

Tangible ICT-based Learning Environments for Enhanced Quality Education

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Outline

- Introduction
- Collaborative group learning and the traditional 'