach refuses to separate the research process from the aim of innovative development; the two must go hand in hand. Actually, more than this, they must embrace each other. Furthermore, it signals the importance – or a certain sensibility – one must accord to entering a context as a researcher; you cannot enter without already being in the process of change. You probably cannot even make a request about entering without changing various components in an institutional context. If you work in an iterative way and continue to work closely with the subjects of a specific learning context, in time you sense this very strongly; you cannot enter without changing something and you cannot try to reach understanding of a specific setting without changing it. And the more you are engaged in iterative processes of change, refinement or redesign, the more you get to understand the setting.

So, we can state that DBR has two main goals: first, the development of new knowledge and understanding about education, teaching and learning. This walks along the line of what could be labelled *traditional educational research*. The other goal is the ongoing desire to develop new designs, new solutions that lead to better practice, more solid learning and more flexible education. In other words, the processes of a DBR project place the researcher in a new light. He/she is not only seen as a researcher seeking understanding, new knowledge with the aim of a new way of analysing education, teaching and learning, but also as a participant, closely involved in iterative processes with a subject from a given pedagogical practice – for students (designs for learning), teachers (designs for teaching) or management (designs for education).

Having taken some space stating that there is no cohesive DBR movement, some principles can still be said to be present in most DBR projects:

- **Collaboration:** Research and developments go hand in hand and are carried out in close interaction with subjects in a given practice.
- **Iterative processes** with the aim of developing prototypes of specific designs.
- They have a **theory-generating aim**. The development of these theories derives from practice. The robustness of such theories is tested in a specific didactic practice. So DBR processes intervene in practice. Understanding and changing are two sides of the same coin.

Chris Dede has stated about the research process that “*only the first five percent or so of the data collected ... is ... needed to introduce the findings*”, and he attacks research that produces large amounts of data, that through an “*elephantine effort, result[s] in the birth of mouse-like insights in their contribution to educational knowledge*” (Dede 2004, 107). DBR in its use of iterative processes creates, evaluates and produces new amounts of data necessary for the refinement of design construction.

Teaching a design activity

In this context I define teaching (planning, carrying out and evaluating a series of activities with the aim of students learning something) as a design activity or design practice:

Teaching is not a theoretical science that describes and explains some aspects of the natural or social world. It is closer to the kind of science, like engineering, computer science, or architecture, whose imperative it is to make the world a better place; a design science. (Laurillard 2012, 1).

Laurillard uses the term “*design professionals*” when describing teachers and stresses the role of new technologies as the land of opportunities for designing learning situations: “*Blackboard and chalk was one of the very few tools ever invented specifically to serve education, and its modern counterpart, after all these years of digital technologies, is the virtual learning environment or VLE*” (Laurillard 2012, 2).

The VLE sets out new standards for designing learning situations and collaboration. Whereas, for example, Van Harmelen (2012) stresses the personal aspect of learning with new technologies in education, Laurillard – and myself – are preoccupied with the collaboration and cooperation aspects and opportunities of virtual learning environments. This brings us back to the tool used in my empirical study for this article, namely Adobe Connect, which is exactly that, a VLE. Adobe Connect is what Laurillard labels *a knowledge technology* because it shapes *what* is learned by changing *how* it is learned (Laurillard 2012, 3).

But before getting more closely acquainted with Adobe Connect I would like to emphasise another important argument about education and technology derived from Laurillard: “*The continual challenge from digital technologies has forced education into the position of following rather than leading innovation, and the academic community needs to gain better control of our use of technology*” (Laurillard 2012, 8). This statement calls for new solutions in education, for a DBR approach in producing design examples (Laurillard uses the term “patterns”) for better use of technology in teaching and learning situations.

Design examples as a way of moving innovative processes forward in education and learning

In Adobe Connect it is possible to design various learning milieus (templates). They are suitable for video conferencing (focus on camera and speak). The various windows which make up a template can be altered (made bigger or smaller) or some of them can be removed to create more space for more important windows in a certain template – for example the window.

When creating an AC meeting, a default setting is created that features a window showing the participants’ webcams (upper left), a list of attendees (which can be removed when you see the webcam of all participants and therefore is not really needed), a chat that is visual and accessible to all participants and a large window to the right which allows participants to share their desktop or a file, etc. The default setting is reproduced in Figure 1.

On the far right, various templates are shown. They can be accessed by a simple click. The templates are labeled ‘sharing’. Others are ‘video conferencing’, ‘discussion’ and ‘collaboration’. Depending on what type of interaction or learning is planned to take place, appropriate templates can be chosen and modified if necessary.

In the second template below (Figure 2) I have chosen ‘collaboration’. This template allows participants to be visible to each other via webcam (far left), a window labelled ‘agenda’ can display the task, there is a list of attendees visible, a chat section, and on the bottom right is a

window where files can be shared, stored and made available for all participants. When a meeting is closed and later reopened (using the same URL) all resources are still there. The large window called the ‘whiteboard’ allows participants to work on the same resource at the same time.

The collaboration template allows students to see each other, talk to each other, chat when necessary, follow an agenda which has been set out by a teacher or is negotiated by the group of participants, share important files and store them for further AC-meeting activities. The whiteboard window allows them to create a negotiated learning resource which can be shared with the rest of the world via a short url. The sessions can also be recorded. This again creates a unique url, which can be linked to others of interest and the students or the teacher can watch the session in the future.

Figure 1. The default setting of Adobe Connect.

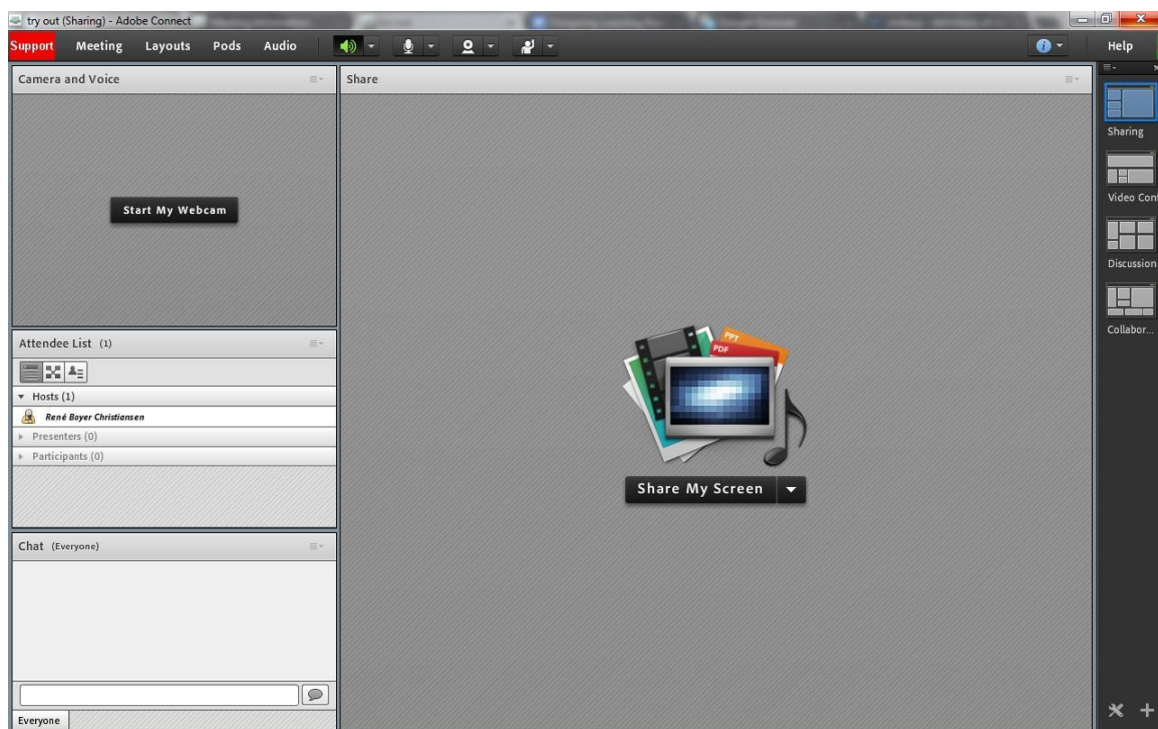
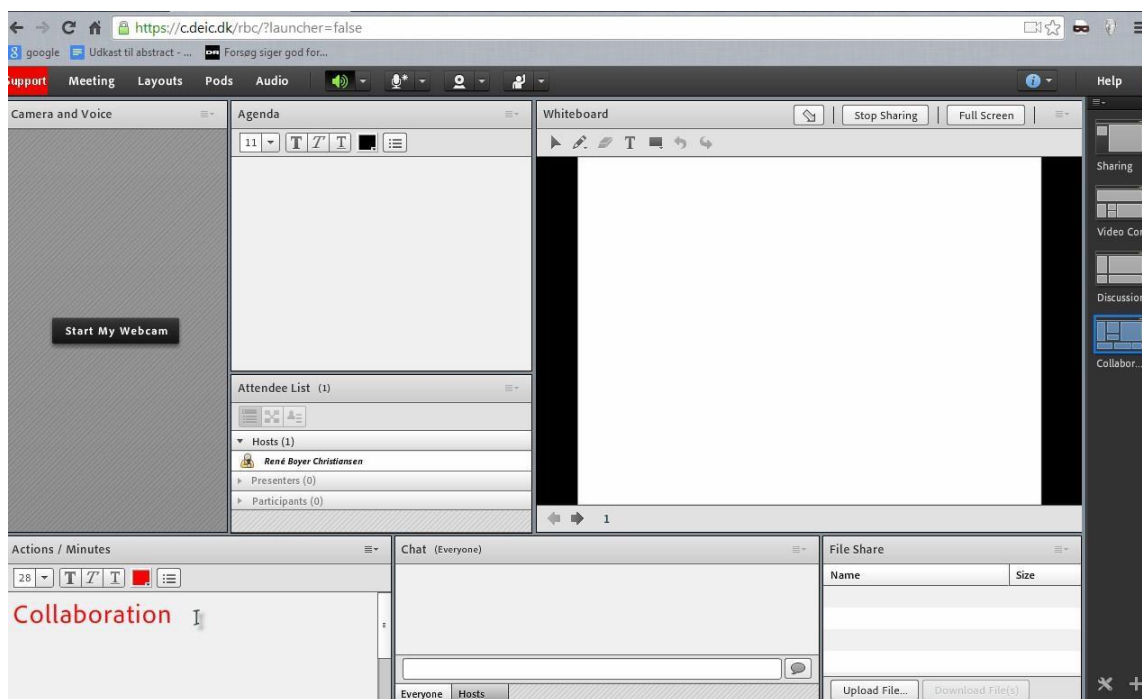


Figure 2. The collaboration learning environment in Adobe Connect.

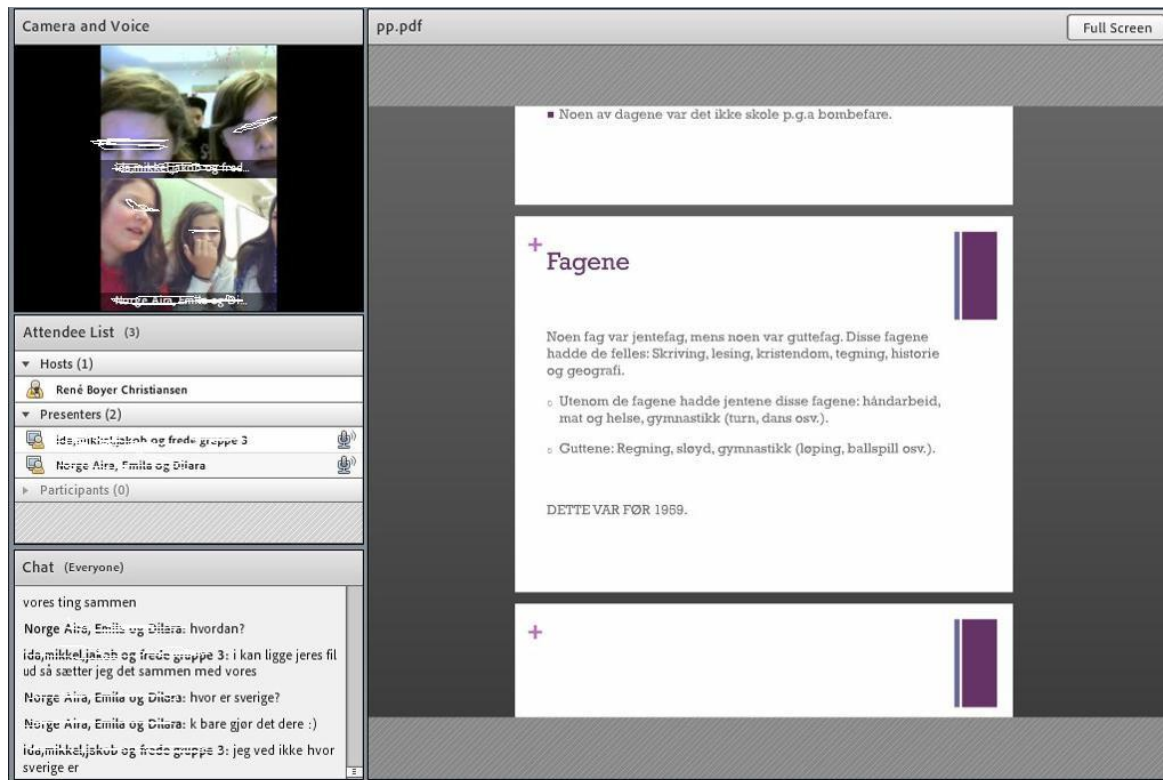


Discussion, negotiation and producing in a synchronous learning environment: an example

