

Content Development within a European e-Learning Project: Guidelines, Results and Reflections

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Abstract: UNITE is an e-learning research project (partially funded by the EU, under FP6), where a number of e-learning scenarios have been developed, covering different educational contexts, pedagogical concepts and subjects (e.g. Environmental Studies, Mathematics, Information and Communication Technologies, and many other), bridging thus the gap between formal and informal learning settings. The various scenarios have been designed by secondary school teachers (with the help of the project's domain experts) bearing in mind the corresponding diverse cultural and educational backgrounds of the school environments they would be implemented in. All scenarios were supported by relevant electronic resources, material, or in other words content that was either developed from scratch, or adapted from existing sample resources.

There were two consecutive e-learning scenario implementation phases in the project. After both implementation phases, the teachers were asked to complete questionnaires in order to capture facts on the one hand and their personal beliefs on the other. Therefore, this paper constitutes a study of the entire content development process within the course of UNITE, presents a summary of the guidelines that were given to the participating teachers and examines the results of the process separately in the two scenario implementation phases, comparing the two, presenting findings and drawing conclusions. Special emphasis is placed on the factors that might have influenced the teacher's performance in content development.

Keywords: e-Learning, content development, scenario implementation

1. Introduction

UNITE: Unified e-learning environment for the school (<http://www.unite-ist.org>), an IST (Information Society Technologies) project partially funded by the European Commission under the 6th Framework Program, aimed to bridge the gap between formal and informal learning settings. This was achieved by implementing innovative e-learning scenarios, promoting interdisciplinary learning, enhancing learning experience and creating a virtual Network of Schools through which students work, cooperate and interact with each other. There were 13 partners involved from 10 different European countries,

The e-learning scenario development process (Zoakou, et al., 2007) followed in UNITE included several phases: design of a scenario map, based on which e-learning scenarios emerge, an e-learning scenario template to structure scenarios in a consistent manner, a number of scenario examples to serve as guides, two handbooks (namely Teacher's (UNITE Public Deliverable D4.2, 2007) and Content Development (UNITE Public Deliverable D5.2 (Part 2), 2007) to aid teachers, implementation of these scenarios in real school settings, as well as formative and summative evaluation of these scenarios. Two consecutive scenario implementation phases took place in UNITE. All e-learning scenarios were complemented by supporting material, or in other words e-learning content. The content could either be adapted from the content complementing guide scenarios that were supplied, or developed from scratch. The teachers were assisted in this process with a set of UNITE e-learning content specifications, a well designed Content Development Handbook, as well as a Quick Guide to the Handbook. Furthermore, the participating teachers had the help of a more experienced person from the UNITE project partners when they needed.

The two separate scenario implementation phases will be presented from this point of view, aiming at illustrating the different settings where teachers (either alone or with help) created content. Subsequently the results of a questionnaire that was administered to the teachers will be presented and commented on. The questionnaires' objective was to identify what really happened in terms of content development and what factors played a role in their performance in content creation.

2. e-Learning content design and development

E-learning content otherwise referred to as e-learning resources or e-learning objects, is any digital resource that can be reused to support learning. E-Learning content is to be used by learners to learn, and for teachers to teach. For the purpose of UNITE, decisions about the development of learning content e.g. design decisions, factors to consider, available resources etc. were addressed in a Content Development Handbook (UNITE Public Deliverable D5.2 (Part 2), 2007), a summary of which is provided here. This handbook was prepared specifically for UNITE teachers.

The handbook's scope was to give the reader (teachers without particular technical knowledge in most cases) an overview of what e-Learning content is all about, along with useful guidelines to develop reusable e-learning content from a more technical point of view – at the same time not requiring many technical skills. Teachers could use this handbook to help them in developing e-learning content for UNITE and in general.

2.1 Guidelines for developing reusable e-learning content

Reusability is the most sought-after characteristic of e-learning content. It allows content to be used by as many learners and/or educators as possible. By increasing the number of people who can potentially benefit from a resource, you make it more popular and at the same time allow it to be refined and improved. For the purposes of UNITE in particular this is highly desirable since content is to be reused by the Network of Schools that participated in the study.

