MC Presenter: A mobile tool supporting various collaborative learning practices in the classroom

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Abstract

Computers have been used to present a wide variety of digital learning material. However, most of the times computers are used for presenting learning material in a linear, pre-arranged sequence, using a one-to-many communication model between teacher and students. This single-speaker paradigm limits the students’ participation and hinders the interaction with the teacher. The teacher is unable to properly assess the students’ knowledge in order to give proper feedback and/or adapt the teaching style and content to the class. We propose a system that runs on PDAs and Tablet-PCs having a human-computer interaction model based on gestures and free-hand sketching. The system functionalities allow the teacher to easily create presentation objects and decide the order in which they will be presented to the students and create problems which the students have to solve on the fly during the presentation. It also allows the teacher to manage permissions in order to allow students to annotate the learning material being presented. The collaborative annotation of the learning material scaffolds the teacher-student and student-student interactions.

Keywords: Collaborative work, computer aided instruction, interactive computing, learning systems

1. Introduction

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Since already many years, computer technology has arrived at the classroom being used by teachers and students in various ways. Much of the attention has been paid to using computers to present learning material [1]. Computers can offer a great variety of digital learning material to be used in the classroom like videos, PowerPoint slides, Web-based presentations, etc. This can also be combined with the use of electronic boards, which make the presentation of this material easier, allowing the teacher not lose eye contact with the students [2]. Computer-based learning material can be re-used, pre-arranged for an ordered or more dynamical presentation; it can be easily distributed and can be collaboratively manipulated. However, it seems that most of the times computers are used for presenting learning material in a linear, pre-arranged sequence [3], using a one-to-many communication model between teacher and students [4]. This single-speaker paradigm limits the students’ participation and hinders the interaction with the teacher [5]. This hinders the students-teacher interaction with the consequence that the teacher is unable to properly assess the students’ knowledge in order to give proper feedback and/or adapt the teaching style and content to the class [6]. Additionally, it has been found that students can keep their attention for about 20 minutes at most on a single issue [7]. It is therefore recommendable to change the activity during the class in order to keep students’ attention [6].

It is possible to find some proposals in the literature of presentation systems for supporting teaching/learning activities the classroom implementing functionalities that enable pedagogical practices which foster teacher-students and student-student interaction. Among these functionalities we can name following:

• Students can take private notes [8].
• Teacher can define problems to be solved by the students during the class [4], [9].
• Students can annotate the slides being presented by the teacher [8].
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As mobile computing devices are becoming more popular, we find in the literature new applications using them in order to achieve higher levels of social interaction among students than with desktop computer. This idea is based on the fact that mobile computers allow students to keep physical proximity and face-to-face contact while working with their devices and allow them to change their physical position to redefine working groups. An example
of this is MCI-Supporter [9], an application running over PDAs supporting collaborative learning implementing problem-based the learning approach, where students learn by solving problems in a collaborative scenario, where the teacher can define working groups and distribute problems which can be created on-the-fly or prepared beforehand.

However, early tests have shown that it is extremely important to anchor the problems the teacher sends to the students to a specific context and to combine teacher’s presentation of learning material with problems related to that material. This alternation can be a powerful tool to the teacher: it not only helps to keep students’ attention but it allows a systematic assessment of students’ progress, which has been mentioned as one of the critical teaching best practices [11].

In this paper, we present a system called MCPresenter (Mobile Collaborative Presenter), which extends MCI-Supporter by including the following functionalities:

- The teacher can easily create presentation objects and decide the order in which they will be presented to the students according to the class needs and background. This can be made at “runtime” during the class, thus creating adaptive learning material on-the-fly.
- The teacher can create problems the students have to solve on the fly during the presentation, adapting the assessment phase of the learning process to the progress achieved by the students. These problems can be defined inside the presentations, anchored to a specific context.
- Collaborative annotation of the learning material can foster teacher-student and student-student interactions.
- The teacher manages the permission for the students to annotate the learning material being presented. The teacher is notified when a student wants to do such an annotation.

The proposed system has a human-computer interaction model based on gestures, being easy to use and can run on PDAs or tablet-Pcs.

2. Related work

Classroom Presenter [4] allows a teacher to send the learning material slides she is presenting to the students. The system allows the sketching over the slides, so the teacher can send them with annotations including open questions the students have to answer also with sketches or choosing the correct alternative. The slides for the presentation material can be imported directly from PowerPoint, using them as background image for the sketching. This application supports only teacher to students and student to teacher interaction, but not collaborative manipulation of the learning material among the students, not it is able to run on mobiles devices like PDAs.