Beetham's research shows that the sharing of representations in different media is often used more by students/learners than by teaching staff (Beetham 2007, 42). Much is probably to be gained from teaching experiments that allow students to build their own personal learning environment (PLE). I enhance the term *personal* here. Van Harmelen (2012) defines a PLE as “a single user's e-learning system that allows collaboration with other users and teachers who use other PLEs”. Personal here can also refer to group learning activities – or a *collective learning environment*. As seen in the photograph below (see Figure 3), a group of students aged around 12 engage in discussion about producing a digital product. They use camera/sound and the chat-function while producing and negotiating the content:

For this session a specific template was chosen in AC, which allows the students to see and hear each other while having access to a chat function. These groups come from two different countries (Denmark/Norway) and studies have shown (Spante et al. 2013) that when engaging in learning situations with other students who speak another language (as mentioned, although Norwegian and Danish are in some ways similar, they differ in just as many) the support of both text, film and sound is essential. The camera and/or the sound cannot stand alone. The combining of both the seen, the heard and the written makes it more plausible that such a session will lead to understanding of one another (Spante et al. 2013). Spante et al. have shown that using only one or two of the three decreases the students' understanding of one another markedly. The study (Spante et al. 2013) indicates that all three channels for supporting understanding are available during a synchronous online session.

Figure 3. Students negotiating content and constructing a digital learning resource.



In the example we can see the students use the chat (on the bottom-left portion of the screen) alongside the camera and sound. The digital production they are working on is on the right. Beforehand, in their respective groups, the students were given the task to produce a digital product about their national school system. They then met up synchronously online to negotiate the two productions they brought along, re-mixing and re-designing the two into one common product that could be presented later for the other students and their teachers in the classes. For the presentation they also used AC, communicating with both students in Denmark and Norway at the same time. Their collective learning environment had been set up – or designed – by their teachers thus making it possible for them to discuss, negotiate and reach agreement and finally produce a digital product. All these activities were carried out in a synchronous learning environment – in this case Adobe Connect – and this leaves space for a discussion about teaching and design as research.

Further research and investigation

As was shown earlier in the review section it seems essential that research regarding CMC turns toward the field of communication and interaction and production that takes place in online, synchronous learning environments. Much indicates that a new set of didactic rules has to be developed both on a student and a teacher level. This calls for research within the boundaries of DBR which can develop new principles for teaching and learning in online, synchronous environments.

At this point in time we still only know little about the progression of students engaging in online, synchronous learning environments. How old – or young – can students be before this type of communicative practice is considered too difficult or too complex?

Teaching and learning in online, synchronous learning environments pays homage to concepts such as ‘teaching in the cloud’ and ‘learning in the cloud’ and requires deeper discussions about and further research into the positions and roles of students and teachers. A whole research field is contained in the need to understand why some teachers find these activities exciting and rewarding while others find them frustrating, difficult and chaotic.

Inspired by Vygotsky, I talk about *the zone for (proximal) didactical innovation* as the difference between what a teacher can design with the inspiration, help or guidance from others and what he/she can design on his/her own, what kind of educational design management can be developed without the guidance of others. Designing synchronous learning environments and learning resources is quite an undertaking and requires the support of both school management and colleagues, and the courage to experiment with educational forms and student learning environments. In the project discussed in this article researchers and teachers worked closely together, mutually inspiring each other, and in doing so moved the boundaries of our own zone for didactical innovation.

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The digital textbook underanalysis: A case study

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Abstract

In this paper, we present the results of an empirical study analysing one of the first digital textbooks available to teachers in the context of Galicia (Spain). A brief overview is also made of the major reviews and studies that have been published in recent years regarding this subject as background for our study. As a reference we used the previous study designed by Reints and Wilkens (2012). After making the adaptations described in the introduction, we analysed the material. The paper presents some suggestions for future research regarding digital textbooks.

Keywords: Digital textbook, content analysis, case study

Introduction

In the Spanish context, research regarding digital textbooks is still scarce and it is especially difficult to find studies using the content analysis approach. Similarly, if we consider the latest reviews of the literature and conferences organised nationally and internationally, in general we find research focusing only on the analysis of digital textbooks (see among others the reviews and papers published in recent international conferences related to textbooks organised by IARTEM: Braga García et al 2013; Bratislava 2003; Caen 2005; Tonsberg 2007; Madagascar 2008; Santiago de Compostela 2009; and the International Textbook Workshop in Santiago de Chile 2006).

It should also be noted that there is currently no clear and consistent criteria in the literature to define “digital textbooks”. For this reason, “undefined” would be the word best reflecting the current situation. First, there is a terminological vagueness surrounding the concept of digital textbooks that is evident in the usual confusion between digital content and the media they contain. Thus, the terms “e-book”, “e-textbook” or “e-reader” are used to refer both to the contents and the container. Adding to the “uncertainty” is the clear lack of consensus on the specific features and types of digital textbooks that may exist (i.e, electronic textbooks developed for e-readers, electronic textbooks created for use on computer, digital textbooks printed on demand, modular sets of audio and video, animations, open-textbooks) (Mardis, Everhart, Smith, Newsum & Baker 2010, 3). Nevertheless, a trend is becoming apparent in research and practice pointing to three characteristics that can serve to define/identify this

type of educational resource. These are adaptability, multimodality and interactivity (Reints & Wilkens 2012), which can be defined as follows:

- Adaptability refers to the ability to adjust the format and content of the digital textbook to student characteristics. In other words, the extent to which the digital textbook can be changed.
- Multimodality refers to the incorporation of different interactive and multimedia elements such as videos, 3D animations or simulations; that is, the possibility to present content in different formats exploiting the potential offered by new technologies.
- Last but not least, interactivity refers to the possibility of communication between teachers, students, and even publishers. Communication is established not only between the content and the student, but there is also the possibility for feedback.

To summarise, the following table lists the main characteristics that digital textbooks should present, taking into account those that are inherent to textbooks in general (Keris 2013, Pere Marqués 2010).

Table 1: Characteristics of digital textbooks (from Pere Marqués⁵).

CHARACTERISTICS IN COMMON WITH TEXTBOOKS	
Technical and structural aspects:	<ul style="list-style-type: none"> • Clear and grammatically flawless texts • Legible typeface • Clear illustrations suited to the content and to the recipients
Functional and pedagogical aspects	<ul style="list-style-type: none"> • They provide information and a learning guide • They have a specific educational purpose beyond routine memorisation and skills acquisition • They are directed to specific students • The training contents are well structured • They often include contributions for student study and teacher guidance • Activities can be continued where they were left off
SPECIFIC CHARACTERISTICS OF DIGITAL TEXTBOOKS	
Technical and structural aspects:	<ul style="list-style-type: none"> • Digital format: online access from the publisher's server (or DVD) • Inclusion of multimedia elements • Organisation with themes, sections, paragraphs, resources • Hyperlinks to other contents in the book or internet • Content navigation: with menus, index, search • Configuring environment, remove, add, change • Environment (entorno virtual de aprendizaje, or EVA) to control student work
Functional Aspects	<ul style="list-style-type: none"> • Some allow you to configure the appearance of the environment (font size), the

⁵ Source: Trad. Marqués, P. (2010). *15 didactic models for using digital textbooks* UAB - DIM group
<http://peremarques.blogspot.com/> (PPT)

- language and the visible content (sections) facilitating curricular adaptation.
- Many exercises are interactive with immediate correction.
- The internal search engine makes it easier to find content based on interest
- Often includes printable activities.
- Easy and quick updates from the publisher,
- It facilitates the exposure of teachers to be able to project on the whiteboard
- The teacher can set up the book that the student will see.
- The student makes an EVA which facilitates control and monitoring.

Educational aspects

- Multimedia elements are attractive and facilitate understanding and student learning
- Exercises can be increasingly difficult and self-adjust according to circumstances and student progress (treatment of diversity)
- Immediate correction of exercises keeps the student attentive and active.
- Any support can be included for exercises

With respect to research on the use of these materials, many studies show that digital textbooks are used for different purposes than printed textbooks. Slater (2010) found that students use these materials to find information or to select text excerpts. Insofar as how the use of this type of digital content affects student learning, secondary and primary school results show that students prefer textbooks in digital and networked format to the printed version (see for example Jones & Brown 2011, Kim & Jung 2010). However, traditional textbooks are still used because teachers are the ones who choose materials and their preferences prevail over students'. We would like to point out the study by Pere Marqués in the Spanish context (like our own research), which assessed the educational content in *educaLine* and is one of the few research projects involving this type of material in Spain. The study was conducted in 23 primary and secondary schools relying on *educaLine* digital textbooks, available in three languages and two formats. The results showed the following:

- Most teachers use the paper or digitised format (pdf) of traditional textbooks.
- The traditional teaching model prevailed in the classroom. Teachers only used new technologies (e.g. interactive whiteboard) to support their explanations.
- While students learned more, their marks were not better. This may be because exams remain basically rote and do not allow assessment of acquired learning competence.

Let us go on to the description of our study.

The empirical study

The main objective of this empirical study was to analyse a sample of open-access primary school textbooks available to teachers in the autonomous region of Galicia (Spain).

We began by focusing on the design of the empirical process. We will describe the phases of the process and the methodological justification (content analysis), as well as the peculiarities of the selected case. Afterwards, we will present the adapted evaluation instrument and, finally, we will present the results of the quality analysis of the digital textbook selected with this instrument.

Method and empirical research

It should be noted that a mixed-methodology design was followed. We considered the contributions by Rodríguez and Vallderiola (2009, 13) and Olabuenaga (2012, 53) regarding the phases to include in this type of empirical investigation.

Problem formulation and determining scope of empirical investigation.

In the first phase, we established the theoretical framework and epistemological bounds. We also aimed to clarify the main objectives in line with the conceptual foundation.

Methodological design of the empirical investigation

In our case, the focus was on content analysis methodology, which is one of the most solid approaches for analysing textbooks and utilised in a wide range of research on the subject (e.g. Parcerisa 1995). We understood content analysis to mean “*technology research to formulate, from certain data, replicable and valid inferences that can be applied in its context*” (Krippendorff 1990, 28 cited by Zapico 2012, 325).

Thus, content analysis is a research method that aims to unravel the discourse (implicit or explicit) included within a certain media (in this case a digital textbook) unveiling the meaning and arriving at a new interpretation. With respect to our study, this method addressed the two functions that Bardin (1986, 22) attributed to content analysis: the heuristic and testing functions, to the extent that we tried to analyse the aspects influencing the digital textbook’s quality (contents, pedagogic, design and presentation) as well as verify that material contents were suited to the parameters identified by Reints and Wilkens (2012).

Furthermore, we chose to carry out a case study, because it is a descriptive qualitative methodology that is used to analyse something specific inside a complex phenomenon. In our case, it has allowed us to investigate the quality of a specific digital textbook. This type of analysis is appropriate for “*delving deeper into small scale research, in a limited frame of space, time and resources*” (as was our initial situation), moreover, “*it could be a way to delve deeper (...) after an initial data analysis*” (Latorre et al. 1996, 237, cited in Bisquerra 2009, 37).

Instrument adaptation

In this phase, the analysis model was adapted to the form of a digital textbook evaluation guide, consisting of various areas classified into thematic blocks, with the intention of being consistent with both theoretical foundations and methodological principles.

Data collection: materials analysis

Data collection was performed by applying the evaluation guide to the selected case. We started by reading the selected material, to provide us with an overview of its structure and components, and then we carefully analysed each of the defining elements identified in the evaluation guide. This was carried out by means of a thorough reading and recording of all the implicit and explicit elements such as images, multimedia activities and roles (determining the type of tasks and the type of learning involved), the presence of proper names, content structuring, colours and typeface used to identify sections and themes, and so on.

