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Situated Learning Teaching Courses in the University Environment: a practical experience

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Abstract: - The capability of learning objects of transferring knowledge and skills depends on the way in which they are thought, organized, engineered and realized. The instructional design is the principal factor that influences the quality of learning objects. The success in use of learning modules depends on the capability in involving learners in e-learning; the utility of electronic didactic materials depends on the capability to provide effective learning environments; learning utility depends on the possibility of applying theories and explanations to the real problems of everyday life. This paper, by considering constructivism a useful model to provide learning by doing, presents the results of a practical experience to develop new learning solutions to make available better e-learning teaching courses to university students. The realized prototype considers in a whole a coaching phase, an exemplification studying phase, a problem solving phase, and a feedback based phase. The analysis of the learners' satisfaction and of the time spent in using the learning object, show that situated learning teaching modules represent an enhancement with respect to previous implementations and a further step toward the ICT knowledge based society.

Key-Words: Situated Learning, E-learning, Academic Education, Knowledge Based Society, ICT.

1 Introduction

In the last years the design foundations of the e-learning teaching courses are being strongly modified. E-learning instructional models are passing from being teacher centered to being learner centered. Recently developed learning objects provides learners with teaching materials and communication tools that support engaging and interactive learning processes.

In the past, in order to supplement or replace live face-to-face instruction, distance learning has more often merely replicated the face-to-face classrooms methods. In this way potentially strongly interactive technologies like computers and networks have been simply used to present one-way lectures to students in remote locations.

Indeed, a good learning experience requires that students can "master new knowledge and skills, critically examine assumptions and beliefs, and engage in an invigorating, collaborative quest for wisdom and personal, holistic development" [1].

Technology used in distance education should promote interaction, sustain active participation and facilitate these "good learning experiences", rather than simply broadcast teacher-centered lectures and demonstrations [2].

To implement good learning experiences, well-designed learning objects should move the teacher from podium to sideline, from leader to coach, from purveyor of knowledge to facilitator of personal meaning making [2].

Constructivist principles provide a set of guiding principles to help designers and teachers create learner-centered, collaborative environments that support reflective, active and experiential processes.

Starting from these considerations the paper presents a learning object developed by applying the principles of situated learning and shows its usefulness for the learning process.

The paper is organized as follows: section two presents the main principles of constructivism; section three describes the role of the context in situated learning and illustrates the critical characteristic of the paradigm for the instructional designers; section four presents the properties of situated learning environments; section five describes the properties of the tools adopted to develop and manage the learning object; section six presents the learning object in terms of contents and organization; and, at the end, section seven deals with conclusions and final considerations.

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2 The Constructivism

According to Constructivists the mind is the instrument of thinking which interprets events, objects, and perspectives while moving in the world. People acquire knowledge while interacting with the surrounding environment, rather than seeking to remember and comprehend an objective abstract knowledge. The mind filters input from the world in the process of making interpretations. Each people conceive the external reality somewhat differently, based upon his own historical background. A unique and personal set of experiences contribute to build new understanding.

Constructivist educators strive to create environments where learners "are required to examine thinking and learning processes; collect, record, and analyze data; formulate and test hypotheses; reflect on previous understandings; and construct their own meaning" [3]. Constructivists engage the learners so that the knowledge they construct is not inert, but rather usable in new and different situations. The purpose of learning is "to discover and to describe formally the meanings that human beings create out of their encounters with the world, and then to propose hypotheses about what meaning-making processes were implicated" [4].

Constructivists consider at the same time experimental and reflective knowledge. Both experiential and reflective knowledge emerge from personal interactions with the world, and they both are required to perform most real-world tasks. Real-world situations embed learning, and learners participate to solve problems to acquire knowledge from real situations [5]. Context includes features of the "real world" in which the task to be learned might naturally be accomplished.