Group Learning Partner [10] is an extension of Classroom Presenter, and as such, inherits all its functionalities. It allows the teacher to define students groups. Students inside a group have access to a shared workspace. It supports the exchange of sketches among students through a wireless network.

DyKnow Vision [8][12] allows collaborative note taking among student and teacher, and “content replay”

<table>
<thead>
<tr>
<th>Application</th>
<th>Platform</th>
<th>Gestures support</th>
<th>Note taking</th>
<th>Type of questions supported by the system</th>
<th>Students annotate presentation</th>
<th>Group configuration</th>
<th>Define presentation’s sequence</th>
<th>Shared workspace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom Presenter</td>
<td>Tablet-PC</td>
<td>No</td>
<td>Individual</td>
<td>simple choice, free</td>
<td>No</td>
<td>No</td>
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<td>Individual, Collaborative (student-student)</td>
<td>simple choice, free</td>
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<tr>
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<td>Collaborative Note-Taking*</td>
<td>PDA</td>
<td>No</td>
<td>Individual, Collaborative (student-student)</td>
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<tr>
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<td>Simple choice, multiple choice sequence choice, free</td>
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<td>MCI-Supporter</td>
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<td>Yes</td>
<td>No</td>
<td>Simple choice, multiple choice sequence choice, free</td>
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<td>Simple choice, multiple choice sequence choice, free</td>
<td>Individual, Collaborative</td>
<td>Yes</td>
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<td>Yes</td>
</tr>
</tbody>
</table>

*: No name was given to the application in the paper. Part of the article name was used.
**: Although this application’s main goal differs from the goal of the others, it is also conceived to foster social interaction.

Table 1: Comparing Functionalities among Applications
stroke by stroke. The teacher can send questions to the students and see the students’ performance results graphically. The teacher can pass the control to certain students anytime, so that they can annotate the slides with the learning material. This is used when teacher wants students to explain something to the rest of the class. However, it does not support group building, nor collaborative work.

“Collaborative Note taking” [13] allows the students to take notes during class using a PDA. The students can allow these notes to be seen by others. The students’ application’s interface shows the page currently being visited by the teacher. Notes are created using the keyboard. Students can reuse the words previously inputted by the teacher or by other students. The system does not allow the input of free hand sketching.

In [14], the authors describe an application where the students use a shared display in order to work collaboratively. The shared display is aimed at promoting the interaction between participants.

Table 1 compares the features of the already mentioned applications with the features of MCPresenter.

3. Principles of the system functionalities

MCPresenter will be an extension of MCI-Supporter [9]. MCI-Supporter is an application allowing the teacher to form working groups, the creation and distribution of questions the students have to answer collaboratively and the assessment of the students’ work. It lacks of any feature allowing presentation of learning content which would give a richer context to the learning activity. The following are the design principles we applied in the development of MCI-Supporter in order to build an effective collaborative learning tool and will be kept in MCPresenter:

- Network setup should be as easy as possible for the user. The system should make the necessary connections among the different application without user intervention.
- The application will run on mobile devices in order to foster social interaction and cooperation [14].
- The supported learning activity should facilitate and support student-student as well as teacher-student interactions.
- The application interface has to take into account the reduced size of the PDA screen when designing the visualization of the material and the interaction.
- The teacher should be able to create questions on the fly or prepare them beforehand in order to send them to the students who have to answer them.
- The system should allow the teacher to create content for the lecture and to adapt them to the class by defining an order in which the material should be visited.

In order to fulfill the requirements mentioned above the following functionalities were implemented:

**Network configuration:** MCPresenter as well as MCI-Supporter run over an ad-hoc WiFi network without a central server. The core of the application performs the discovering of partners. As soon as the application starts, it announces its presence sending multicast messages, which are consumed by the other applications. In the same way, the application consumes the multicast messages sent by others discovering who is present. In this way, the users do not need to input any data at the beginning in order to start the communication among them.

**User Interface:** The application runs on a PDA as well as on a Tablet-PC. The interface adapts itself to the screen size. In a Tablet-PC the whole working area is shown at once, but in the PDA only a portion of it will be visible at the beginning. The user can move to the rest of the working area through panning. This will adapt the working area to a size that fits the screen size of the device on which the application is running.

The human-computer interaction with the interface is based on gestures in order to minimize the use of widgets leaving more space for working [15]. While writing over the screen, everything which is not recognized as a gesture is converted in a stroke. Some works have shown that sketching is a more natural way to enter data than using keyboard. [15], imitating the use of pen and paper [16].