Data interpretation

The evaluation guide provides a field in every area for “comments/conclusions” so that critical interpretations (reasoned and justified) of the data can be made. Furthermore, these interpretations are summarised in the final block.

Case selection

The digital textbook selected in our study was: *Lingua 6º Primaria. Proxecto Temoneiro* (*Language for 6th grade of primary school. Temoneiro Project*) by SM Publications.

Unlike traditional textbooks which are widely available, digital textbooks published in Spain are still scarce and most have restricted access, which is why one of the criteria underlying our choice of digital textbook was that it be open access.

Regarding the choice of publisher, we used the following criteria:

- Consistency: years of experience as a leading publisher producing educational materials with a certain degree of prestige and recognition. As these materials are relatively novel, we also considered the opinions of teachers and publishing professionals.
- Proximity: publishers in our territorial area, i.e. Spain and Galicia
- Accessibility to us: one criterion was that the textbook allow free viewing, either in full or in part.

We also took into account the textbook consumption figures (both digital and printed) provided by the National Association of Book and Teaching Materials Publishers, the Galician Publishers Association, the Federation of National Associations of Publishing Distributors and the Federation of Publishing Guilds of Spain. They all indicated that the Anaya group, Grupo Santillana and SM Publications controlled the majority of production and consumption.

Taking all of the above into consideration, our preliminary selection included the following publishers: Grupo Anaya (including Xerais), Santillana, SM Publications, and Digital-Text. We also looked at websites and parent associations that provided open-access digital textbooks but subsequently rejected these as mere scans of traditional textbooks in pdf format.

In addition, we reviewed which publishers had digital textbooks that met the other criteria, i.e., were fully or partially open access, published in Galician and for primary education. Only one publisher, SM Publications, met these three requirements. Ultimately, the textbook selected was *Lingua 6º Primaria: Proxecto Temoneiro*.

Evaluation guide

General characteristics and justification for the elements in the guide: areas, units and analysis categories

In the empirical part of the research, we proceeded to adapt an evaluation and interpretation instrument previously designed by Reints and Wilkens (2012). The instrument includes a total of five areas. Three of these are a reflection of those in Reints and Wilkens (2012): content analysis, pedagogical analysis, and design and presentation analysis. The remaining

two relate to material identification and the final overall evaluation. The basic structure of the guide is presented schematically in the following table.

Table 2: Analysis areas of the evaluation guide for digital textbooks.

A) Material identification
B) Content analysis
B.1. Content selection
- Prior learning
- Interest
- Identification
B.2. Organisation of content
B.3. Modalities of content
C) Educational analysis
C.1. Teaching strategies
C.2. Educational activities
C.3. Regulation of the learning process by students themselves.
D) Design and presentation analysis
D.1. Text presentation
D.2. Presentation of visual effects

As can be seen, the first section of this analysis tool aimed to achieve a basic description of the material to be analysed. Afterward there are a number of analysis blocks or areas covering the major issues involving the quality of digital textbooks, based on theoretical assumptions and the considerations made by Reints and Wilkens (2012).

As a final summary, there is a last analytical block in which to express an overall score for the material under analysis marking the end of the individual inquiry into the digital textbook in our study.

We should point out that each of the different analysis areas has a section for conclusions (or comments), making it possible to progressively substantiate the essence of the results obtained throughout the process.

It should also be noted that most of the areas identified, especially those with a greater number of questions, were subdivided into more specific units of inquiry in order to bring together inter-related issues, as well as to more precisely sort, clarify and systematise the evaluation process. For example, area B was divided into three distinct analysis units (B.1, B.2 and B.3), which sought to clarify and relate matters that can be grouped under one thematic umbrella. In turn, each unit of analysis was further subdivided into a series of items or indicators (in the interrogative or affirmative) and through which the quality level of the textbook gradually becomes outlined. Each of the items has different response options that

users of the guide must choose from in a reasoned and thoughtful process. Sometimes the analysis units may be subdivided into smaller units in order to more deeply address issues that, although deserving individual treatment, are closely related.

The instrument consisted of 51 items, in addition to those constituting the initial “identification” block, which were not numbered as they were merely identifying elements that, although important, were not fundamental to determining the quality of digital textbooks.

In short, the analysis instrument consisted of a series of items for which an assessment or choice was required regarding the particular aspect. In every case, the answer had to be explained in a field called “comments”. The response options were as follows (singly or in combination):

Option or dual response, to which the researcher must choose “Yes” or “No” and justify the answer. This was the most frequent option type in the instrument.

Option or multiple-response, in which multiple responses are presented and the most appropriate had to be selected.

Graduated response option (0-1), in which the researcher had to assess different aspects on a scale from 0 to 1.

Open response options, for which there were no default options and the researcher could answer what they considered to be most appropriate.

In view of the above, we can say that this was an eminently qualitative analysis tool, however, it presented some quantitative aspects such as the number of references in a given situation and a rating scale.

Results

Now we will present the results found in light of the empirical research and grouped according to the “dimensions” analysed.

Content analysis

We should point out that the digital textbook used, *Lingua 6º Primaria: Proxecto Temoneiro*, reflected the evident influence of traditional textbooks. Although an attempt was observed to incorporate e-textbook elements, the structure and teaching models implicit in the material were those of a paper textbook.

It should be noted that with respect to content, an attempt was observed to associate with the student’s own context by introducing places and names familiar to the learners (e.g. two readings referred to natural areas in Galicia, and 12 proper names were found that are used in the Spanish context, of which two are specifically Galician). In terms of organisation, the digital textbook presented a linear structure where units or topics (as well as sub-sections) were presented progressively and included a self-assessment at the end of each topic. The topic entitled “Nature in verse” was subdivided into nine sections that were common to all topics in the book: “reading comprehension”, “spelling”, “grammar”, “literature”, “speaking”, “writing” and “test your skills”. The analysis has determined that although

different types of content were included, the potential of multimedia educational resources was not taken advantage of since only still images, audio recordings and webquests were included. This fact is in line with what Muñoz de la Peña already reported in 2008 when he noted that, *“the approaches to date have not gone beyond digitising existing content or creating simple interactive exercises”*.

Pedagogical Analysis

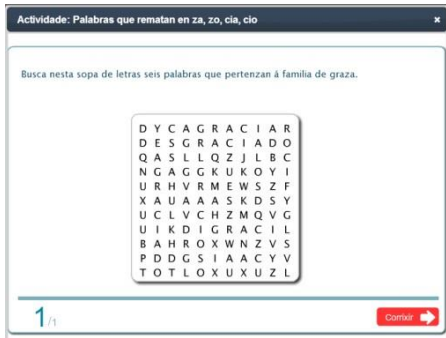
With respect to the pedagogical aspect, the digital textbook analysed predominantly presented a learning style characterised by direct reproduction, with most of the activities focusing on memorisation and repetition of content (for example, several activities asked students to complete a series of words with given endings, most of which had repeatedly appeared either in previous exercises or readings). In addition, the use of a traditional textbook structure reflected a desire for the syllabus (topics) to be followed strictly (otherwise the content would lose coherence).

However, given that the student could choose (a priori) whether to perform the multimedia and complementary activities and work autonomously, it can also be said that there was a style of “directed significant learning”.

There is also a notable distinction between multimedia activities and activities on paper, as the first are characterised by fostering somewhat superficial learning involving presentation and interaction with the information. We could conclude that these multimedia activities were meant to support exercises requiring a higher level of understanding that were intended for development on paper (see Figure 2).

A strong point of this material was that it integrated activities fostering different intelligences, thus addressing a variety of student learning styles. Most activities, however, were based on the identification of the correct answer, as we have noted, and this fosters rote learning (e.g. multimedia activities that tell the student whether their answer was correct but provide no explanation, or that offer the answer as a solution, (see Figure 3). As Area (2005, 3) notes, *“learning situations that require students to develop or construct knowledge such that it is the student who has to take appropriate steps to solve a particular problem”* must be planned and implemented, thus developing students’ skills involving multiple literacy or transliteracy. Many authors (e.g. Snyder 2004 and Moreno 2007) agree that digital literacy should be a learning process built by students themselves using a variety of media and technologies.

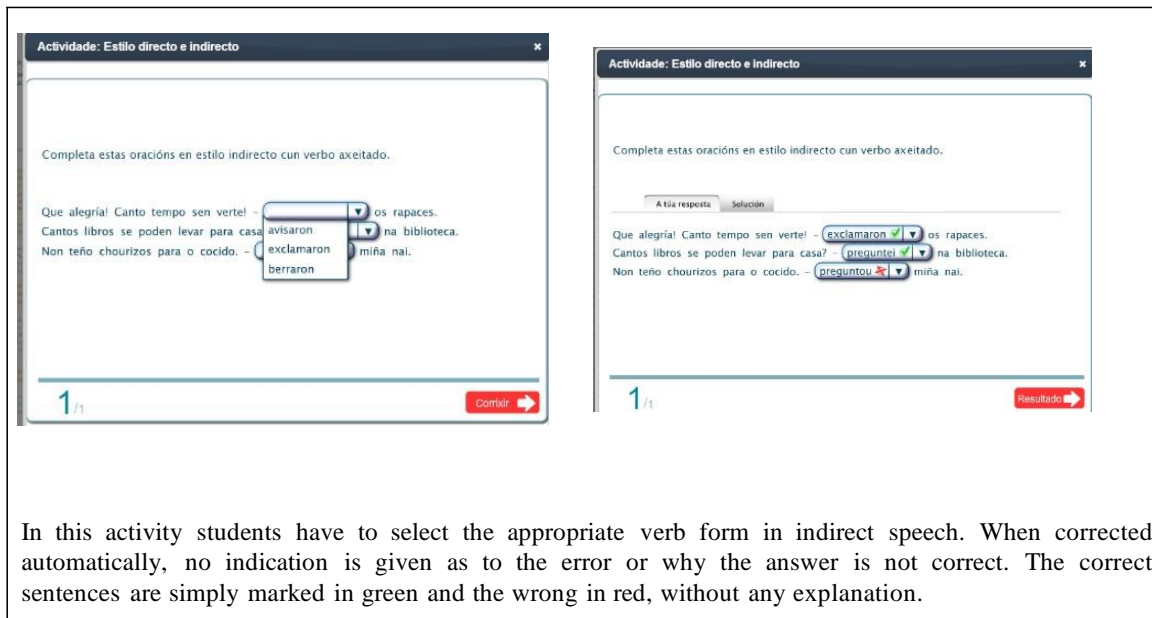
Figure 2: Multimedia vs. paper activity.

Multimedia activity	Paper activity									
 <p>Actividade: Palabras que rematan en za, zo, cia, cio</p> <p>Busca nesta sopa de letras seis palabras que pertencen á familia de graza.</p> <p>Word search grid:</p> <pre> D Y C A G R A C I A R D E S G R A C I A D O Q A S L L Q Z J L B C N G A G G K U K O Y I U R H V R M E W S Z F X A U A A A S K D S Y U C L V C H Z M Q V G U I K D I G R A C I L B A H R O X W N Z V S P D D G S I A A C Y V T O T L O X U X U Z L </pre> <p>1/1 Comprobar</p>	<p>6. Forma catro palabras novas engadíndolles prefixos a estas palabras.</p> <p>in- des- pre- mal-</p> <p>graza diferenza querenza xuízo</p> <p>7. Escribe no teu caderno nomes formados a partir destes verbos. Fíxate no exemplo.</p> <table border="0"> <tr> <td>cobizar → cobiza</td> <td>comerciar →</td> <td>sacrificar →</td> </tr> <tr> <td>menosprezar →</td> <td>sentenciar →</td> <td>exercitar →</td> </tr> <tr> <td>beneficiar →</td> <td>financiar →</td> <td>licenciar →</td> </tr> </table>	cobizar → cobiza	comerciar →	sacrificar →	menosprezar →	sentenciar →	exercitar →	beneficiar →	financiar →	licenciar →
cobizar → cobiza	comerciar →	sacrificar →								
menosprezar →	sentenciar →	exercitar →								
beneficiar →	financiar →	licenciar →								

The media activity is a word-search related to the same word family.

There are two activities on paper. First, the student has to form new words using a given prefix, and second, the learner has to write nouns from verbs provided.

Figure 3: Example of an activity in the digital textbook.



In this activity students have to select the appropriate verb form in indirect speech. When corrected automatically, no indication is given as to the error or why the answer is not correct. The correct sentences are simply marked in green and the wrong in red, without any explanation.

