Differences in e-learning material production according to the learners' age and comprehension level

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Abstract. *E-learning materials production requires thorough planning and design. In traditional approach teacher is in front of the learners and he changes the learning process dynamically according to the mood in the classroom. The process of e-learning does not give immediate feedback to the teachers and can be frustrating for the teachers and students alike. Therefore e-learning materials need to be prepared differently as learning materials for the lectures. On the other hand it is mandatory to know the prior level of experience of learners and also their age. Good learning material for university students is suitable for the high-school students and is totally useless for the primary schools. There are some commons that should be applied to all e-learning materials and some specifics that make e-learning materials useful. In our article we will present the analysis of the learning materials we have prepared for primary schools, secondary schools and university students. Presentation of the commons and the specifics that was detected; taken into account; and verified in our e-learning materials is going to be the goal of our article.*

Keywords. e-learning, production, comprehension level

1 Introduction

Our faculty was to prepare the e-learning material for environmental studies for primary and secondary schools. We also have the experiences with the preparation of learning materials for the university level of education. Those different preferences of students and their different age were the unique constraints in the development of the e-learning materials. In this article we will present the difference between the design and development approach of preparing e-learning materials according to the student's preference and age.

In the 2007 the Government of Slovenia and ESF (European Social Funds) prepare the public tender for e-learning materials production projects. Due to external reasons the project was very short.

Projects goals were to develop e-learning materials for environmental nature studies. It covers the learning material for the third year of primary school (8 to 9 year old) and elective subject in secondary school (14 to 17 years old). In the third year of primary school we need to pay additional attention to the text [13]. Pupils are unable to read large amount of text. Everything needs to be simple, evident, fun, exciting, nice, didactically suitable, and must encourage the research spirit in the pupils [10, 14]. This approach is not suitable for the secondary school students. They regard them-

selves as grown up and such approach would seem to them as childish.

We have pretty good overview of what kind of ICT equipment is used in the schools. Therefore we need to prepare the e-learning materials according to the limitations of average school's computer and internet access. There are also some environments that use Linux instead of Windows and in some environment we see the growth of Apple computers. Despite the fact that most of schools use Microsoft Windows we discover that Internet Explorer is not used as default browser on all of them. Close to 40% of the users use Firefox web browser which is not entirely compatible with the Microsoft IE. Therefore it is not suitable to use Microsoft specific multimedia distribution system. Other options were classic HTML with JavaScript or Flash. Even according to the research on web for the good practice projects the Flash was therefore our favorite [5]. It is portable and packed into one file. It works even if we have problems with SCORM packages and it also has some disadvantages. The file may grow if multimedia materials are included into the flash video. Time to transmit is much longer then acceptable 8 second [2, 1]. Problem with the Flash player upgrade can render Flash video unplayable and waste all our effort. The decision was not easy but we decide to choose Flash anyway.

1.1 Team members

We start the project with the developers - didactics specialists of the learning material. Didactic specialists from the area of biology, chemistry, physics, geography and technology started on the projects preparing the scenarios. After the scenarios were over the design of screens begin and all the preparation instructions for the multimedia and interactive elements starts [3].

For the preparation of the third year primary schools materials didactics specialists prepare the materials in the PowerPoint and then we prepare the Flash according to their presentations.

Preparation of the secondary schools learning materials were bit different. We need to prepare the web textbook; interactive waterways according to the existing learning waterways used in field education; and preparation of learning materials for healthy living.

2 Learning material preparation

2.1 Preparing learning material for third grade primary schools

Topics that we need to cover were the following:

- Who we are and what we are doing
- Me and you
- Where we live
- Our country
- Celebrations
- Once upon the time
- Me and the nature
- Me and health
- Human and nature
- Illnesses
- Protection against illnesses
- Changing of matters
- Air
- Movement
- Light
- Sky
- Weather
- Sound
- Time
- Looking around
- Traffic
- Transmission of data in information
- Data saving
- Press
- Objects and their parts

Learning materials consist of different types: text, images, graphs, tables, sound and video. Those materials are different in the complexity. Easiest of them is the text. But we must not forget that third grade primary school students (8 to 9 year old) are not good readers. Text must be prepared simple, easy to read and in small amount. In some cases this is a trivial process but this is not always true. No matter how we change the text we could not write them small and simple. Therefore we have to help children to read and understand the text despite its volume. We decide to read the text; record it and give children a choice to listen the recorded text on demand. One positive side effect of this approach is that children learn to read too.