Construction of knowledge results in an active process of articulation and reflection in a stimulating environment. By interacting with the world, by extricating from traps, and by making clear hidden processes, learners are able to build new, and modify existing, knowledge. This activity involves reflecting on what is known and what needs to be known, the viability of various plans and the potential effectiveness of the actions to be done.

The interaction with the world promotes knowledge construction through the procedural facilitation process. The procedural facilitation also provides a scaffolding effect and makes available to learners the necessary support to become prepared for more complex strategies and information.

Making knowledge construction activities explicit contributes to the building of new knowledge and skills through internal negotiation and deliberate actions. In this way the entire learning activity is oriented to goal setting, identifying and solving problems, and connecting old and new experiences [6]. The entire process is oriented to an active knowledge building.

3 Situated learning

Situated learning emphasizes the role of context in learning. The situated learning paradigm argues that most learning is context-dependent. What is learned is matched to the experience surrounding the learning, which assigns meaning to what is learned. As a result, the process of solving real-world problems is much richer and better understood.

The model requires the adoption of problem solving techniques. The students must acknowledge the problem, identify resources, set priorities, explore alternative solutions, and select the most profitable.

The use of situated learning as an approach to the design of learning environments has significant implications for the instructional design of computer-based programs. Many of the researchers and teachers have accepted that the computer can provide an alternative to the real-life setting, and that such technology can be used without sacrificing the authentic context. McLellan points out that context can be:

- the actual work setting;
- a highly realistic or 'virtual' surrogate of the actual work environment;
- an anchoring context [7].

In terms of the instructional design of interactive multimedia, the critical characteristics of situated learning can be examined in terms of three elements:

- the learner;
- the implementation;
- the interactive multimedia program.

It is important, when designing interactive multimedia programs, to consider all these three interacting elements. It is not enough to produce a program without considering how it will be used by the students or how it will be implemented to support the learning process.

A number of important aspects need to be considered while developing learning objects:

a. Provide authentic context;
b. Provide authentic activities;
c. Provide access to expert performances;
d. Provide multiple roles and perspectives;
e. Support collaborative construction of knowledge;
f. Provide coaching and scaffolding;

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g. Promote reflection;
h. Promote articulation;
i. Provide for integrated assessment.

A) A situated learning environment need to provide an authentic context that reflects the way the knowledge will be used in real-life, that preserves the situations without fragmentation and decomposition, that invites to exploration and allows for the natural complexity of the world [8, 9, 10, 11, 12, 13].

B) A situated learning environment need also to provide authentic activities which are ill-defined, in which students find as well as solve the problems. It is an environment where tasks provide the opportunity to detect relevant and irrelevant material [8, 10, 11, 13, 14]. Steps, procedures, hints, suggestions, clues and facts, which neatly add up to the 'correct' solution, are interspersed within the program, waiting to be discovered and solved by the learners.

C) Situated learning environments need providing access to expert performances and the modeling of processes, allowing students to observe the task before it is attempted. Such access enables narratives and stories to be accumulated, and invites the learner to understand strategies [5, 8, 9]. Short movies of experts performing skills give students the opportunity to observe the experienced practitioner at work.

D) A situated learning environment needs to provide the learner with the opportunity to investigate multiple roles and perspectives [8, 11, 12, 13, 14, 15, 16]. Giving the learner multiple roles and the opportunities to explore the program from a number of perspectives means that the resource must have an integrity which enables close scrutiny and examination, and may yield fruitful information and rich learning situations.

E) A situated learning environment should support the collaborative construction of knowledge [8, 14, 15]. Also the interaction with computer can lead to a constructive form of interaction and construction of knowledge, and a verification and or confirmation of previous knowledge and assumptions.

F) A situated learning environment should promote reflection to enable abstractions [8, 10, 11, 17, 18]. The learning environment should require students to reflect upon a broader knowledge base to solve the problem.

G) The environment should promote articulation to enable tacit knowledge to be made explicit [10, 15, 17].