In this way, technology becomes more than a mere work resource or support material for teaching tasks, and instead also becomes an environment in which students must learn to resolve problematic situations (Area 2005, 10).

In this context we find the so-called “self-regulated learning” or “self-directed learning” which is defined by Zimmerman as the “degree to which the student has an active role in their own learning process” (1989, cited by Castro, Durán, & Valero 2006, 15).

Considering what we have said regarding the pedagogical level of digital textbooks and the learning strategies that characterise effective learning according to Van Beek (2009 cited in Reints & Wilkens 2012, 8), digital textbooks should do the following:

Allow students to plan their learning process and be aware of their progress.

Include activities that provide feedback (beyond correct/error tasks) that makes students reflect on their answers.

Provide motivating activities and resources that give access to varied sources of information, while taking into account student characteristics and interests.

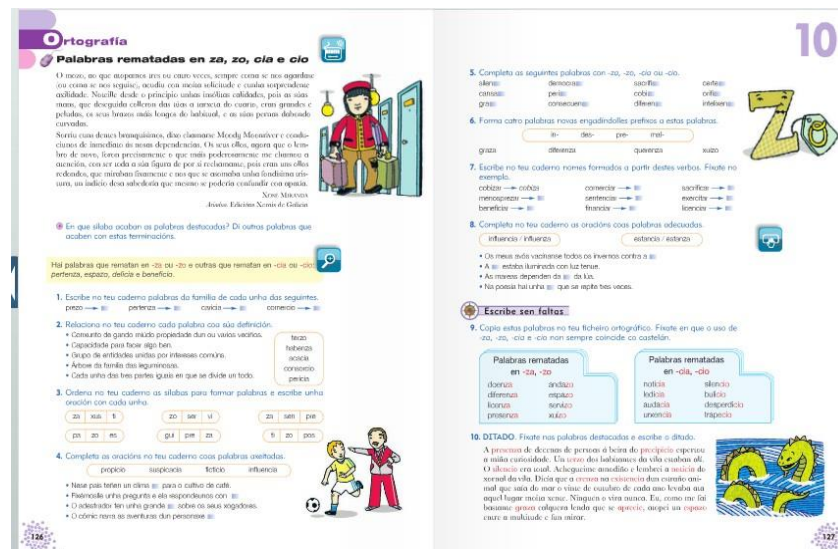
Above all, and most importantly, we believe that a change is necessary in the general conception that currently pervades schools in general. The vision of education should go beyond the acquisition of knowledge and specific skills.

Education also means providing opportunities for significant changes to take place in the way of understanding and acting in the world.

Analysis of design and presentation

Regarding the last analysis area, design and presentation, we can say that the visual elements are those of a paper material, that is, they are all static (see Figure 2). It should also be noted that a large part of them (with the exception of only six) have a merely decorative function, thus, constituting a distraction to learning (Carney & Levinn 2002 cited by Reints & Wilkens 2012, 6). Nevertheless, we consider the presentation of content to be generally good, since there is an appropriate use of typeface, colour and visual markers and that the structure of information at the page level facilitates understanding, attention and search for information. For example, in Figure 4 a subsection of the topic is outlined in purple with larger typeface, exercises are in blue, important files are boxed in yellow with red keywords, and difficult-to-spell words are boxed in blue.

Figure 4: View of a page in the selected digital textbook.



Conclusion

In our view, it is necessary to rethink the use and appropriateness of the component elements of digital textbooks and to look beyond the traditional textbook. In this regard, we believe that “another type of school” is possible that goes beyond simply relying on prearranged content displayed on paper or in digital format. To do this, it is necessary for teachers to be able to analyse and reconsider the meaning and importance attributed to these materials. Here teachers are a key factor. Teachers are the ones who select and use books and their use will largely determine success, as materials alone do not produce improvements in education. We firmly believe that, in this sense, it is more important to innovate and change teaching methods than it is to incorporate a given technology into the classroom. Before the effective arrival of digital textbooks, we should rethink the practices and learning experiences that take place in our schools. In this context it makes no sense to use old teaching methods with new educational materials and resources. Like teachers, students also play a major role because, as Perkins (2010) states, “our students have changed radically. Today's students are no longer the kind of people our educational system was designed to teach”. Today's young people are

considered “digital natives” (people who have grown up amidst “new” technologies), therefore, their way of accessing and processing information is different. They are used to getting information quickly. They prefer graphics over texts, instant gratification, frequent rewards and work best online. Therefore, digital textbooks must adapt to their particular ways of learning. Similarly, teachers must rethink their teaching methods and learn to “communicate with the language and style of their students. This does not mean changing the meaning of what is taught or of good thinking skills [...] it means going faster, less step by step, more in parallel [...]” (Perkins 2010). In this regard, what is needed is more vocational retraining to endow teachers with the tools to function properly in a digital environment.

We would also like to draw attention to the need for a conceptualisation to aid understanding of what a digital textbook is, as well as the need to establish a common term for referring to it. In this sense, after searching for open-access digital textbooks, we have experienced both difficulties. For one thing, there are digital textbooks that are mere containers of activities, digitised books put in pdf format to appear more innovative, and digital textbooks that may seem to have all the right characteristics but only include activities as part of multimedia material (without videos, animations, or wikis).

We could say that there are still many questions surrounding textbooks (both digital and traditional paper) as one of the most valued, demanded and widely-used tools. Textbooks provide teachers with guidelines and criteria for making decisions, and have an unquestioned hegemony in the framework for presenting and specifying curricular practices. From this standpoint, and in view of the results presented above, we believe it is necessary to continue analysing the role played by textbooks as teaching aids that structure teaching-learning processes. It is particularly important to estimate the quality of digital textbooks, seeing as there are currently few studies on this topic in the Spanish context. With respect to the needs that come to light after a review of the research on digital textbooks, we consider that the following should be addressed in the coming years: decisions and reflections involving the publishing industry should not focus primarily on the need to provide more textbooks and on digitisation, but on developing another type of discourse regarding the quality of their use, adaptation and integration in the classroom. Similarly, materials elaboration teams should include professionals to help incorporate digital tools in the design and use of didactic materials from a pedagogical perspective. Furthermore, it is essential that teaching materials and digital textbooks include experimentation processes in their development as recent studies suggest that this may be lacking.

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Digital pre-texts and the creation of ‘open’ learning resources

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Abstract

The majority of published learning resources and textbooks are to some degree ‘complete’ in the selection, arrangement and publication of their content and realised in a final published form. While open to interpretation and various means of implementation and enactment, there are limitations to the degree that they may be rewritten in each learning context. In a digital age, processes that involve adaptation, co-configuration, co-construction and creation are required to ensure learning is relevant, meaningful and extend students’ creative capacities. There are various models that promote these processes. This paper explores the creation of digital pre-texts as ‘open’ texts, which may be used as the framework for co-constructing learning experiences and locally relevant resources. It also looks at an integrating a model known as ‘Rolling Role’, drawn from the drama education field which provides for open but structured activity fields for resource development and learning.

Keywords: Open texts, digital resources, pre-text, Rolling Role

Introduction

The role and nature of textbooks and educational media is increasingly open to question in what is variously called the networked society, the digital age, and the connected society (Castells 2000, Mizuko et al. 2013, Siemens 2006). With the proliferation of free content available online and the option for students to quickly ‘Google’ any topic in the world, is there still a need for textbooks anymore? There are a number of recent reports that document the changing nature and role of the textbook and call for more rapid movement towards embracing digital textbooks and media (Digital Textbook Collaborative 2012, Fletcher, Schaffhauser & Levin 2012, McFadden 2012). For example, the ‘Out of Print’ project in the USA (Fletcher et al. 2012) involves several states in planning how they can support the transition from traditional print-based text books to digital text repositories, highlighting the potential of utilising the vast array of ‘rich, interactive’ content that is available. In the transition planning much of the focus then becomes less on purchase of textbooks, and more on the curation of content and the technologies required (such as tablets devices, Internet and broadband access). An analysis of trends in the higher education textbook market by the Follet Higher Education Group (McFadden 2012) identifies that the shift from print to digital content and textbooks does not mean that the textbook is dead, but that the faster uptake is in native digital texts and content that capitalise on features such as problem-based learning and interactivity, with a forecast for reduced growth of enhanced-print texts (which are basically e-book versions of traditional print textbooks with added links and content). For those educators and researchers who are interested in capitalising on these shifting agendas,

different models are required that utilise the interactive potential of the Internet and digital media but also appropriate pedagogical processes.

This article will provide case study examples of two models for the creation of locally responsive educational media that also capitalise on the affordances of the digital era. These models are drawn from the field of drama education and in particular from process or improvisational forms that recognise the key role of the teacher or learning facilitator. This article also draws on socio-cultural theory and activity theory, recognising the important role of mediation, including different mediating signs, tools and artifacts (or learning resources) that are involved in learning processes. The research question that informs these case studies is therefore: ‘What might be some key features of models that allow for the creation of open-learning resources that are locally responsive and use digital technologies and online spaces?’

The ongoing role of the ‘textbook’ and the curation of learning resources

To help understand the ongoing role and purpose of textbooks and learning resources in the contemporary educational setting it is useful to think about them in the context of an underpinning educational framework. In relation to the work discussed in this article the framework is drawn from Vygotsky’s foundational work and later developments in the area of cultural-historical activity theory (Daniels 2008, Engeström 2009, Vygotsky 1962, 1978).

Vygotsky identified the key role of social and external interactions with others and the artifacts of culture as integral to learning processes. Within a learning context, tools such as textbooks and educational media can therefore be recognised as important artifacts of the historically-valued accumulation of culture. Textbooks and educational media become cultural artifacts, a highly selected body of concepts and examples from a culture that represents what a particular group believes is valuable and important to engage with. There are ongoing issues that arise in a post-modern era where there is much greater awareness about the contested nature of what is important knowledge, and ongoing issues regarding the lack of cultural and linguistic diversity represented in textbooks (Rodríguez Rodríguez 2011, Rodríguez Rodríguez, Horsley, & Knudsen 2009). The reality in practice is that education systems and authorities do decide upon and make these selections, though there are varying degrees of flexibility available for teachers and schools to make decisions that are more contextually responsive and relevant.

In the current context there is also a plethora of information freely available on the Internet, which in theory means students can draw on it to learn about anything they want. However the sheer volume of material available means that the role of the teacher can become increasingly important for assisting with the selection and introduction of relevant resources, but also in designing related interactions and appropriate learning experiences. Vygotsky’s notion of the zone of proximal development (1978) is helpful for highlighting the importance of the teacher’s role as one who helps extend the zone of learning for students and interacts with them as they engage in problem-solving processes.

This means that a focus on selecting the resources or tools should not be seen in isolation, but considered in the wider context of learning design and processes. The role of the teacher is that of curator and designer opening up avenues for questioning and inquiry, inviting students into the process of knowledge creation and transformation. The role of more knowledgeable other or educational resource creator is not restricted to the teacher or professional media

maker however, and the students may also be active participants in creating resources and artifacts as part of their learning.

Principles drawn from this theoretical work that informed the two cases to be discussed were therefore as follows:

- There is a key role to be played by the teacher as curator and designer of learning resources;
- The creation of learning resources can be a shared process;
- The design of learning materials and resources can provide opportunities for inquiry and co-construction.

Model 1 – Pre-text and open texts

The first model discussed emerged from a project which included the creation of locally-responsive educational media and a design framework that built on the concepts of ‘open’ texts and pre-texts. The concept of ‘open works’ builds on the tradition of Umberto Eco (1979) but is highly appropriate for thinking about learning design in the digital age. Eco identified developments in certain twentieth century artworks whereby the ‘author’ or creators had deliberately left some sections ‘unfinished’, and open for the individual artist or performer to complete the end product. He emphasised that this did not just mean “open to interpretation” and that not every text that is open (i.e. a dictionary) is an open work. To translate this into educational textbook and media terms, what this means is that some key parts of a text or learning resource are created to initiate a learning program. They are carefully planned and designed as they provide the parameters for the ongoing learning process. They must relate to identified learning goals and content selection, determine the form and structure for work that students will subsequently create and direct the trajectory for problem solving and inquiry.