Taking photographs are relative simple but in the implementation phase this usually takes more time. There are certain conditions where taking a picture is not trivial.

Drawings are much more demanding (see Fig 1). Not everyone has the drawing skills and it is sometimes hard to explain to the painter what should be on the drawings. The post processing of the drawing is also different. Changing colors and setting the transparent colors can be very tricky on aliasing pictures. On the other hand the custom made drawing as signs enables students to better see the whole picture [8]. Therefore we pick the two birds to guide us through the material and a set of arrows for navigation.

Figure 1: Drawings in the e-learning materials

Graphs and tables are simple (see Fig 2). Really anyone with the basic skills in Excel and Word can do graphs and tables. Problems sometimes arise with the experimenting on the graphs. A bit of traditionalism is good in graphs.

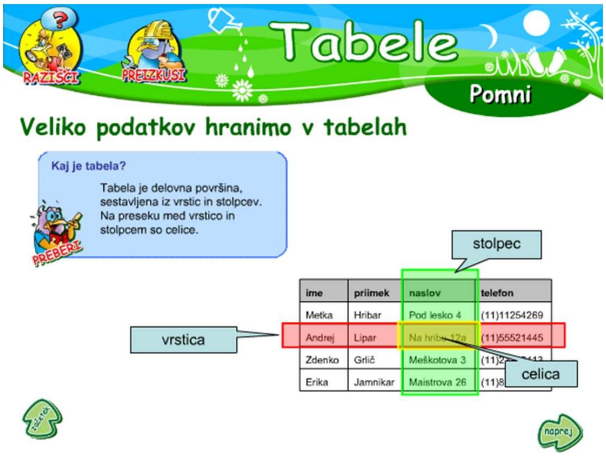

Figure 2: Tables in the e-learning materials

Sound is complex. It is true that anyone can speak but only a speaker with the right voice is needed in the production of high quality e-learning materials. To prepare the voice recording the text must be written and an audio studio is needed. In our case this was very complex problem. All the text has to be equal to the voice and no changes were permitted even if we discovered that something can be written better.

Video is complex (see Fig 3). We could not afford to hire professionals and each of the authors of the learning materials made its own video. They got equipment - cameras and training how to use them. The raw video was just a beginning. Processing the video means cutting, synchronizing, combining, making titles, music background etc. It is quite a problem if you get the wide movie (9:16) and you have to combine it with the normal one (3:4).

2.2 Preparing learning material for secondary schools

For the secondary school the topics were the following:

- Let's visit the creek
- Waterway Dobrava

Figure 3: Video in the e-learning materials

Figure 4: Web textbook

- Waterway Mokoš
- Waterway Selo
- Ecoremediation waterway Mala Krka
- Preserving environment and health

As previously mentioned the "Let's visit the creek" is the web textbook and consist of 12 topics and in the paper presentation it would be around 100 A4 pages (see Fig 4 and 5).

Preserving environment and health was also prepared as interactive web textbook. Inside this SCORM package we include also a FLASH game about the healthy food.

Waterways were presented as research interactive web pages. Despite the fact that much more knowledge is retained in the sequential presentation in some topics we want our students to explore the learning material. Therefore we want to maximize the effect of transfer and we did not care too much about the effect of retention [9].