**Content:** The content is organized as a collection of presentations containing a variable number of slides. Each slide may contain a hierarchical node tree, each node being another slide. Slides may contain images, sketches, multimedia objects and more nodes.

**Questions creation:** Questions can be defined before the lecture and stored before the lecture or created in runtime during the lecture. This allows the teacher to adapt the questions to fit the knowledge of the students. The teacher can see the students’ answers to the question as they are generated. Questions can be sent to the individual students or to a whole group attached to a certain slide.

**Fostering interaction:** As we said beforehand, we would like to support a teaching/learning style different from the single-speaker paradigm [5]. For this, the application will provide a shared working area where teacher and students can input content at the same time. In this way, the teacher as well as students will be able to show things and express themselves at the same time. The teacher will have the right to grant and take permissions to a single student or a whole group of them to use this area, in order to organize the participation. This shared working area will promote the participation of all students [14].

4. MCPresenter Description

Author names and affiliations are to be centered beneath the title and printed in Times 12-point, non-
boldface type. Multiple authors may be shown in a two- or three-column format, with their affiliations below their respective names. Affiliations are centered below each author name, italicized, not bold. Include e-mail addresses if possible. Follow the author information by two blank lines before main text. As already said, MC Presenter, is a content presenter which also preserve many functionalities of MCIS upporter. The application implements two different roles: student and teacher. For the teacher, the application allows the creation of a presentation consisting of an ordered set of slides with questions associates to each slide. For the student, the application allows note taking over the slides, making contributions to the learning material. Of course, they have also functionalities to answer the questions.

In the next sections the most important functionalities of the system are described.

**Annotations:** By entering “Notes taking mode” any student can make free hand annotations to the lecture content, where the teacher’s slide is shown as background. Each student can decide whether he/she wants to share the annotations with others or not by using a menu option visible on this mode. This implements a sort of public/private note taking. If many students decide to share their annotations they can engage in a collaborative note taking session.

Another menu option allows the student to display or hide the annotations made by others. The teacher can also see the public annotations of the students. This gives her an idea about how the good or bad the students are following the class and if they understand the subject being learnt.

**Teacher’s working area:** The teacher can write on the teacher’s area at any time. A student expresses the desire to write on this area by just trying to make a stroke. This will immediately trigger a petition for writing which will be sent to the teacher. The teacher may then give the right to write in this area to the student as described in the Fig. 1.a. As default, the right to write on the teacher’s area is not granted to the students.

On the teacher’s role, the application shows a list of all the students’ devices present in the session. If students have requested permission to write but this has not granted yet the system will additionally show the time passed since the request was made. With this information the teacher might decide to give the next writing permission to the student who has requested it before the rest. The students’ contributions are also made with free hand writing.

This functionality allows the students to express doubts they might have about the learning material being presented, as shown in Fig. 1.b or to make contributions to complete the information being shown.

**Creating presentations:** Another key feature of the system is the creation of presentations. A new presentation can be created working under the “Slideshow” mode, by sketching a capital “L” on the workspace. This gesture will be recognized by the system and a rectangle shaped icon representing the new presentation will be shown (Fig. 2).

After the new presentation is created, it should be filled with slides. A double click over the presentation icon will “expand” it to take the whole screen size in order to start the creation of slides the presentation will include. At this point, a double click will create will create a slide. Slide’s content might be imported from another application (like Power Point), it might be an image imported from a file, free hand sketches, or a combination of them.

![Fig. 1.](image)

(a) The teacher is authorizing the student identified as Gustavo to write on the teacher’s area (magnified view). The yellow dot indicates the student has asked for permission to write on this area. The red dot indicates the students does not want to write in this area yet. (b) Gustavo writes questions marks over the content in order to express that he/she did not understand a certain part of the content and/or explanation presented by the teacher.

A presentation might consist of many slides. Since PDAs have a limited screen size it was necessary to create a method enabling the use to zoom-in and out the slides’ overview, and to change the part of the whole slides’ view being shown: the zooming scale is changed by moving the stylus to the left or to the right, and the “window” showing part of the whole slide collection can be moved by moving the stylus up and down as shown in Fig. 3.

![Fig. 2.](image)

Being in the Slideshow mode, a new presentation is created by making a capital “L” gesture over the workspace (magnified view of MC Presenter interface).
Slides can be copied by selecting them with a single click and dragging and dropping them on the clipboard icon. The clipboard holds the dropped slides in a stack, this means, many slides can be added to the clipboard and they recovery order will be last-in-first-out. A single click over the clipboard icon will recover the slide on the top of the stack, which can be dragged to the desired place on the workspace. The teacher can create a presentation before the lecture or during the lecture. The last option allows a more constructivist way to present the learning subject.