H) A situated learning environment should provide for coaching at critical times, and scaffolding of support, where the teacher provides the skills, strategies and links, that the students need to complete the task.

I) A situated learning environment needs to provide for integrated assessment of learning within the tasks [14, 19, 20]. Assessment of situated learning products can also take the form of a number of evaluation measures that do not include necessarily formal tests: portfolios, summary statistics of learners' paths through multimedia programs, diagnosis, and reflection and self-assessment can also be taken in consideration [19]. Young notes that 'assessment can no longer be viewed as an add-on to an instructional design or simply as separate stages in a linear process of pre-test, instruction, post-test. Rather assessment must become an integrated, ongoing, and seamless part of the learning environment' [14, 20]. The implication of this for instructional design is that software engineers need to design an assessment which is concerned with the process as well as the product.

4 Situated learning environments

The learning process can be best facilitated through the design and implementation of learning environments that simulate real world situations. The designers shift from creating prescriptive learning actions to developing environments and situations that actively engage learners. Interactive environments require learners to construct the knowledge that is most meaningful to them. These environments will emerge from authentic tasks, engage the learners in meaningful, problem-based thinking, and require negotiation of meaning and reflection on what has been learned.

New technologies can effectively contribute to a movement away from the duplication of traditional instructional methods, both in the classroom and at a distance, toward a more resource-based approach to instruction that no longer emphasizes the teacher as the main source of knowledge [21]. According to Wiggins, situated learning environments should have the following characteristics [22]:

- be centered on engaging and worthy problems or questions of importance in which students must construct knowledge for effective performance;
- include tasks that are either replicas of, or analogous to, the kinds of real-world

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problems faced by citizens, consumers, or professionals in the field;

- provide access for the student to resources commonly available to those engaged in analogous real-life problems or activities;

- present problems requiring a repository of knowledge, judgment in determining appropriate application of knowledge, and skills in prioritizing problem classification and solution phases.

5 The adopted tools

The learning environment has been organized as a learning object and developed by adopting Adobe Acrobat Presenter: a tool of the Adobe Acrobat Connect Professional suite, formerly known as Macromedia Breeze Presenter [23].

In e-learning content production and organization, the reference paradigm is based on learning objects. The organization of contents in learning objects allows an easy management and a good use of web resources. Specific metadata describe the properties of the product and specify how it will be used [24]. Standards ensure uniform management, portability, and interoperability [25].

Some of the most important organizations involved in e-learning standards are:

- IMS Global Learning Consortium [26]: an organization that groups some of the most important research centers and farms interested in e-learning; its purpose is to develop open specifications to produce interoperable e-learning products;

- Aviation Industry CBI Committee [27]: born to produce guidelines for e-learning products of US Air, it has become an international reference point for problems concerning computer-based training;

- Association of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE) [28]: a European foundation that aims to involve European citizens in the opportunities and possibilities offered from web-learning.

E-learning standards ensure fulfillment of RAID requirements:

- Re-usability: the possibility of modifying and reusing the learning objects;

- Accessibility: the possibility of searching and making available didactic contents to selectable users;

- Interoperability: the possibility of using the product on different platforms;

- Durability: the capability of the product of being installed on new management software versions.

Once realized, the developed learning product has been published according the AICC/SCORM standards [27, 29], imported in the "Oracle iLearning" Learning Management System [30, 31, 32] and offered to university students [33, 34, 35].

The Learning Management System (LMS) provides administration of the learning activities. It makes possible the planning of learning cycles and it traces learner performance. It is useful for the scheduling of learning resources and for the planning of associated events. Like other LMSs, it is realized by means of a collection of integrated software pieces. The implemented services allow to import, organize and distribute learning contents, to monitor behaviors and results, and to provide effective activity feed-backs.

Enrolled learners can access the LMS from university classrooms, through a dedicated e-learning infrastructure [36], or by using domestic personal Internet connections, via a web URL [37].