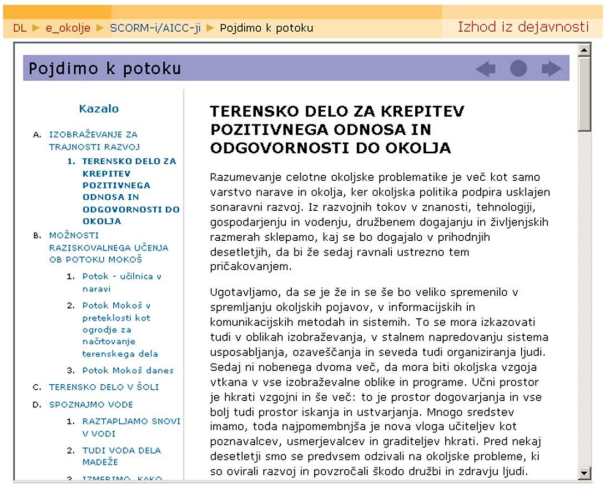

Figure 5: Different levels of web textbook

3 Technologies

3.1 Process of development

As we have two different types of students we also have two different approaches to the development of e-learning materials. For primary schools we have to prepare everything from the beginning. Team members for the primary schools were also little less skilled in the design process from the team members for the secondary school learning materials. Therefore we decide that the simplest way to produce the e-learning material for the primary school is a two steps process. First authors of e-learning material prepare PowerPoint presentation and this presentation was later used by the team of implementers to produce the Flash video.

With this in mind we decide to give free hands to the authors to prepare the materials up to their limitations and also provide the descriptions what

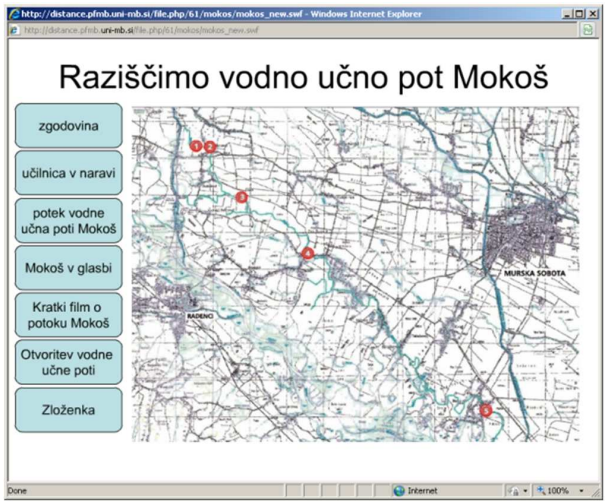

Figure 6: Interactive e-learning materials

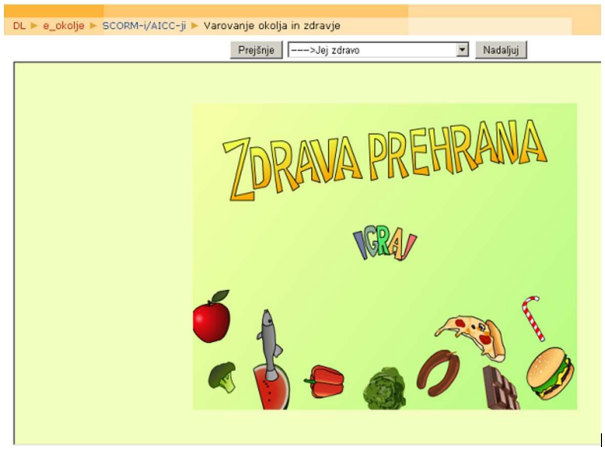

Figure 7: Flash game in the e-learning materials

should be on the slide and where should the links point. The text we receive was far beyond capabilities of PowerPoint and conversion to the Flash was not an option. In each of these topics we search the consensus how to change their desires to satisfy the objectives of e-learning materials and to be easy for implementation.

We were much more successful in the preparation of the e-learning materials for the secondary schools. Materials were prepared, most of the materials were digital and the authors know exactly what they want to do with the materials. It was also easier since we did not have to worry too much about the text constraints and students have significantly higher prior knowledge.

3.2 Software development tools

In our projects we use Flash and SCORM packages. There are different Flash development tools. Some of them know how to translate PowerPoint presentations to the Flash other are for pure Flash production. We have find out that freeware software was useless for many reasons. Producers' logotypes were always displayed on the screen and are so limited that enables only basics effects and transitions to be converted.