Here are some general guidelines to help an e-learning content developer to develop content that will be as reusable as possible:

- **Include Metadata.** This is the most fundamental point to make sure one considers, because providing metadata for learning content allows it to be cataloged and easily searched thereafter.
- **Copyright and related information.** Learning resources are covered by copyright laws, given that they are something that someone created for a specific purpose. Information regarding who owns the copyright and how the resource can be used by everybody other than the owner has to be made clear.
- **Pedagogy-Related Guidelines.** It is very important, if one aims his e-learning content to be used by as wide an audience as possible, to design it for multiple educational settings, multiple educational levels and to offer multilingual support.
- **Content Structure.** Content will be easier to reuse, if it is collected into chunks or even provided in single units, but with one clear learning objective. Reusing a resource with “Next” and “Previous” buttons may not allow it to be used properly if these links were hard-coded. Try to keep content separate from navigation and presentation and adhere to accessible design guidelines.
- **Interoperability.** Portable formats are required in order to use content on different systems. UNITE requires that content is provided also in an editable version so that teachers can take it and bring it to their needs. Industry interoperability standards should be used whenever possible for communication, sequencing and navigation.

Figure 1 depicts a diagram – synopsis of the content development process that has appeared in the Quick Guide for content development in UNITE (UNITE Public Deliverable D5.2 (Quick Guide), 2007).