5.1 The authoring tool

Adobe Acrobat Presenter (Macromedia Breeze Presenter) is a software tool for creating e-learning contents and multimedia presentations rapidly [23]. The tool enables people to use Microsoft PowerPoint to quickly and easily turn PowerPoint presentations (PPT files) into dynamic, multi-media content for the web.

People can personalize presentations with narrations and deliver presentations through any standard web browser. They can record and edit audio for each slide or animation, create quizzes or self-tests, or embed animations and video.

Published presentations result in Flash format (SWF file), they are SCORM and AICC compliant and can be made available via a simple URL.

Breeze Presenter supports different types of questions that can either be graded or used as survey questions. It is also possible to use branching to guide users through different paths in the presentation, based on their answers to quizzes.

Breeze Presenter provides a simple interface for using a microphone to add audio narration. In addition, it is possible to easily synchronize the PowerPoint animations with the audio narration.

The Presenter has an intuitive interface. Its complete integration with PowerPoint eliminates the need for additional training or Flash programming skills. Easily, it is possible to transform static PowerPoint files into dynamic web experiences.

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5.1.1 Presenter features

Breeze Presenter allows:

- Rich Presentation Viewing Experience – Provide viewers with instant access to compelling, self-running, rich-media presentations ensuring maximum transfer of knowledge in minimum time.
- Audio Narration and Editing – Add narration to presentations using a PC and a microphone; edit-out mistakes and pauses, or add an external audio track to a presentation with the Audio Editing tool.
- Branding – Content authors can add corporate logos and color schemes, or presentation viewer layouts and save these settings as a theme that can be reused.
- Full Size Control – Select image and audio quality settings to balance conversion fidelity with a great viewing experience.
- Flexible Publish Options – Publish content locally to preview or directly to a Breeze server; automatically zip up files or create an auto-run file for use on a CD-ROM.
- Integrated Slide Notes – Import, edit and export slide notes as a "script" in the record audio dialog; during recording activities, the notes will be readily available; it is also optionally possible to publish the notes in the generated presentation.
- Multi-Lingual Support – Full support for converting presentations appearance in any language; the presentation viewer automatically detects the language of the viewer's operating system to display localized language strings in the viewer.
- Pixel Perfect Conversion – Create pixel perfect, web-ready renditions of PowerPoint presentations, including support for the full suite of PowerPoint animations.
- Presentation Attachments – Add context to the presentation content by adding attachments of any file type or web links to external sites.
- Presentation Viewer Customization – Customize the presentation viewer on a per-presentation basis; add presenter information and customize what is included in the presentation viewer and what text is displayed to end users; include speaker information such as a photo, biography, and contact information.
- Presentation Viewer Templates – Choose a preferred one out of the box presentation viewer templates; save custom presentation templates for future use to maintain consistency.
- Presenter Video – Import a pre-recorded flash video of the presenter increasing the overall impact of Breeze Presentations.
- Quiz Authoring – Easily add quiz questions to presentations to evaluate understanding and retention; specify pass/fail grades and the number of times a quiz may be taken; use question branching to tailor a learning path through a quiz based on answers.
- SCORM and AICC Support – Use Breeze Presentations to create SCORM and AICC compliant content to deliver and track content through existing corporate learning management systems.
- Slide Properties – Control slide navigation and titles and create complex slide branching to guide users through the presentation.
- Streaming Audio and Video – Enable adaptive video and audio streaming for presentations to ensure a great presentation viewing experience.
- Synchronized Multimedia – Link Flash movies to viewer controls so that, when a presentation is paused by the viewer, all embedded animations and videos are paused automatically and resume when the presentation is resumed.
- Universal Standards Support – Breeze allows creating a single package; this means that Breeze content can be published once and then used across multiple systems.
- Survey Authoring – Add survey questions to presentations to gather feedback on published contents or to gather valuable customer data.