To design a framework, which invites participatory input, the concept of pre-text was found to be instructive. The term pre-text was coined by Cecily O’Neill (O’Neill 1995) for describing the notion of a stimulus text which acted as a framing and ‘launching strategy’ (Taylor 1995, 13). O’Neill used this term in her reworking of the Heathcotic style of educational drama (O’Neill 1995, Taylor 1995) whereby certain parameters are determined for the learning activities, but then the actual outcomes of the drama are not necessarily scripted or pre-determined but created throughout the process. The term ‘pre-text’ is therefore used to describe the various texts and strategies which serve as the springboards to initiate a drama or other inquiry learning process. Pre-texts are generally rich, but open texts, they suggest possible roles, landscapes, relationships, attitudes and dilemmas:

An effective pre-text is simple and functional. It sets in motion situations in which appearance and reality, truth and deception, and role and identity may be contrasted and explored. (O’Neill 1995, 20)

A pre-text is realised in various material forms, and may be an artwork, a letter, a photograph, a piece of music, a historical document or map, or other such form or combination. Pre-texts often pose a problem that needs to be solved or set up a situation that requires investigation and action on behalf of the students. They are often emotionally evocative and also aesthetically engaging and this can be important for hooking students into the learning process. As well as traditional print forms of texts and artifacts, digital pre-texts can now be

created and shared online and used in combination with interactive online spaces that prompt ongoing input and contributions from participants (Carroll & Cameron 2009).

A digital pre-text can be shared with students as part of the orienting phases of a learning unit and help initiate them and motivate their learning. The benefits of using related online spaces are that students can participate in ongoing interactions and create their own texts and resources to contribute to the learning process and open text. Finally the material created and contributed by students may also constitute demonstrations of their learning as assessment products for that unit of work.

To demonstrate how this can work in practice, an example from a primary school context will be used where a pre-text and open text were created as the prompt for initiating learning processes for three different primary school classes.

TreeMappa – An example of open educational learning resource design

The TreeMappa project involved students from three different year levels in one Australian primary school. While each year level had their own specific curriculum outcomes to target, a common learning focus and framework was designed to enable each class to learn about significant local trees. The trees could be significant for various reasons such as environmental, historical, social and so on. Utilising drama, art and digital media, children engaged with local history and the natural environment to explore concepts and issues of relevance to their context.

Each class took a particular focus depending on their specific curriculum, and teachers collected and created learning resources and materials that were appropriate for their class. Some focussed on persuasive writing in English, others on science-related learning about plants, and a third class had a local history focus. The three classes also worked with a common pre-text, some learning resources and processes. The author developed these in partnership with the teachers. To help generate a need state, a problem was introduced and an invitation extended to students to be involved in documenting the stories about a local tree.

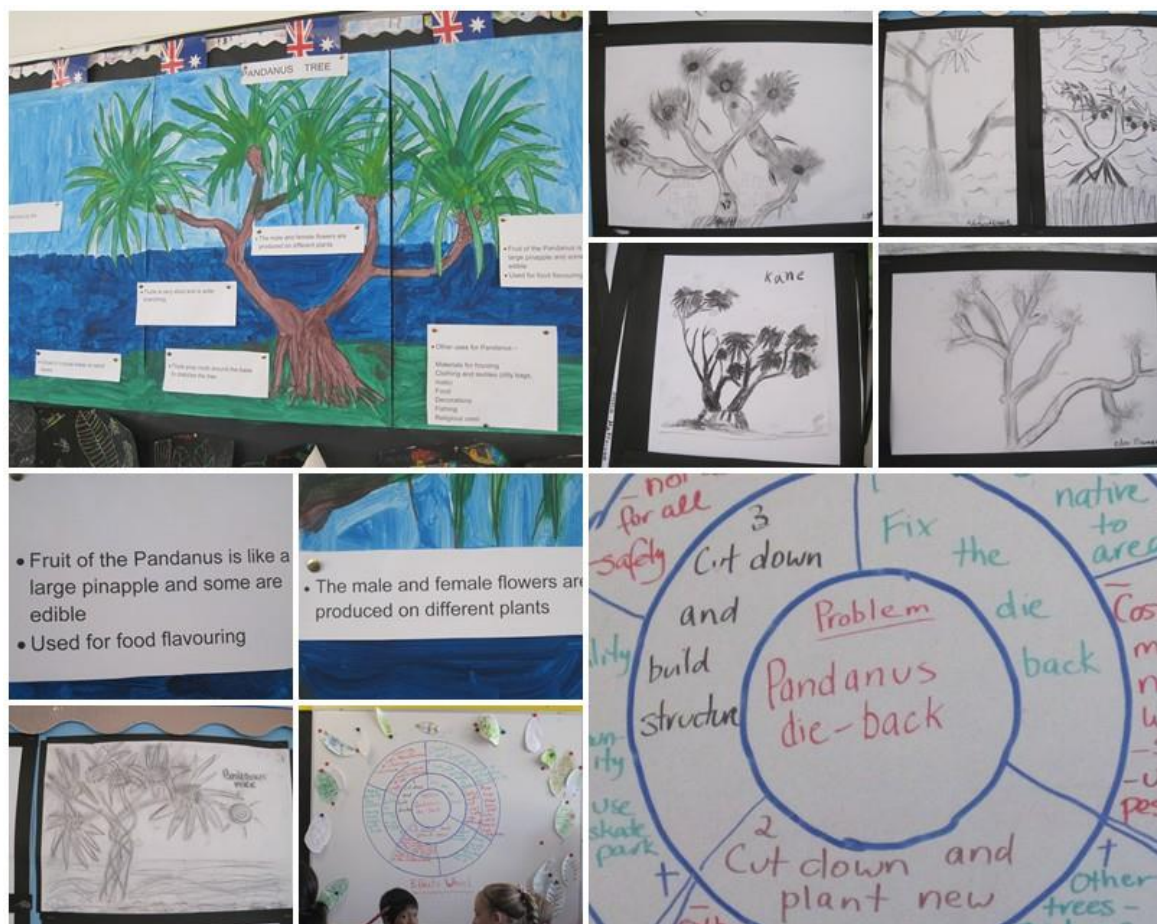
This problem and invitation was enacted through creating a set of initiating resources, which introduced students to the learning focus, provided them with some general and locally-relevant knowledge about trees, and invited students to become ‘custodians’ for a specific tree. An initial motivating experience was used to launch the process and this included creating a role taken on by the researcher who attended school as a ‘teacher-in-role’, a strategy that comes from the field of drama in education. Taking on a fictional role, the teacher or leader interacts with students within a structured situation to explore relevant issues and problems (Heathcote & Bolton 1995, Morgan & Saxton 1987, O’Toole 1992, Wagner 1976). A specific role and situation was created which facilitated the introduction of key concepts about trees from around the world (and this was accompanied by a related video clip and Voki animation). This strategy was planned to act as a prompt for cognitive engagement and a gateway into the affective and operative fields of engagement:

Dr Rita: Good morning students. My name is Dr Rita Strong and I am an environmental anthropologist with the TreeMappa program. We are an international research group finding out about ‘special’ trees. We need to gather stories about the world’s significant trees as in the future we may lose many of them because of global warming and climate change. We need custodians to

record and interpret these important stories and share them with the world. We don't accept just anyone though, to become a member of our hand-selected team you need to apply to become a 'custodian' for a special tree in your region. You must commit to investigating its significance and to share what you find with others. Who is up to the challenge?

The pre-text was further complemented through the creation of educational resources that included informational texts and profiles that invited responses from students (see Appendix A). A number of PowerPoint presentations were created and shared live but then made available to teachers for reuse. Two of these included one that deliberately focussed on trying to spark student motivation through sharing interesting facts about trees from around the world (e.g. the oldest, tallest, widest, most remote and so on) and another that included basic information about trees, as well as images and facts about local native trees. These locally-produced educational resources were then used by teachers in follow up lessons. Some of these resources were also uploaded and made available for the wider public to use and have since been accessed by others, with the presentation Sunshine Coast Trees now showing it has received over 2000 views (<http://www.slideshare.net/TreeMappa/sunshine-coast-trees>).

Figure 1. Examples of educational resources created by the teacher with student drawing responses



Each class subsequently developed role cards and identified a specific tree to learn about. These included: learning about the native pandanus trees and the die-back disease that had plagued them in recent years; researching the history of the Norfolk pines that grace the shoreline of the local beach; and learning about the wallum scrub land (and eco-system) that

still exists within the school's own grounds. Materials used throughout these processes were also uploaded online and therefore contributed to a bank of learning materials that were shared through a wikispace. Teachers and students therefore created educational resources which could be used by others (see Appendix B for an example of a student-created profile). Throughout the learning process students contributed to the open text through contributing drawings, poems, photostories and videos and these were shared between the groups. While there were limitations regarding the sharing that could occur outside of the school's e-learning platform, it is possible that such resources could also become part of a bank of learning materials that could be used by other classes and schools in the future.

At certain points in time teachers did need to draw on other texts and existing publications or media (such as a local field guide (book) on native trees). This information was then fed into the process via both traditional learning processes but also complemented through interviewing and working with the author of that book and other knowledgeable locals. For example the book author and local plant expert came and tagged the plants in the school's wallum remnant area and engaged students in experiential learning within their own context.

The contributions of groups were then fed into the developing resource bank through uploading content to a shared Google map. Content included information, photos and short video clips which were then 'pinned' onto a map (see Figure 2 below).

Figure 2. Example of a Google map with geo-located content pins



Throughout the process the open framework enabled the creation of a repository of resources and media and that material then contributed to the creation of different versions of the open text. Key features of the process included:

- Creating an engaging launching pre-text;
- Creating local, contextually-relevant learning materials;
- Designing a framework that invites student contribution and input;
- The sharing of student- and teacher-generated resources and artifacts through direct and online formats.

While the TreeMappa project only involved several classes at one school, there is the potential for such models to be scaled up and shared across multiples sites and that is the approach that was used in the next case study.

Model 2 - Rolling Role and co-construction of educational media

Rolling Role is another model drawn from the field of drama in education that builds on similar principles of openness as already described. In this case the process relies upon the active involvement of the students or participants in the creation and publishing of materials in an ongoing way, and this work is meant to be used to inform the work of other groups and classes. The concept of Rolling Role was developed as a model for secondary schools as an integrating device to connect work between different classes who may be studying different subjects. Renowned drama educator Dorothy Heathcote created the model throughout the 1980s and 1990s as a result of her collaborating with a range of teachers including the first two, New Zealanders McAra and Pearse. In one of the first published articles about Rolling Role, McAra describes key features of the process as follows:

The principle of the Rolling Drama is that one set of stimulus material and one basic drama framework be planned and employed with a number of different classes (and perhaps over a substantial period of time). The work of each class is different because they are framed differently in relation to the material, and the work of one class can produce materials which provide a starting point for the work of another group. (McAra 1984, 3)

The way the project ‘rolls’ is that work is often left incomplete (and therefore is to a large degree ‘open’), but one important addition to the first model is that work is meant to be published and shared, so another group can use it, take it forward and continue the drama. This is a significant point when it comes to the focus on educational resources and pre-texts, as while the teacher may choose or create the initial materials, as the work unfolds the work created by students becomes crucial to extending the ongoing learning process. In the 1980s and ‘90s documented examples of Rolling Role tended to describe work being typed up and ‘published’ through being shared on the walls of a classroom. With the emergence of digital technologies, Heathcote later suggested that Rolling Role work lends itself to sharing through something like a website (Heathcote 2002).

Heathcote also identified the importance of exercising ‘high selectivity’ as the teacher/initiator searches for a sufficiently interesting context for the activity. She highlighted the importance of finding or defining the *particulars* of the context that would allow the opportunity to explore *universal* issues or concerns. She also advised that the drama should have contemporary relevance for the participants but issues were often explored through an historical lens. One of her students, Kerley, summarised these framing considerations in her master’s thesis. She identifies three key features for planning Rolling Role as follows:

1. A community that exists in the present;
2. An event in the past, with links to the present (through the existence of, for example, a building, a ruin, a myth or a legend);
3. A plan for the future of the community. This hinges on a ‘point of change’ and is the immediate focus of the drama.

(Kerley 1993, 89)

Several Rolling Role project descriptions found at the Heathcote Archives discuss the importance of creating artifacts to help situate the ‘reality’ of the fictional contexts and ground the actions for the drama. Artifacts found with Rolling Role examples include maps of villages, letters seeking assistance, archival documents, photographs of buildings and so forth (Davison, Cochrane & Berwick 1990, Heathcote & Mills 1993, Kerley 1993, Mills 1989-90). As Heathcote discusses elsewhere, for her it was very important to select and organise different signs and objects to create “arrangements of significance” (Heathcote & Mills 1993, tape 1). This can be very important for hooking students into the process but also used throughout the various parts of the process. As the core materials have to be used by multiple groups, Heathcote and other rolling role creators have suggested that there should be at least three related contexts that can provide the focus and entry points for participating groups. These related contexts may also have more relevance for different subject areas. In the case of the first major project created with McAra and Pearse the three contexts were:

1. The existence of a set of unique rock paintings to be found in a mountainous area in South America (art, history focus)
2. Plans to build a major dam on a lake close to the paintings (science, technology focus)
3. A village that lives nearby for whom the paintings are precious (anthropology, language focus)

(McAra 1984).