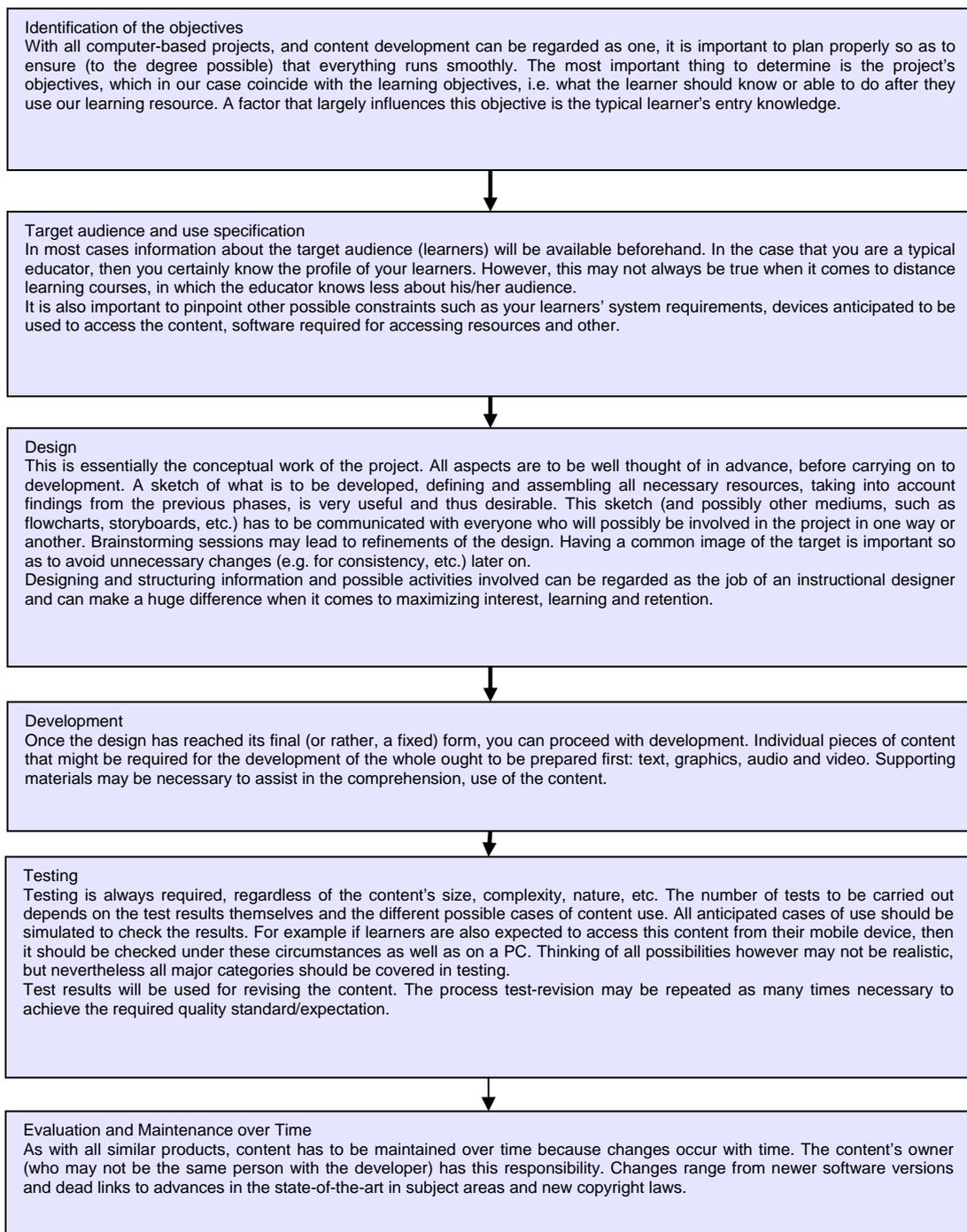


Figure 1: A synopsis of the content development process

2.2 Issues to consider – Summary of guidelines given to teachers

2.2.1 Subject matter

It is very important that the content is carefully prepared so as to sufficiently and appropriately cover the subject matter and meet the learning objectives originally set. The content, depending on its nature, will need to be more or less strictly structured. It is a mistake to assume that the learners will perceive the content's structure on their own, and in fact it is sometimes a good idea to explicitly put forward the structure through e.g. a diagram or outline.

The quality of the language used in the content (whether it is English, or any other language) has to be of some standard. The same applies to the style used and the grammar. All of the content items have to meet some standards that should ideally be set before the content is developed so as to also guarantee consistency in case more than one developer is involved. Spelling and punctuation has to be very accurate and thus checked before the content is used.

Another issue that is worth mentioning is that of cultural bias. It is a fact that some words, phrases, images, examples, references, etc. might be prone to be interpreted differently depending on the cultural heritage of students and teachers. This should be avoided whenever possible, always keeping in mind the content's target audience.

2.2.2 'Affective' impact

What is your content's impact on its users from an affective point of view? Does it make them more motivated to learn, to explore more content item and even look for the recommended reading titles? These are factors that can determine the success of your content: its impact on learners.

Recommendations for keeping the learner motivated include maintaining learners' attention, maintaining learners' confidence that they are making progress and last but not least maintaining their satisfaction by giving support such as e.g. useful feedback.

2.2.3 Content's interface

When you decide to present a piece of information, this may be formed as text, audio, video or graphics. Each form should be used appropriately in order to reinforce the way information is perceived. Using graphics for example has to contribute to the content's learning objective and not just be there for impressing learners.

Text, which is a form nearly always used, has to be checked for quality and its presentation should be well thought of considering the display devices that are expected to be used. Scrolling either horizontally or vertically makes reading more tedious and wastes users' time, so it should be avoided. The same principle of ease of use should be applied to all types of content, removing any extra burden from learners, allowing them to focus on the learning process itself.

2.2.4 Navigation

Navigation primarily applies to more complex hypermedia content where we have a set of items interlinked. They will obviously have an organization, as well as a recommended sequence of presentation. In this case however, the sequence can in most cases be changed by the user who has the option to navigate through the content in any way he pleases (assuming he is allowed to do so through controls being present). Navigation aids (especially in complex content), consistency among all items and keeping the user informed about his/her location at all times is important.

2.2.5 Robustness

Robustness means that your content should not 'fail' to be accessed. This can entail looking into several issues, some of which may require more specialized skills. It is not difficult to make sure that everything is ok on your own (the developer's) computer, while (nearly) all possible user actions have to be tested. It is however difficult to claim the same for computers of all manufacturers, all operating systems, with different memory sizes, display sizes etc. Even more requirements apply when content is web accessible, in which case one should also consider issues such as browsers and bandwidth. To conclude, a developer should have his/her target audience and its characteristics constantly in mind.

3. Observations in the content development process

Content was developed to support and accompany scenarios designed and implemented in two implementation phases in UNITE. A total of forty three (43) e-Learning scenarios were designed and implemented in an 11-month period (UNITE Public Deliverable D5.3, 2008): 20 scenarios during the first implementation phase and 23 during the second. All schools were secondary education level and came from the partners' 10 different European countries; the subjects were those of the teachers who volunteered to participate in the study.

For the first scenario implementation phase, school teachers, after having attended both local workshops and a specialised teachers 2-day UNITE training workshop (one teacher per country), designed their scenarios using the UNITE scenario template. Teachers in cooperation with UNITE local partners created content for their scenarios, by either developing new or adapting existing content that supported e-learning scenario examples supplied by project experts. All content was subsequently uploaded and stored in the UNITE e-learning platform (<http://pilot.unite-ist.org/>) to allow reusability, i.e. other interested teachers to locate it and use it (with or without first customizing it). One of the tools they used to assist them in this process was the Content Development Handbook.