5.2 The LMS

Among the world most widespread LMSs there are the well known IBM Lotus Learning Space, the SumTotal Total LMS, the Microsoft LRN 3.0 Toolkit, the Macromedia Breeze and the Oracle iLearning.

- The IBM solution [38] can be used in two versions: core module and collaboration module. It supports self learning, collaborative learning and real-time learning.
- The SumTotal solution [39] consists in a highly scalable collection of dedicated and interoperable software products.
- The Microsoft solution [40] is an Xml implementation of the Content Packaging 1.1

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LMS; it supports the Metadata 1.2 specifications and the SCORM model.

- The Macromedia solution [41] is essentially based on the flash technology; the server allows publishing and organization of e-learning activities.
- The Oracle solution [30, 31] allows an effective online learning; it supports user creation and aggregation, content publishing and delivery, test creation and management, course and test tracking.

5.2.1 Oracle iLearning technology

Oracle iLearning adopts the most important standard technologies such as XML (IMS Enterprise Specification v1.01), Web Services, and Java (J2EE) Services to provide e-learning. Among the other it supports JSP, Java Servlet, EJB, JDBC, SQLJ, and BC4J. Programmable interfaces allow facilitating and personalizing the use of available services. By means of the LMS, it is also possible to import and export user profiles in XML format according to IMS Enterprise Specification v1.01.

The availability of Oracle9i Database and of Oracle9i Application Server allows registering from few dozens to hundred thousands users keeping high performance of the system and continuous availability of the services. Secure HTTP connections, Single Sign-on and Trusted-URLs facilitate both the access to the different services and prevent improper use of the system. The access control and profile management mechanisms of Oracle RDBMS warrant the authentication phases.

The LMS supports IMS vl.2 to index learning objects by means of metadata (IMS Metadata), to package learning contents (IMS Content Packaging) and to register information about users (IMS Enterprice). It supports SCORM vl.l and vl.2 to manage distribution and tracing (SCORM Run Time Environment) of learning activities. AICC is adopted to describe learning contents structure and status; IMS QTI (Question and Test Interoperability) v1.01 to manage platform evaluation tests.

5.2.2 User and content management

Platform administrators can manage identities and organize virtual communities. Three types of user registration are available: self-registration, manual registration and automated registration. Registered users can be successively partitioned in organizations, re-arranged in groups of people, or structured in a hierarchy of managers.

Specific privileges enable control on selectable operations. Pre-determined roles can be assigned to

single users, to organizations or groups, or to the entire population registered in the site.

The learning objects constitute the base elements of each learning product. The various learning objects form a library of didactic contents that can be used independently or can be grouped to realize greater learning contents. The platform can spread every type of web content, but only products developed according standards can be traced.

The availability of the digital repository allows learning objects to be reused in different courses. It is possible to organize learning objects in groups treating the same argument, in courses or curricula, or according to a hierarchic structure. User defined folders allow organizing contents according to specific competence areas and facilitate the management of the entire system. Course prerequisites allow settling specific learning paths.

After having been imported, a learning content is in a non published state. While in this state, it is possible to set properties and manage attributes.

Once published, each single component or an entire structure of the learning contents can be offered to single people, to organizations or groups, or to the entire site. Contents can have a limit of validity and it is also possible to plan a certification of performed activities. Three different types of course enrolment are available: autonomous enrolment, authorized enrolment; and compulsory enrolment.

Different types of offerings are also available in the platform. Offering can be planned to be used in synchronous or asynchronous activities. Reference materials such as technical documents, registration forms, and link to external sites, download files and collaboration tools can also be associated to specific offerings.

5.2.3 Collaboration and personalization tools

The LMS provide various collaboration tools to support the learning process. The tools allow different forms of interaction among all people involved in the learning process (teachers, students, tutor, administrator, content-object producers, etc.).

Chat or forum sessions can be associated to didactic materials. An integrated SMTP server enables a MAPI compliant mail exchange. A news service can provide information about the site, the courses and the offerings. Announcements on administrative, didactic and specific activities can easily be published and broadcasted. Students can also use a tool of course rating to express a judgment about the learning product.