The main resources used to launch this drama therefore consisted of a wall display that included a map of the area, with drawn copies of the rock paintings with explanatory details. The central dilemma was that of a final appeal being lodged with the UN about whether the paintings could/should be saved.

For the purposes of the case to be discussed, the Rolling Role model was revisited with the specific intention of exploring its potential in a digital age, enabling shared learning experiences across schools sites and countries. Throughout 2013 an international project was trialled which involved five different student groups (from Australia, Greece, Singapore and the USA), their teachers and researchers in testing out how such a model might operate, and this project became known as ‘The Water Reckoning’.

The Water-Reckoning rolling role project

The early planning process for this Rolling Role project centered on finding and creating a common set of dramatic materials which would stimulate the learning and dramatic action across the different site classrooms. After several months of online discussions and negotiations, the project team agreed on the main context or frame and then the initial dramatic materials and pre-text (for more detail about this process see Davis & Simou 2014). As many communities had experienced extreme weather events in the time leading up to the project enactment and we discovered that 2013 was to be the UN Year of Water Cooperation, the focus for this drama became related to community response to water events. The guiding question became, ‘How do humans cooperate to share and manage water and deal with situations such as drought or extreme weather events?’

The planning group also determined an initial set of considerations for developing a context and pre-text that included the following:

- Groups should be able to explore specific issues around the consequences of not ‘cooperating’ as related to water use or water-related disasters;
- Each group should be able to explore ‘universal’ human issues through the particular, with relevance to the local contexts and events;
- Each group should have some flexibility in what they focus on while still contributing to a collective endeavour;
- There should be opportunities for young people to engage in real issues and be able to learn about them with the potential to take action;
- The central context needs to have historical, contemporary, and future relevance;
- There should be a common digital repository for sharing learnings and material and this should also have relevance to the dramatic frame;
- The pre-text needs to be aesthetically engaging and help motivate involvement.

The context that was developed came to focus on the contemporary discovery of a set of statues – or frozen people – from a civilisation who had suffered some extreme water-related event. The three contexts that flowed from that were those of the contemporary researchers, the society of the past and what happened to the inhabitants up to and at the time of the event, and finally the descendants of those people who had escaped or been saved and their response to plans to introduce tourism into the site.

The key resource or artifact used to launch the process was based on images and a video entitled 'Human Nature', which depicts figures from ocean-based underwater sculpture parks by Jason deCaires Taylor.

Figure 3. Example of a Jason DeCaires Taylor image that was used as part of the pre-text package of resources.



The artist has created these parks in an attempt to explore the relationship between art, the environment and humans. For our project, we layered a fictional meaning over the existence of the pieces to enable the work to act as a dramatic stimulus. The additional framing added to the drama was that the underwater statues were to be the frozen people of a lost city called ‘Ardus Unda’. The proposition was that contemporary researchers were investigating the discovery of Ardus Unda - a civilisation that has been frozen in time. Throughout the proces

the experiences of inhabitants of Arduus Unda were explored in what would have been the lead up to a devastating event. The intention was that digital artifacts from each group's work (in the form of photos, text and videos) would then be 'published' and shared through an online water museum on a platform called PlaceStories (see Figure 4 for a screenshot of one way to view the uploaded context). This online space became the central location for sharing and publishing work throughout the process and enabled groups to interact with the material uploaded by others and therefore allow the process to 'roll'. The outputs from the PlaceStories site as well as the pre-text material and other resources were all made available through a central web portal with the creation of a free weebly website <http://www.water-reckoning.net>.

Figure 4 Water Reckoning PlaceStories Project page with thumbnails representing different content contributions generated by different project sites.



One of the key actions required to allow the different groups to interact with each other and to connect the work, was that before groups began their sessions, they would review the work that had already been published by others. Groups were then welcome to build and extend on ideas presented by others and use that to inform the next frame of their activity. Figure 5 shows how some of this occurred visually. Early on in the process one of the Australian groups organised for students to meet at the beach one morning and to create possible images showing survivors from Arduus Unda arriving on foreign shores. The image on the left also depicts students recreating one of the images from the Jason deCaires Taylor statues (from Figure 4). A range of other images were captured including some of one student wearing a white dress. The images and a video from this photo shoot were uploaded to the water museum. These images stimulated a number of responses from other groups, with the Greek students then wanting to explore their own beach location and possible narrative frames. In their case they created a series of images for the inhabitants of Arduus Unda, recreating the

moments before impact of a major tidal wave. They also decided to dress one of their members in a white dress (see image below right in Figure 5).

Figure 5. Example of how pre-text material 'rolled', was used and extended upon by different participant groups.



The creation of these aesthetic artifacts and resources occurred across the process, and these were complemented by locating and making other resources that served a more traditional information-sharing purpose. A number of appropriate websites and resources were used that unpacked issues around global water issues and these were shared through a resources page set up on the project website. A PowerPoint presentation was also created that identified relevant facts and examples about water with the title 'Water – Things to think about'. This presentation was uploaded to slideshare (<http://www.slideshare.net/TreeMappa/water-21205885>) and also embedded on the website so teachers could use it with their groups at the appropriate time in their process. It is once again worth noting that this resource has since been accessed by many other people and at the time of writing had received over 600 views.

A final key resource to be used in the process was one selected from YouTube and this played an important role in connecting the students to the reality of the issues in the contemporary world. To help students understand how pressing water-related issues are for some cultures, mid-way through the project students were introduced to an existing video entitled 'There once was an island', a video clip about the residents of the Pacific island nation of Tuvalu (<https://www.youtube.com/watch?v=HIFVJBZfsBY>). This video, combined with classroom activities based on sharing one bucket of water within their fictional family group, highlighted the real and immediate impacts of rising sea levels, fresh water scarcity and related implications around the loss of home and culture. These experiences brought home to students the idea that water is a precious resource and helped raise empathy for the individual and social challenges confronting communities.

The planning and implementation confirmed the ongoing relevance of many of Heathcote's strategies and advice about designing meaningful learning experiences that utilise the rolling

role concept. The important role of ‘high selectivity’ required for the selection of learning resources was confirmed in every phase of the work. The aesthetic power of Jason deCaires Taylor’s pre-text, music selected and the incorporation of evocative artifacts, tools and documents motivated the participants’ imagination and enabled them to engage and build commitment to the drama. The creation of context-specific resources and materials was also confirmed, with some of these focusing more on the aesthetic and engagement features and others more on information and education.

As the project developed and the content ‘rolled’ it can be said that certain components of the ‘open’ text became filled in and completed, and to a large degree became ‘closed’. There were still some variations to be found in the created history and narratives about Arduus Unda, but there were certain components that had to remain constant to enable participants to develop an understanding of what might have happened. This is an important point to note, in that the open text opens up possibilities, but then at some point will generally result in a more complete and closed version of the text.

From the two models and projects discussed there are some common features that can be identified that respond to the research question raised in this article. These features and principles include:

- The creation of a central initiating context and concept that opens up possibilities for different responses and text creation;
- The importance of finding or creating aesthetically-engaging pre-text materials that will hook students in;
- The development of a central issue or problem that can be approached through multiple related contexts (and possibly subject areas);
- The important role of the teacher/facilitator exercising high selectivity in finding and creating learning resources and processes;
- Processes and ongoing resource development being responsive to participant contributions and publishing;
- The value of using online spaces and tools for facilitating resource sharing and interactive processes between different participants and groups.

Conclusions

It is clear that the revolutionary changes occurring within education and beyond are creating new challenges regarding the concept of textbooks and educational media. Their purpose and form have been destabilised as the quantity of information that is freely available and accessible explodes. The closed nature of textbooks is also destabilised as expectations about interaction, experience and co-configuration become increasingly important. In this environment it may be useful for teachers and educational media creators to explore the potential for creating ‘open’ texts, carefully constructed pre-texts and interactive learning processes. The design of the learning journey draws on skills of selectivity and creativity, and then processes that involve customisation and co-construction. The creation and use of pre-texts can provide the framework for engaging students in interactive processes whereby they might themselves generate the texts that may subsequently be used by others. The Rolling Role model can further expand the opportunities for text creation and create a platform for wider collaboration and creative engagement.

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APPENDIX A

TreeMappa Custodians – Tree Profile



Tree or trees:

Location:

Nominees:

Why is this tree significant?

What are the botanical features of this tree?

What stories can be told about or by this tree?

Image/s

APPENDIX B

TreeMappa Custodians – Tree Profile (Example)

Tree or trees: The Burial Tree, Tewanin

Location: To the north, west of the council offices at Tewanin

Why is this tree significant? The original fig tree is believed to have been an Aboriginal burial tree. It has been reported that the bodies of some Aboriginal children were wrapped in tea-tree bark and buried between the roots of the tree. The original tree was apparently over 600 years old. When the tree died back, concrete supporting was created to try and support the tree, and a new white fig tree was planted to grow up and around the old one.

What are the botanical features of this tree?

It is a white fig.

What stories can be told about or by this tree?

One story about the tree is that early in the 20th century some local people were removing the bodies and trying to sell them.

Image/s



Textbooks and curiosity for science

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Abstract

In opposition to the current disenchantment of students with schooling, this paper proposes an arousal and necessary renewal of curiosity, through problematic or motivating situations, to maintain the interest for knowledge. What is at stake, for textbooks and schools, is to develop activities where students can do more than confine themselves to receiving information and, conversely, to challenge them to use their mental abilities to solve problematic situations, thus arousing their curiosity for scientific knowledge. Despite some innovative official curriculum guidelines, which come from current theories, and their assumptions about the authorship of textbooks, the research of our team concluded that, in the most widely-used textbooks in Portuguese schools currently, the activities are limited in general to repeating information contained in the preceding pages, asking about easy relations between concepts previously described or suggesting experiments whose outcomes are easily induced. Supported by adequate theoretical frameworks, we propose a new structure for the organisation of textbooks (or of e-books) and describe some exemplary educational situations, collected from textbooks, challenging the curiosity of learners.

Keywords: textbooks and e-textbooks, curiosity for knowledge, problematic situations, active learning.

What I cannot create, I do not understand

The student should be able to intervene in problematic situations,
imagine the way he needs to a solution¹

Michel Fabre

The current research shows a disenchantment on behalf girls and boys with schools and indiscipline, both phenomena that some authors associate with expository, verbal, demotivating ways of teaching, prevalent in schools (Fabre 2008, Amado & Freire 2002, 2009, Souto-González 1998). We can postulate from this research and from our own observations (Duarte 2005, 1999) that boredom is perhaps an important cause of dropouts in French, Portuguese and Spanish high schools, and therefore teaching absolutely needs to change. Can schools organise activities arousing the interest and participation of young people? Might textbooks, which are a repository of practices (Astolfi 1995) but also a guiding

¹ My translation.

instrument of pedagogic action (Hummel 1988, Apple 2002, Gerard & Roegiers 2003), contribute to a 'new' school? These issues have been discussed by our team of researchers for the past six years, through the analysis of the activities included in the most widely-used textbooks in Portuguese secondary schools. In other words, to change the verbal methodology still prevalent in our schools, the debate over student activities proposed by textbooks seems fundamental to us. As postulated by Fabre (1999) "it is by doing that we learn" (98), or, in the native French discourse of the author: "c'est en agissant qu'on apprend".

Or, as the physicist Richard Feynman proposed "What I cannot create, I do not understand" (quoted in Santos 1991, 9). That means that it is important to discuss and to solve problems, even those that have been already solved by other people, in opposition to rote memorisation, emphasising form over understanding (Feynman 1999). He added that what is important for students is what they are learning by observation and by the problems coming from it, in order to explain the situation in their 'own words', instead of being exposed too soon to concepts. He exemplified this idea with a textbook for the first grade which compared the movement of a real dog and that of a wind-up dog toy. The textbook asked what makes them move and the answer was: 'energy'. Instead of mentioning this concept, which is difficult for children to understand, as energy is "a very subtle concept (...) very difficult to get right" (116), as the textbook does, Feynman proposes showing how the toy works inside, by opening it. Briefly, curiosity and interest go side by side with creativity.

Concerning textbooks, we believe that chapters or themes should begin with problematic situations or, more generally, by motivating situations, i.e., situations enhancing the curiosity of girls and boys to acquire knowledge. This approach would surely influence the start and mood of classes, considering the influence of textbooks on teaching, as proposed above. We refer here to the idea of motivation by curiosity, in the wake of Berlyne's concept of 'epistemic curiosity', adopted by Fleming and Levie (1993), which is accomplished when there is a discrepancy between a stimulating situation and a given person's existing knowledge: "when epistemic curiosity is aroused, a person is motivated to seek more information to resolve incongruity" (3).