At this first implementation phase which lasted 6 months, observations made by the partner responsible for content development included that some content was not delivered in English in addition to being in the native language, and that the content's quality and complexity was just average. We must report at this point that it was agreed that content would be submitted in English (in addition to the native language, if different) for reasons of reusability: more teachers would benefit from such content. This put an extra burden on some teachers, who even considered this to be a problem, because of them lacking the necessary skills to translate to English. In addition, adding metadata to content items that were stored on the platform was also a requirement because it increased search accuracy tremendously.

Although teachers did not give evidence of applying everything that was included in the Handbook, they did manage to produce content of acceptable quality from a technical point of view and definitely of very good quality when it comes to it following pedagogy-related guidelines, addressing specific learning objectives within learning activities. This was indeed anticipated and would probably not have been the case if content development professionals were hired to create content.

At the end of the first implementation phase, a questionnaire was specifically designed and administered to investigate the conditions (who, to what extent, etc.) under which content was either developed from scratch, or customized. The goal was to identify possible problems during the process that could be addressed during the next implementation phase. The problems that were identified and are presented in the following section were discussed amongst the consortium to find potential solutions. It was concluded that a possible explanation was the time constraints placed by UNITE partners to teachers on the one hand to develop and implement their scenarios, and the limited experience using the platform on the other. The time they had at their disposal was probably further affected given that they had to satisfy other requests from UNITE partners with respect to e.g. the employment of the UNITE Pedagogical Framework, validation of the platform, etc. Therefore it was more or less anticipated that these problems would be resolved by the next implementation phase because of better planning (now that both teachers and partners knew what they had to do) and of higher level of familiarity with the platform.

A similar questionnaire was completed after the end of the second implementation phase to find out whether problems were solved, and the types of content mainly developed. This second phase lasted for 5 months and was completed in December 2007. Qualitative observations from the beginning of the project until the end, demonstrated that the participating teachers were very happy to participate in an e-learning project of this nature (innovative, with a European character), while they were also motivated and eager to learn and to adopt new practices in their teaching. Their cooperation was undoubtedly crucial for the success of the project.

The results of the study were analyzed mainly through descriptive statistics although some inferential statistics were also used. The goals of these analyses were to determine a) the type of content that was created by the teachers in each of the two phases of the study, b) the types of problems that were encountered by the teachers who participated in the study, and c) the teacher's satisfaction with their content development.

The results of this study are based on the whole population of teachers that participated in UNITE. 19 teachers participated in the first implementation phase and 21 participated in the second. Teachers that participated in the second phase were not necessarily the same as the teachers from the first, although they belonged to the same schools. All schools that participated in UNITE took part in this study through one or more teachers.

3.1 Type of content created

After the first implementation phase, the teachers were asked to indicate the amount and type of content that they created on their own. To do so, they had to check the corresponding boxes that contained the various types of content. This enables the researchers to determine how many types of content each teacher created as well as what were these types of content. On average, the teachers indicated that they had created 2.32 different types of content (sd.=1.70). However, 4 teachers (21.05%) had created no content of their own, in contrast to two other teachers who had created 5 different types of content for their classes during implementation phase 1. The teachers who had created 5 types of content taught science-related courses. Courses related to ICT, Mathematics, Statistics, Biology and Geography were characterized as science-related for the purpose of this study. However, only one of the teachers who had created no content of their own taught a science-related course.

In the second e-learning scenario implementation phase, there was a slight increase in the average amount of content created (\bar{x} =2.67, sd=1.59). During this second phase only two teachers indicated that they had created no content. Both these teachers taught subjects that were not science-related. One of those teachers had created no content in the first phase of the study as well.

During the second implementation phase, the maximum amount of content created was by a single teacher who had created 6 different types of content – this was an ICT teacher. The only type of content that was not reportedly created by the specific teacher was that of simulations. Overall however, from all the teachers that took part in the study in both implementation phases, simulations was the type of content created least often. This content was created only in phase 1, again by one ICT teacher.

In both implementation phases, the type of content created most frequently was that of word processor documents, images, and presentations. Table 1 presents the percentage of teachers who had created each of the different types of content.