User and course profile can be enriched with new attributes that can be used to enable a personalized

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information collection or to perform ad hoc searches in the course catalogue. In this way the knowledge base can be organized according to the administration needing, or to implement standard recording methodologies by defining, for instance, thematic areas, information source, external references, catalogue information, etc.

6 The developed Learning Object

A prototype of learning environment has been realized according to the principles of situated learning. The learning object is entitled "Introduction to Processing Systems". It describes the main components of a PC: CPU, Main Memory, I/O Modules, and Interconnection System. It is organized in four sections, each one ending with a problem. The sections can be accessed or sequentially or in a random way. When also the last section is successfully completed the learning activity ends with a success.

University Students of the first year in Computer Science use the learning object while being introduced in the course on Operating Systems.

6.1 Organization of the product

The learning object is organized as follows: an introductory page presents the theme of the module and drives the learner to a video that briefly presents the assembling procedure of a PC (Figure 1); successively a list of themes is presented. The learner can select one or more topics to study or also leave the module. Each insight consists of a sequence of animated and commented slides that presents details of the specific selected subject. At the end of each topic a simple problem is proposed to complete the activity. By considering the correctness of the solutions an adaptive path is built. If the problem is correctly solved, the learner can select the successive activity, otherwise he is invited to repeat the current activity to deepen the concepts related to the subject under consideration.

Figure 1. *A snap of the coaching video*

The coaching video presents the fundamental steps to assemble a PC. The video shows how to:
- Open the case;
- Prepare the elements to be mounted;
- Fix the I/O interface panel protecting panel;
- Bolt brass spacers;
- Install the electric feeder;
- Tighten the mother-board;
- Settle the RAM and the Video Card Adapter;
- Insert the hard drive(s);
- Arrange eventual other I/O devices;
- Realize the data interconnection system;
- Provide internal electric power supply;
- Put in order all cables;
- Close the case.

The list of choices offers the possibility to select one or more arguments to examine closely. The learner can select among:
- Mother board;
- Processing Unit;
- Main Memory;
- I/O modules;
- Hard disk;
- Interconnection system.

When a topic is selected, the learner enters into a presentation that explains the subject with more details. A sequence of slides presents the main aspects of the specific argument. A background voice explains the content of each slide. When the comment associated to the slide completes, the system automatically goes into the next slide. Each slide is enriched with images, schemas and animations that graphically illustrate the content of the page (Figure 2).
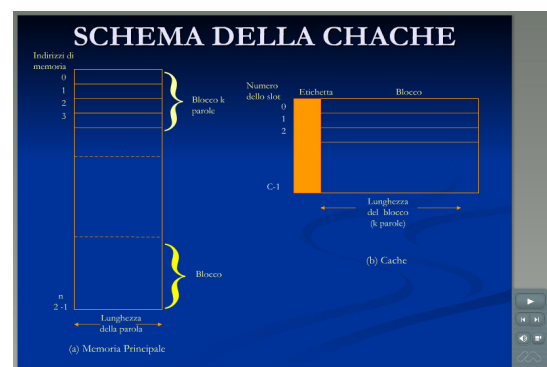

Figure 2. *An example of graphical presentation*

6.2 The contents of the module

The section on mother board shows a photo of a mother board, highlights the processor slots, the main memory slots, the AGP slot for video card adapter, and the PCI slots for I/O Interface adapters.