**Defining the slide presentation path:** The teacher has the possibility to adapt already created learning material to a certain class by modifying the content of the slides or by redefining the order in which the slides that should be presented. Various factors may influence the decisions which slides to use and in which order to present and work with them, for example, the previous knowledge of the class, the pace at with the student learn, the time.

The mode which allows the teacher to define paths over a presentation divides the screen in two parts. The left part shows a tree view with all the available slides while the right side shows a linked list with all the ones already chosen for the presentation in the order they will be presented. This list is empty at the beginning of the definition of a new path.

In order to add a node to the path the teacher drags a node from the left part of the screen to the right one and drops it in the desired place. By default, a certain node can appear only once in the path, and is deleted from the right side of the screen. This is done in order to give the teacher a better view on the nodes which are already on the path and which not. In order to use twice a node in the same path, the node has to be copied from the list and pasted again in another place of the same list. A node can be taken out of the path by dragging it back to the right side of the screen. Inside the path it is possible to relocate the nodes by dragging and dropping it at the desired position of the list. All the paths defined over one presentation are saved and loaded with the presentation.

**Creation of questions:** The teacher can at any moment (before or during the lecture) create a question attached to a slide by clicking on the icon for this option. The first thing to do is to define the type of question to create: simple selection, multiple selection, sequence definition or free format. After that, the question and the possible answers (in the case of a selection or sequencing question) has to be created by freehand sketching and enclosing the sketch with an “L” gesture. This will create de required elements. The role each created node will play is defined by chosen the right answer(s), the wrong answer(s), and the questions buttons (see Fig. 4a). There is no limitation for the number of alternatives.

A question can be sent to the students by clicking on the “send” option. The teacher decides whether the question will be sent to individual students or a whole group. The view the students will have when they receive the question in their devices is shown in Fig. 4.b.

As already discussed in the introduction of this paper, the advantage of having questions anchored to the presentation its that they can be made in the context of the learning material being presented, without changing the focus of attention of the students. They can also help the teacher assess whether the students understand the stuff being explained.

**Checking the students’ answers:** The teacher can see students’ answers as they are being produced. The teacher can filter the view of the answers in order to show them to the rest of the class in order to discuss them and provide the students with feedback.

![Fig. 3. (a) View of a presentation’s slides. (b) Zooming is controlled by dragging the pen on the working area. The number of slides shown in a row depends on the zooming factor being used.](image)

![Fig. 4. (a) creation of a question by the teacher. (b) Students’ view of the question when it is sent. Note that the question, as well as the alternatives are free and written strokes, which allows to ask for the right chinese character for mother.](image)
6. Conclusions and Future Work

MCPresenter is an application combining learning content management with pedagogical practices. The review of the literature on existing similar applications shows that most of them have been developed to address the presentation of learning material in the classroom in a linear pre-arranged sequence following the one-to-many communication model between teacher and students called the single-speaker paradigm. They lack of a shared visual focus of the learning material among the learners’ group which is the main focus of this work.

Previous works presented some applications making use of free-hand-based interaction. Others take the advantages of the networked to implement collaborative activities inside the classroom to foster teacher-student interaction. MCPresenter combines those solutions showing positive results including functionalities not present in any of the existing applications, as can be seen in Table 1.

Preliminary usability tests on MCPresenter’s have shown to be easy to use and fast to learn for the teacher as well as for the students. The incorporation of content management in MCPresenter preserves the human-computer interaction characteristics of its forerunner: MCISupporter. Since usability tests on MCISupporter produced very good results, we expect a similar outcome for MCPresenter.

As future work, we envisage several tasks. For example, we would like to validate that the teacher can easily manage the presentations’ content which includes creation of learning material, its modification, deleting content, duplicate content at various granularity levels (whole presentation, node, slide, question), while at the same time using the functionalities for implementing pedagogical practices oriented to support feedback, assessment, reflection, collaborative problem solving, and problem solving in real time. We also would like to validate the levels of teacher-students interaction the application is able to promote as well as the interaction levels produced by the introduction of a shared display groupware, which arises when the teacher’s display is projected to the whole class against using MCPresenter without it.

Since many teachers are used to prepare their presentations with PowerPoint, it would be a good idea to implement the possibility of importing PowerPoint files as content for MCPresenter’s presentation.

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References


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