Here, we are concerned with the concept of 'problematic situations' where students can do more than confine themselves to receiving information about the facts, i.e., being called to act and building their knowledge in a more demanding way, one of discovery or creativity. Fabre points out, rightly, that there should be, "an emphasis on the problem and not the theorem, on the invention more than on what is found" (1999, 87) and, in the wake of Vygotsky, he proposes:

the student should be able to intervene in problematic situations, imagine the way he needs to a solution (...) the problem must remain in the zone of proximal development of the student, neither too close nor too far from what they already know. (90)

The knowledge of the students is usually insufficient to immediately solve the problem. This reflects the characteristics of a real problem. (90)

All authors insist on three dimensions to the problem situation: to enable students to invest their previous knowledge, make them aware of the inadequacy of this knowledge, and help them to build new procedures. (92)

In short, the mobilisation of prior knowledge, the confrontation with new applications of this knowledge and its reconstruction result from the challenge posed by problematic situations. But if other authors define ‘competence’ (a concept we reanalyse further down) as the capacity to mobilise knowledge for a “series of situations” (Perrenoud 1999) or for “new situations” (Gerard & Roegiers 2003), Fabre (1999) explicitly states that “students’ (prior) knowledge should be insufficient to resolve the problem immediately” (92). In other words, the problematic situation should include innovative aspects that require young people to reflect and seek information. This is the ‘epistemic curiosity’ mentioned above.

Our research team tried to assess how, and to what extent, Portuguese textbooks privilege the expositive function or, conversely, make it interact with problematic or motivating situations in *new dynamics of learning*, as is, in fact, usually proposed in the forewords of recent textbooks. The active learning process or the students’ activities determined by a given textbook cannot be analysed without considering other dimensions: content, language, methodological approaches, format (Hummel 1988, Richaudeau 1986). These dimensions are considered in our inquiry, but the *activities* required of students seem to be a mirror of the whole textbook and they are the core of our research. To this end, and following the approach of the authors already mentioned, we conceived a matrix of categories to analyse the activities proposed to students in the most popular textbooks adopted for use in our country in the first decade of the twenty-first century.

The categories of analysis

The discussion on new learning dynamics spurred on by official propositions and by specialised literature on evaluation and certification of textbooks led to our research question:

Given the more traditional educational practice tending to submit students to a passive posture, and given the influence of textbooks on teaching, will school textbooks (as well as e-textbooks) promote new dynamics in class or an active learning process, including the resolution of problematic situations and other motivating situations?

We recall, from the above reflections, that active learning depends on problematic situations or, more generally, on situations motivated by curiosity. In other words, as Hummel states (1988): “The textbook involves the pupil in an active learning process, and does not confine itself to the transmission of facts. It teaches therefore through guided discovery” (119), and he concludes: “Questions interrupt descriptive texts – thereby stimulating ongoing discussions rather than being placed at the end of the chapter. Problems are raised and the pupil is incited to think critically rather than simply to memorise facts, thus fostering problem-solving skills” (119).

So, as curiosity is the desire to learn what is unknown, or the unconformity between what the student knows and what he wants to know (Loewenstein 1994), it can be explored to maintain students’ interest for learning. Thus, a textbook must present information, of course, but also connect it with frequent questions and problematic situations to develop a curiosity for knowledge. Therefore, in textbooks, curiosity and problematic situations can support a continuous process of interest for knowledge and critical thinking, so that a “pupil can interpret the world where he lives” (Hummel 1988, 23). Briefly, problematic experiences not only bring perplexity, but they become essential conditions to develop “hunger” for science

and critical thinking, in contrast to the current disenchanted processes of learning that exist in most schools.

Our team of researchers from five different institutions analysed the most highly-used textbooks for history, language, geography, biology, physics and mathematics in the 7th and 10th grades. For the analysis, we borrowed from the theoretical frameworks mentioned above, particularly from Gerard and Roegiers, Hummel, Fabre's typology of problem-situations (1999, 225) and from classical taxonomies such as those of Bloom and Gagné, to construct a typology of the activities to be used in the analysis of those textbooks. We endeavoured to establish a scale which delineated simple activities (categories 1 and 2) up to more complex ones (categories 3 and 4). In the style of classical taxonomies, the first categories relate to factual or procedural knowledge and the higher ones to evaluating/creative levels. We propose in this paper that learning should be based in the last three categories of our typology in order to assure the understanding of concepts by students and not only factual remembering. The categories, in order, are as follows:

1. *Memorisation and/or transposition of concepts*;
2. *Exploration of documents* (interpretation of sentences, of charts, of diagrams, and exercises on a model presented, or preferably imagined, by students);
3. *Reformulation* (personal definition of concepts, production of abstracts, of paraphrases);
4. *Problematic situations* (corresponding to challenging activities/projects/ critical reflection).

Some rare exemplary findings in current textbooks

Some official curriculum guidelines on active learning or learning by problematic situations are adopted by authors of textbooks, as we said. And of course, in some cases, some theoretical principles, quoted from prestigious pedagogical writers, are also paraphrased at the beginning of textbooks. But our team of investigators found, after examining the contents, that the activities proposed in currently used 7th and 10th grade textbooks are not very different from those included in the preceding traditional textbooks. In fact, the issues discussed in the textbooks in question are generally limited to proposing a repetition of the information contained on the preceding pages, formulating relations between two concepts previously presented or to suggesting experiments whose outcome is easily produced. Let us exemplify one case in a 7th grade history textbook which corresponds to a category 1 activity ('Memorisation and/or transposition'): "What civilisation are you studying in this unit?". And for category 2 ('Exploration of documents'): "Mention some features of the Roman economy from the document above".

In short, these activities seem situated in *elementary levels* of common taxonomies. On the other hand, if textbooks underline the authors' concern about "competencies", with an emphasis on a very important one, the "capacity for research" to be developed in students, the most frequent and concrete proposal observed in the textbooks analysed was for students to conduct research of information on the Internet, without any methodological guidance. On rare occasions, problems situated in the 4th level of our categorisation, described above, also appeared in the textbooks analysed. Let us look at one case, from a 7th grade history textbook,

in which a category 3 task is given ('Reformulation'): "Define the concepts of democracy and direct democracy". And we also would like to emphasise this interesting activity, that we assigned as an example of a category 4 task ('Problematic situations'), involving discovery: "Research the differences between the current Portuguese regime and the one of classical Athens".

For the 10th grade, we present two problematic situations (4th category) that will contribute to the reflection of readers. In a geography textbook we found one example: "Suggest measures that can be taken on a daily basis, taking into account the structure of water consumption presented in the attached table, to rationalise its consumption at home and at school". We also present an activity that we classed as category 4 in a physics textbook: "Design a fun slide for the children, which allows them to slide easily, but also produces a lowering in the speed value at the end". In this activity, we note an interesting reflection on concepts of movement, forces and the effects they produce, as well as considerations about energy. This will motivate students by presenting them with a problematic situation concerning concepts about energy (potential energy, kinetic energy) instead of the traditional exercises involving only memorised settings.

How to transform traditional exercises into challenging situations

Now, let us describe in detail a case in a mathematics textbook and other situations in language and history textbooks, where we attempt to exemplify what could be done to enhance students' curiosity for knowledge.

To calculate the width of a river... but without wetting our feet

It seems a 'problem' to inspire young people... We found this problem in an 8th grade textbook (but not including the direct challenge of not wetting one's feet...), amid a host of other similar problems. The problem seemed more complicated than others included afterwards, for example, asking to calculate the height of a tree trunk, whose shadow measured 2 metres, compared with the height of a broomstick 1.20 high, whose shadow measures 0.40 m (see Figure 1).

Figure 1.

Tree trunk

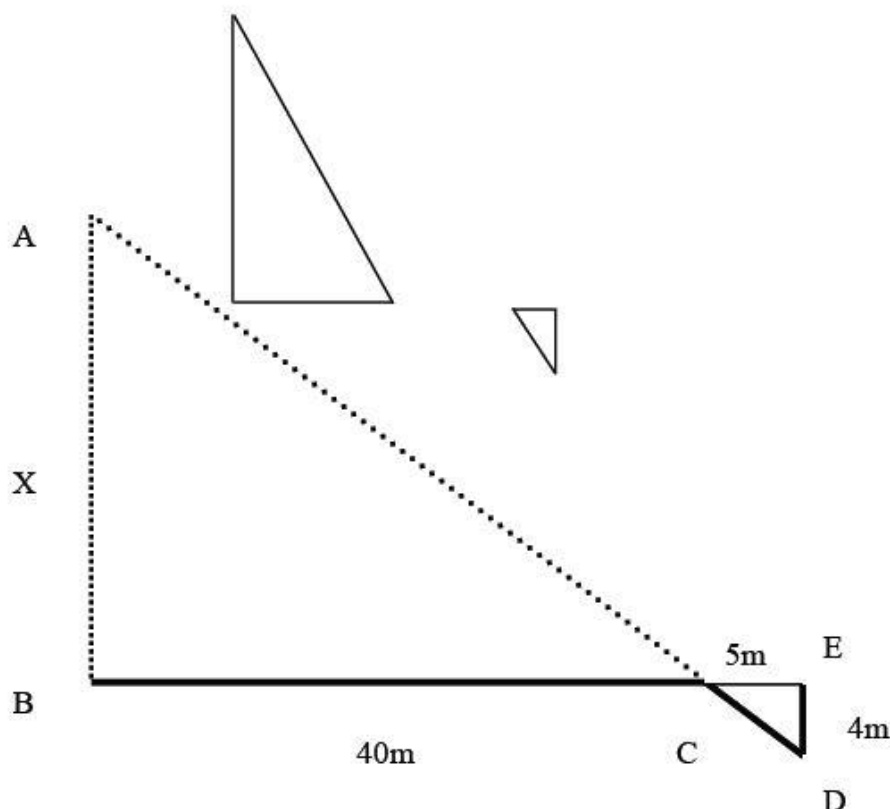


We stress that, in the preceding pages, the textbook presents the various "cases of similar triangles" (proportionality of two sides and equality of the angle formed by them; proportionality of the three sides of these triangles; two equal angles). This order of presentation is indeed observed in the current pedagogy of our high schools: *firstly, the*

theory and then the application exercises. But what is happening here is that, instead of this expository mode, the problematic situation seems interesting because it invites us to find out the height of a tree... without having to climb it. Then it will be essential for a given textbook to make students realise that the shadow of the tree trunk increases more rapidly than the shadow of the stick and that this increase is proportionate to their sizes. We accept that this discussion will lead the students to find the height of the tree trunk through a simple rule of three. Thus, if the shadow of the stick is 0.40 m long, the broom is 1.20 high and the shadow of the tree is two metres long; students would calculate the height of the tree as 6 metres. Facing these two equal angles formed by proportional sides, the textbook could conclude that it is a case of “similar triangles” from the curricula of mathematics: in this case it is a right angle but it could be a case of an acute or obtuse angle. This situation shows that the concept of “similar triangles” can be reached by solving a problematic situation drawn from everyday observation.

Let us now consider the interesting challenge of trying to measure the width of a river... without wetting one's feet. It is a more difficult situation, as we said, and it should come after the tree problem (which is not the case in the textbook analysed). Otherwise, after the problem of the tree, the textbooks should invite students to remember that the two triangles, imagined for the tree and the broomstick but in a reversed position, are “similar” too, as follows in the sketch of the river (see Figure 2).

Figure 2.



The scheme reproduces a situation, where X equals the width of the river, which constitutes the unknown datum. So, the smaller right triangle, drawn near to the river, includes the extent of two sides, while the larger triangle indicates only the extent of a side as the other side represents the width of the river, the datum to be discovered. Here too, the consideration of a

direct proportionality should lead students to find the solution through a simple rule of three, without knowing in detail the theoretical information of the previous pages about the cases of “similar triangles”. And all of this would be more accessible if the problem of calculating the height of the tree were to precede this one of the width of river.

In short, the possibility of *transferring knowledge* to new situations is the core of the concept of *competence* (as it is accented by Fabre 1999, Perrenoud 1999 or Gerard & Roegiers 2003). Finally, we note that, in both cases, two triangles are considered “similar” by having proportional sides and an equal angle formed by these two sides. As a detail, on reflecting on the problems of language, the term “congruent triangles” is common in some countries instead of “similar triangles”.

My question is: is the triangle formed by the tree, its shadow and its trunk “similar” to the one formed by the broom, its shadow and its hypotenuse? Is the first one not “bigger” than the other? Would it not be more adequate to call them “proportionate”? At least, the term “congruence”, used in some countries, seems more appropriate as synonymous of that harmonious relationship between two objects.