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The section on the processor defines the CPU acronym, illustrates its main functions, the principal components, and the registers (Figure 3).
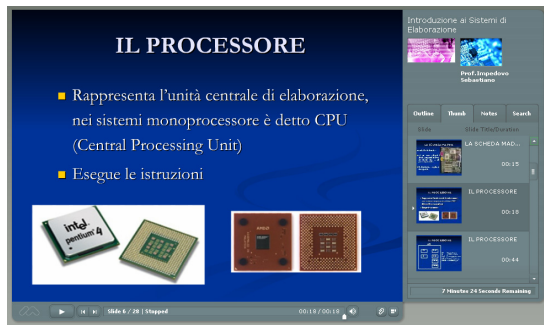

Figure 3. *The CPU presentation*

The section on main memory presents the cache, its function and organization, the transfer function between CPU, cache and RAM, the content and the organization of the RAM, the properties of the main memory and its structure.

The section on I/O modules presents different interface cards, their main functions, and structure.

The section on hard disks illustrates structure, properties and contents of secondary storage devices, their organization in sector and tracks, and their working principle.

The section on interconnection systems presents examples of interconnection systems.

6.3 The problems in the learning module

Each topic ends with a problem about the subject presented. The problem is presented in a graphical way and is organized as a simulation problem in which the learner is invited to perform tasks that simulate the operations to be realized in the real word (Figure 4). To complete the activity the learner should perform tasks like to select a component and locate it in the right place.
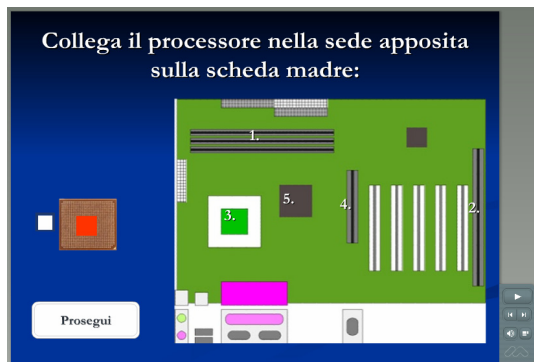

Figure 4. *Example of problem formulation*

The problem solving can result correctly completed or not. After a successful completion, the learner can select another topic. After a failure, the learner is introduced in a new more detailed exemplification which illustrates the actions to perform to solve the problem. The sequence of slides implicitly solves the problem, but does not explicitly provide the solution. When the explanation ends, the problem is newly presented to the learner. If the problem is correctly solved, he is immediately introduced into the following topic, otherwise he is sent back to the beginning of the topic and he is invited to visit again the subject under consideration. Finally the correct solution of the problem is presented. Successively the learner is automatically driven in the successive topic.

6.4 The use of the learning module

The learners used the learning object in blended learning to repeat and deepen the classroom presentations. They also had the possibility to compare this implementation with a former one that consisted of a sequence of presentation slides, without coaching video and problem solving sections [42]. They were invited to formulate a judgment on both products. Thy used a survey consisting of three main sections: quality in use, learnability and involvement [43].

The results showed that while the quality in use in this product is nearly the same as in the previous implementation, learnability, that is to say the capability to acquire new knowledge and skills, and learner involvement in the new product obtain better results, with an improvement of about 10% - 15% with respect to the previous implementation.

These results are also confirmed by the time spent by learners in using the different versions of the product. At this purpose, two test groups were formed. The first test group had the possibility to use only the previous implementation, while the second test group had the possibility to use only the new implementation. The time spent in using new version increases of values which ranges from the 50% to more than the 100%.

7 Conclusions

Developing products according to situated learning paradigm requires much more time and skills in the engineering phase, but results show that the lesson is much more supportive for the learning process, and learners effectively use the product to acquire knowledge and skills. Each problem presents real situations and capture learner attention. The learner realizes that while providing the correct solution to the problem he effectively learns how to

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solve real situations of everyday life. The accessibility of the solution involves the learner to continue the use of the learning module and to visit the different topics. In this way learners became responsible of their learning and decide to continue to use the learning object. Exemplifications, investigations and practices capture learner attention and strengthen curiosity. As a consequence activity completion, strictly related to the time spent with the subject, significantly grows.

In conclusion we can say that this experience, without any doubt, represents a step toward the ICT knowledge based society [44, 45].

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