For the preparation of SCORM packages we wanted to find the tool that transform Word to SCORM but it was impossible to acquire the product. The vendor gives us only option to pay 3000 €for educational corporate license. Therefore we used the freeware tool "Reload packager" and transform the text to the SCORM. For the tests we use different tools: HotPotatoe, eXe and Articulate QuizMaker. For the interactive Flash pages we use the Macromedia Director.

4 Implications and results

Images, animations, sound and video are multimedia elements on the screen. Multimedia is used for better explanation or for motivation purposes. But can also be seductive details on screens with questionable results [4, 11].

Video can be incorporated into the video or streamed (Fig 3). If video is incorporated the size of the e-learning material increases and time to download too. Therefore we decided to provide hyperlink to the streaming video or sound. There were some questions about the effect of video in the learning materials but since we tested this many time and even according to other researchers the video has positive effect on learning [6, 7, 12].

As we see in the Table 1 the text for the primary school students need to be of limited size, didactically suitable and simple to understand. In the secondary schools the text can grow in size and we can increase the complexity of text. We still need to prepare text according to the didactical requirements in the secondary schools. At the university level we can use any kind of text. Only considera-

Table 1: Differences in types of learning materials according to the age of students

Type	Primary school	Secondary school	University
Text	• simple text • small amount • didactically suitable	• medium complex • didactically suitable	• complex text • non ambiguous
Pictures	• clear presentations • little background is possible • few details • indications on the picture	• with descriptions • clear presentation • indications on the picture	• with descriptions • indications on the picture
Drawings	• desired as guides • fun elements • sketches	• sketches	• sketches
Animations	• slow • controlled	• sufficiently fast • controlled	• sufficiently fast • controlled
Tables and graphs	• simple • little elements	• large • good overview	• complex • pivots
Sound	• desired • special attention to the language	• non desired unless requested	• non desired unless requested
Video	• desired • good design • clear presentations	• desired • presentation of skills	• desired • presentation of skills • analytical approach
Interactive elements	• simple to medium complex interaction	• complex interaction	• complex interaction

tion we need to take into account is that the text are understand in one way only - it is non ambiguous.

Pictures (images, photographs, snapshots) should be clear in presentation (present only what we want and nothing else). Background is distractive element we do not want in primary schools. Small kinds have problem to spot all details. Pictures also should be self explanatory for primary schools children.

Secondary school students are capable to spot details but still have problems to get the "big picture". Therefore pictures need to present mainly what we want to show them (clear presentation). We can include longer text attached to the picture.

Indifferent to the level of education we need to include the indication on the pictures. This is especially important if we have pictures with multiple details that are hard to spot. On the primary school children may miss light indicators on the car; in the secondary school a complex machinery may be used (the parts of laser printers); and at the university we see that student cannot see the borders of the domains in the liquid crystals. Therefore we include the indication on the picture. Applying the principle of interaction we enable learners to turn on and off indications on the picture.

Drawings are used for sketches in all levels of education. In primary school we use them also as fun elements and a guide through the learning materials.

Animations are not always useful. Long animations with lot of procedures are hard to remember. The speed of animation is also critical factor. Each person has individual speed preference. For primary school pupils animations need to be slow and controllable. But for other level of education it should be sufficiently fast, but what is fast enough?

Tables are used to present all kind of data. From the primary school to the university level the complexity may grow. As we need to control the amount of information in tables for primary schools we can present complex transformations; multiple data; and pivots at the university level.

Sound needs special attention in the primary school. We need to verify that sound - especially speech is well understood and linguistically correct. At the later levels we need to ensure the quality of speech and the level of background sound. Sound as element of fun should be omitted in higher level of education.

Video requires a lot of time. It starts with the scenario; following the recording; to editing; ending with the post processing. It is especially useful

for presentation of skills. But no one is capable to handle few minutes of video. The amount of information that can be presented in the video is so huge that viewer may easily lose a track even during the multiple previews. From our experiences we find out that video needs to be sufficiently high quality and short. Less than a minute for single video is desired. Primary school pupils are unable to track complex video. We prepare multiple repetition of the experiment inside one video for them to grasp the concept. At the university level a video may be used as a start for later analysis (technical, theoretical, practical etc.)