Table 1: Breakdown of type of content created by scientific quality of the course

	% of teachers creating this content	Scientific subject			
		No	Yes	No	Yes
First Implementation Phase		N	N	% of non-science-related subject teachers	% of science-related subject teachers
Word	68.42%	3	10	50.00	76.92
Spreadsheet	15.79%	0	3	0.00	23.08
Animation	42.11%	0	5	0.00	38.46
Image	26.32%	1	7	16.67	53.85
Presentation	57.89%	2	9	33.33	69.23
Simulation	5.26%	0	1	0.00	7.69
Movie	15.79%	0	3	0.00	23.08
Second Implementation Phase					
Word	90.48%	8	11	88.89	91.67
Spreadsheet	33.33%	0	7	0.00	58.33
Animation	57.14%	2	1	22.22	8.33
Image	14.29%	4	8	44.44	66.67
Presentation	42.86%	4	5	44.44	41.67
Simulation	0.00%	0	0	0.00	0.00
Movie	28.57%	2	4	22.22	33.33

A series of independent sample t-tests were performed to determine whether teachers who taught science-related subjects were more likely to develop more types of content compared to the teachers

who taught subjects that were not science-related. In the first implementation stage, the 13 teachers who taught science-related subjects created an average of 2.9 types of content. This was in contrast to their non-science-related-subject counterparts who created an average of only 1 type of content. These differences were statistically significant ($t_{17}=-2.64$, $p=0.02$).

In the second implementation stage, the teachers who taught science-related subjects created an average of 3.0 types of content. The teachers who taught non-science-related-subjects created an average of 2.36 types of content. The differences between the two groups were not statistically significant during the second implementation stage ($t_{19}=-1.12$, $p=0.28$).

Table 1 also describes the amount of teachers who had created different types of content, broken down by whether the course taught was scientific in nature or not. What can be seen from the table is that during the first implementation phase, the majority of the teachers who taught scientific courses created more types of content overall. These teachers created more non-advanced types of content (e.g. word documents and spreadsheets) as well as advanced content such as images and animation.

In the second implementation phase of the study however, the differences between the content created by teachers in scientific as well as non- scientific courses were less pronounced. The exception is found in the creation of spreadsheets, where none of the teachers in the non-advanced subjects created them, in contrast to 58.33% of the teachers in the scientific courses. In addition, there were slightly more teachers in the scientific courses who created movies, and images.

The participants were also asked whether the help of the UNITE partner in content development was absolutely necessary for their participation in the project. This question was asked on a Likert type scale that ranged from 1 (strongly disagree) to 5 (strongly agree). What was interesting was that 71.42% of the participating teachers agreed or strongly agreed that the help of the UNITE expert was absolutely necessary. The average response to this question was 3.90 on a five-point scale ($sd=1.00$).

A Pearson correlation was then performed to determine whether there was any relationship between the amount of content created on their own and whether the teachers considered the help of the UNITE partners absolutely necessary. The correlation was not significant, ($r=0.20$, $p=0.385$), indicating that there was no relationship between the two variables.

3.2 Problems encountered

The questionnaire used in this study included five possible reasons for which the teachers might have encountered problems with content development. During the first scenario implementation phase, the teachers listed 2.21 types of problems that they encountered ($sd=0.98$) (see Table 2). The most frequent problem was that of not having the technical skills to develop more complex content (68.42%), and that of limited time for scenario implementation (63.16%). During the second implementation phase, the amount of problems dropped to 1.85 ($sd=0.96$), indicating that the teachers encountered less problems at this stage. The most frequently encountered problems were those of not having enough technical skills (70.00%) as well as not feeling comfortable using the platform (50.00%).

Table 2: Percentage of teachers encountering each type of content development problem

Type of problem	Phase 1	Phase 2
Limited time for scenario implementation	63.16%	45.00%
Needing to translate content to English afterwards	31.58%	25.00%
Not getting enough support/help	0.00%	5.00%
Not having the technical skills to develop more complex content	68.42%	70.00%
Not feeling comfortable using the platform	57.89%	50.00%

These results were backed up by qualitative observations made by the UNITE partners who had worked with teachers. Throughout the study, the UNITE partners reported that teachers had a hard time with content development in general (as well as other tasks), that their teachers did not feel confident about the tasks that they were asked to perform, and asked for their help very frequently. Help was mainly related to the use of the e-learning platform.

3.3 Satisfaction with content development

The teachers in the study had to rate their level of satisfaction with the content development that they created during the first implementation phase. This question was also asked on a Likert type scale that ranged from 1 (strongly disagree) to 5 (strongly agree). The average response of the teachers was 3.68 (sd=0.67) which indicated that they tended to agree with this statement although not strongly (see Table 3). However, their responses were much stronger in agreement with the statement that they *will be more* satisfied with their content development of phase 2 of the study (\bar{x} =4.21, sd=0.63). When asked about the reasons for which they believed that they would be more satisfied during the second implementation phase, the most frequently listed reasons were those of being more knowledgeable about the platform (89.47%), having more time (68.42%), and the fact that a newer and better version of the platform will be available (63.16%).