What this “experience” with a textbook shows us (and we imagine that this may happen with students) is that learning should be based on curiosity and intuition in terms of learning key moments, related to the method commonly known as “discovery” or “critical model”, described by Arends (2008). But, from these moments, textbooks and teachers can lead students to concepts contained in the curriculum (such as triangles which can be “similar” or “congruent” or “proportional”). Shouldn’t the development of a given class begin with the observation of real-life problems and introduce mathematical concepts later on, for instance, the ones of other subjects, in a motivating fashion? At the least, these moments should happen often, so as to trigger students’ curiosity. As we saw in the mathematics textbook analysed, these problems appear after all the theorising on “the cases of similarity” of triangles. And, in fact, the first situation included is the famous problem where Thales of Miletus, at the request of a pharaoh, calculates the height of a pyramid, a problem seeming more complicated and less directly motivating than to discover the height of a tree... without having to climb it.

A cautionary note was presented by a college professor of mathematics after examining this paper. She stated that it is interesting, especially at certain ages, to arouse curiosity with simple problems, in order to lead to abstract ideas, thus built from daily life observations, in a procedure which should be an impetus to work the concepts included into the syllabi. In other words, as Astolfi (1995) proposes, verbal exposition of concepts is ineffective if it is exclusive: “If at times it is good to experiment with the way knowledge is prepared and transformed, this will give even more meaning to other times when knowledge is presented as something completely finished” (130).

Challenging situations in a history textbook

Traditional history textbooks and teachers tend to present historical facts in a logical sequence and in classroom oral interventions or written exercises students try to remember those facts as indisputable “things”, thus accomplishing activities situated in elementary levels of taxonomies. *Can a history textbook lead students to interpret sources and propose their personal vision of history and debate it with their fellow students and their teacher? That's what a 10th grade history textbook tries to do but in a way that is not completely*

*different from tradition, as follows. Discussing the controversy over heliocentrism in the 16th century, this textbook presents a picture of Copernicus and suggests how he resisted publishing his views and delayed publication of his book, for fear of criticism, expressed in some sentences quoted from the dedication to Pope Paul III from *On the Revolutions of the Heavenly Spheres*.*

On the same page, the textbook presents some sentences from the abjuration of Galileo before the inquisitor in 1633 when Galileo maintained that for many years he had faithfully kept his promise not to hold any of his prior ideas about heliocentrism. In the booklet for teachers, the authors propose that the objective of doing so is to *allow students to formulate their own interpretation of history by analysing sources adopting different perspectives and so developing their critical competences. To do so, the authors add some questions also, the first one asking what students can find “in common” in the two situations. The second one asks them whether they find nowadays the same attitude towards science. If the second item is an open question allowing to develop critical thinking, the first one seems directive. Instead of this question, an alternative should be included, for instance, by asking what is similar or different in the two situations. But, let us conclude that the way of studying history adopted by this textbook seems promising for a time when knowledge must be, not to receive highlights from books or teachers, but to debate/argue on different perspectives about problems.*

Challenging situations in a language textbook

One language textbook presents some pages from the first and last chapter of a given novel as the first text for the students to read. All of the pages concern the family at the core of the novel, which is situated at the end of nineteenth century. After this, it asks the students to explain, using these pages, the decline of this family. This procedure seems the opposite of a strategy aiming to trigger the interest of the students, since it “gives” them the global sense of the novel. What enhances youngsters to read is uncertainty and a curiosity to solve something, to find out what can be accomplished by obtaining more information and, so, they continue to read.

My proposition for arousing curiosity and maintaining the interest of youngsters in reading a book is to present them with some problematic situations from the beginning of the book and some from the middle. In the case of the novel above, about a declining family, a discussion, in the first chapter, we find a young man talking to his father about his proposed marriage. His father tells him he knows that the father of the bride-to-be is a slave dealer and refuses to give his permission to a marriage which would bring shame to the family. The young man gets furious and leaves the dining-room where his father was having dinner. The father orders the waiter to remove the second plate on the table, declaring that, from then on, one single plate would be placed on that table. A strategy of curiosity would ask students to debate this situation and to imagine the possible future events coming from this opposition between the two characters.

A second situation is to ask how a given character of the novel, who is a medical doctor, discovered his interest for medicine, starting from his childhood. A third situation, placed well in the middle of the novel, would be to ask students how a prostitute influenced the lifestyle of this doctor.

Back to theory

Many studies in Europe conclude that most of the textbooks in use confine students to an expository way of learning about concepts and facts in activities of a low taxonomic order (e.g. Sacristan 2009, Graf 2009). European projects on textbooks (MANES, in Spain; ECKERT, in Germany; EMMANUELLE and Journées PIERRE GUIBERT, France) focus on historical and sociological questions related to a European process of integration. Without forgetting that ineluctable line of research and also engaging it, research is needed to focus on curiosity for knowledge and critical thinking, i.e., didactic issues of a higher taxonomy level in textbooks and other educational media. In order to achieve that objective, we are trying to develop, in a more comprehensive and profound way, our ‘4th category’ of analysis of textbooks and educational media, proposed by our previous project and described in the previous sections of this paper.

To this aim, let us quote a pioneer of the development of critical thinking and curiosity in learners, Dewey (1916, 1944), who argues: “The essentials of method are identical with essentials of reflection. They are first that the pupil has a genuine situation of experience – that there be a continuous activity in which he is interested for his own sake” (163). Otherwise Pingel (2010) recalls UNESCO’s textbooks strategy, proposing: “the change of paradigm from knowledge-based education to outcome-oriented learning stresses skills and competencies rather than rote learning and memorisation of facts” (78). This author concludes that:

Under these methodological premises the content no longer stands alone; it has to serve certain aims such as developing critical thinking, discussing different value judgments, writing an essay, building up an understanding of time and space and developing a sense for taking over responsibility in the community. Therefore, the delivery of content should match with the training of skills. (78)

For textbooks, Gerard and Roegiers propose that, if their first function is the transmission of knowledge, the second one is the development of capacities and competencies (2003, 84). And they recognise the problematic situation as a pertinent way of developing competencies, particularly at the beginning of a learning process, by allowing to “explore and to mobilise different knowledge and practice” (68). Since 2001, official Portuguese guidelines have recommended the perspective of problematic situations producing “competencies” and proposed, in fact, general and specific competencies for each subject. But there is controversy in the French and Portuguese pedagogic literature on the concept of *competency*. As Crahay (2006) says, it is too simple a notion, since it doesn’t give teachers the chance to distinguish notions related to knowledge, practice, attitudes, capacities and operative schemas.

This controversy can be bypassed by establishing how to articulate competencies with the numerous cognitive dimensions of learning (concepts, skills, attitudes, values). But it seems very difficult – and perhaps insane – to provide concrete lists of competencies for each subject. Nevertheless, ‘competence’ or ‘competency’ seems a “concrete” concept for “basic domains”, e.g., of reading, writing, counting, analysing and summarising general texts on the one hand, and, on the other hand, a “potential” concept for the transferring of those cognitive resources (concepts, skills, attitudes) to new situations, as we described in some examples earlier.

Briefly, as we stated at the beginning of this paper, *curiosity* is the desire to learn what is unknown; therefore, it can be explored by textbooks and other materials to maintain *interest*

for learning. Those materials must present information, but connected with frequent questions and problematic situations to develop curiosity for knowledge, in a reflective and complex process where students infer unknown ideas from what is presented. A textbook can be analysed for the different qualities already quoted: content, language, methodological approaches, format (Hummel 1988, Richaudeau 1986). Assuming these qualities, and supported by Dewey (1916), Hummel (1988), Fisher (2001) and Graf (2009), we have formulated the following set of criteria on how to foster an active learning process in educational materials. It is a further development of our 4th category, designed to deepen our future research on textbooks or *e-textbooks* and as a proposal for other researchers:

- Problematic situations at the beginning or in middle of thematic expositions, some of them reproducing debates over dated scientific “discoveries”;
- Different sources of information, from within or outside of the school context;
- Proposal of individual or group activities, enhancing interactive and learning-by-doing processes;
- Proposal of ways to test the ideas in question, by confronting them with other ideas or situations;
- Clear presentation of concepts, assumptions, arguments and inferences to promote access to content and to develop these skills in learners;
- Opportunity to write reports in an argumentative way;
- Project works grounded in real-life problems/situations from a given time (to be elaborated in a period of time).

Conclusions: textbook or e-book, a companion of the young learner?

Giordan (1998) rightly proposes that a textbook “can become a formidable instrument of self-instruction and a reference book, in a time where students feel lost on facing the variety of information from different resources and looking for books in order to find what is essential in a general perspective” (240). Textbooks, then and the newly emergent e-textbooks can somehow become a companion for students. Gerard and Roegiers (2003) remind us that the boys and girls of today, the main users of textbooks, are not the same as they were a few years ago, showered with image settings, where the use of computers and other media is made in the logic of ‘discovery’. So, this logic should be assumed by teachers and textbooks.

However, this situation cannot be seen as granted. Some writers emphasise the importance of new learning resources and conclude that today’s *e-textbooks* tend to be developed from platforms showing digitised versions of printed books at one end of the scale, to tools maintaining vastly interactive and multimedia experiences (Roskos, Burstein & Brueck 2011). But empirical studies on *e-books* and digital educational media as curricular tools are still rare. And what is at stake is whether that ‘discovery’ coming from current digital media means learning. As Arno Reints asked in his keynote address at the 12th IARTEM Conference in Ostrava, 2013: “How can screens be designed in such a way that learners are willing to *study* these texts and not only to *scan* them?” (Reints, this volume). Quoting some recent studies, Reints suggested that the current “decorative tendency in these media will hamper

learning”, an assertion confirmed by other writers, for instance, Kashdan, Rose and Fincham (2004), who, revisiting Berlyne's concept of epistemic curiosity, proposed two types of exploratory tendencies in the properties of curiosity: “(a) diversive curiosity—actively seeking out varied sources of novelty and challenge and (b) specific curiosity—actively seeking depth in one’s knowledge and experience with a particular stimulus or activity” (291). In this sense, ‘diversive curiosity’ fosters multiple contacts with new stimuli and opportunities, but ‘specific curiosity’ is activated by those stimuli with “inherent uncertainty and complexity that can be further enjoyed by obtaining more information” (291). The paper quotes Csikszentmihaly (1990) who comparing specific curiosity to a ‘flow’ as people experience clear and immediate goals, maintaining deeply focused concentration and feeling a strong sense of personal control, where individuals devote increasingly more attention to complex behaviour. Briefly, in true didactic situations, *self-regulation* to actively seek depth in knowledge is essential to curiosity.

So, some questions come to our mind: as digital resources lead to online connectivity, including that between learners and teachers, how is digital technology influencing the process of teaching-learning? Is it influencing learning as a behaviour of self-regulation to deepen a particular cue or as a diversion, turning learners’ attention away from curricular concepts? And – moving towards a democratic society by a participative and inclusive school – can these resources be useful by a differentiated pedagogy responding to different profiles of students including those with special needs? Reints (this volume) suggested that “digital textbooks can try to *adapt* the difficulty of exercises to the level of the pupils and to their learning styles”. But he also said that at the current time all of these new media “are not primarily developed to learn from”. This is why this very important line of research presents an interesting challenge to educational researchers.

In conclusion, our proposal is that a pedagogy of ‘epistemic curiosity’ will bring to our schools a different atmosphere of work and organisation – away from the current boredom and growing indiscipline. By the way, we recall that “discipline comes naturally from the organisation of work in the classroom”, as Freinet (1973, 23) proposes. Therefore, problematic situations at the beginning and in the middle of chapters of textbooks, of course influencing, as usually textbooks do, the beginning and middle of lessons, will bring to schools an atmosphere of curiosity, work and discovery. In other words ‘new’ textbooks or their emerging brothers, e-textbooks and other digital media, can be a fundamental resource to enhance the (re-)enchantment of girls and boys in schools.

A last brief challenge to readers who, as I imagine, are mostly researchers: look at the exercises at the end of chapters of textbooks and try to move some of them to the beginning or to the middle of chapters, as exemplified in this paper. To do that, follow the proposition of Fabre (1999), already quoted, about problematic situations: “the knowledge of the students is usually insufficient to immediately solve the problem. This reflects the characteristics of a real problem” (90). So students must reflect on problems and *research information* to solve them, helped by textbooks and teachers. That would be a new paradigm for textbooks... which will influence schools – where epistemic active curiosity or hunger for science, versus boredom, is absolutely necessary.

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