Interactive elements are simple concept for younger generations. Children who play computer games take them as granted. But we did not want to experiment with the complexity of interactivity for the primary school pupils. We rather stay at the safe side and suggest up to medium interactive complexities for learning materials. Filling the text into textbox is proven to be hard problem for students in all levels of education. Preparing such tests require thorough consideration of acquiring multiple correct questions.

5 Conclusions

We still remember the early days of the Internet. In the beginning we could only exploit the text. After the analog modems' connections face inevitable extinction we were able to discover new level of data transfer. Today multimedia learning material and streaming video is common but the problem of e-learning material is still present. The right learning materials for the student is today goal in the development of contemporary multimedia based e-learning materials. Instinctively we know that we could not use the same principles for different level of education but what is the right principle. After the years of development of e-learning materials for different levels of education and testing them in practice we were able to make conclusions. It is not a surprise that the most difference can be seen in the oldest types of information transfer. Fun elements are useful in the frontal presentation but not in the materials for the higher levels of education. Videos mostly give huge amount of information and should be relatively short. In general we confirm that the complexity level grow according to the age of students despite the fact that in some areas we find almost identical complexity suitable for different levels of education. Applying these principles in practice we developed good learning materials and prepare the blueprint for future.

References

[1] Bhatti N, Bouch A, Kuchinsky A: Integrating User-Perceived Quality into Web Server Design, 9th International World Wide Web Conference, 2000.

[2] Galletta D E, Henry R M, McCoy S, Polak P: When the wait isn't so bad: The interacting effects of website delay, familiarity, and breadth, Information systems research, 2006.

[3] Hardin P C, Reis J: Interactive multimedia software design: Concepts, process, and evaluation, Health education & behavior, 24 (1), 1997, pp. 35-53.

[4] Harp S F, Mayer R E: How seductive details do their damage: A theory of cognitive interest in science learning, Journal of educational psychology, 90 (3), 1998, pp. 414-434.

[5] Jedrusik P, Preisack M, Dammann F: Simplified production of multimedia based radiological learning objects using the Flash Format, ROFO-Fortschritte auf dem gebiet der rontgenstrahlen und der bildgebenden verfahren, 177 (7), 2005, pp. 1009-1015.

[6] Krašna M, Bratina T, Gerlič I: Video supported learning material for distance education, 14th International Conference on Information and Intelligent Systems IIS, Varaždin, Croatia, 2003, pp. 109-113.

[7] Krašna M, Gartner S: Video for exchange of teaching practices, WSEAS transactions on information science and applications, 2 (6), 2005, pp. 805-813.

[8] Mautone P D, Mayer R E: Signaling as a cognitive guide in multimedia learning, Journal of educational psychology, 93 (2), 2001, pp. 377-389.

[9] Mayer R E, Chandler P: When learning is just a click away: Does simple user interaction foster deeper understanding of multimedia messages?, Journal of educational psychology, 93 (2), 2001, pp. 390-397.

[10] Mayer R E, Fennell S, Farmer L, Campbell J: A personalization effect in multimedia learning: Students learn better when words are in conversational style rather than formal style, Journal of educational psychology, 96 (2), 2004, pp. 389-395.

[11] Mayer R E., Griffith E., Jurkowitz I T N, Rothman D: Increased Interestingness of Extraneous Details in a Multimedia Science Presentation Leads to Decreased Learning, Journal of experimental psychology-applied, 14 (4), 2008, pp. 329-339.

[12] Mayer R E: Applying the Science of Learning: Evidence-Based Principles for the Design of Multimedia Instruction, American psychologist, 63 (8), 2008, pp. 760-769.

[13] Moreno R, Mayer R E: Verbal redundancy in multimedia learning: When reading helps listening, Journal of educational psychology, 94 (1), 2002, pp. 156-163.

[14] Wang N, Johnson W L, Mayer R E, Rizzo P, Shaw E, Collins H: The politeness effect: Pedagogical agents and learning outcomes, International journal of human-computer studies, 66 (2), 2008, pp. 98-112.