When similar questions were asked at the end of the second implementation phase, the teachers slightly agreed that they were more satisfied with the content they developed in the second implementation phase (\bar{x} =3.64, sd=0.75). However, the teacher's level of satisfaction was not as high as they had expected during the end of the first phase. In addition, there was slight agreement (\bar{x} =3.57, sd=1.03) as to whether they could develop better content during a possible third scenario implementation phase. When asked about the reasons for which they believed that they would be more satisfied during a hypothetical third implementation phase, the most frequently listed reasons were those of being more knowledgeable about the platform (92.31%), having more time (76.92%), the fact that a newer and better version of the platform will be available (53.85%), as well as better planning for themselves (53.87%).

Table 3: Reasons for future levels of satisfaction

Reasons	Phase 1	Phase 2
More time	68.42%	76.92%
Better planning by myself	36.84%	53.85%
Better planning by the UNITE partner	10.53%	15.38%
Newer and better version of platform would be available	63.16%	53.85%
More knowledgeable about the platform	89.47%	92.31%
More motivated*		15.38%
More help from UNITE partner and/or others	10.53%	7.69%

*This option was only included in phase 2 of the study.

4. Conclusion

This paper describes the content development process in the course of the UNITE e-learning research project. The content could either be adapted from the content complementing guide scenarios that were supplied, or developed from scratch. The teachers were assisted in this process with a UNITE e-learning content specifications document, a well designed Content Development Handbook, as well as a Quick Guide to the Handbook. Furthermore, the participating teachers had the help of a more experienced person from the UNITE project partners when needed.

The development occurred in two consecutive phases, namely during the two e-learning scenario implementation phases, which lasted 11 months in total. Questionnaires were administered after each phase to capture facts and identify any possible problems. After the first implementation phase results, the problems identified in content development were discussed amongst the consortium members and it was concluded that they were faced because of the time constraints placed by UNITE partners to teachers on the one hand, and the limited experience using the platform on the other. The time they had was further limited because of other requests from UNITE partners with respect to e.g. the employment of the UNITE Pedagogical Framework, Validation of the platform, etc. Therefore it was expected that these problems would be resolved by the next implementation phase because of better planning and of higher level of teacher familiarity with the platform.

However the figures from the questionnaires analyses show that although fewer teachers reported the lack of time to be a problem after the second implementation phase and the percentage of teachers 'not feeling comfortable with the platform' slightly dropped, the percentage of problems from limited technical skills remained roughly the same. Furthermore, teachers felt that having more time even after the second implementation phase (in a hypothetical third phase) and becoming more knowledgeable about the platform would make them more satisfied when it comes to their

performance in content development. 'Better planning by myself' got a higher percentage after the second implementation phase compared to the first as a reason for being more satisfied with their performance in content development.

When it comes to the types of content developed it became apparent that teachers of science-related subjects appeared to be more skilled and opted to develop more complex content compared to the others. In the second phase the difference was not that pronounced, but we cannot be entirely sure because complex content from a non-science-related-subject teacher may have been developed by the UNITE partner who was helping them at the time. However, these cases cannot be identified from the questionnaires that were administered. The results nevertheless demonstrate that the non-science-related-subject teachers might need to be specifically trained on developing more complex content in a future study or application.

The result that nearly 77% of the teachers felt that in a hypothetical third phase they would be more satisfied with their performance in content development, because they would have more time, is very interesting. Teachers went through local workshops, had the assistance of an expert in most cases and after two implementation phases that lasted 11 months in total, still felt they needed more time. Time was a factor we came across very often and it has become apparent that teachers need a significant amount of time to adjust and to carry out tasks (like develop e-learning content), which is on top of what they would normally do.

Finally, qualitative observations demonstrated that the participating teachers were very happy to participate in a project like this, while they were also motivated and eager to learn and to adopt new practices in their teaching. This project was quite large-scale, involved teachers from different European countries and cultures and therefore its results can be indicative of the situation one will encounter when attempting to employ e-learning in secondary education and particularly when it comes to developing e-learning content. However special attention should be paid to ensure that a) teachers are trained appropriately in creating e-learning content, b) teachers should have adequate time to prepare for such tasks and c) teachers are provided with lots of technical support throughout the process. What would be especially encouraging would be for researchers involved in such studies to follow up such teachers through a period of years to keep them motivated and continuously involved in the e-learning process.

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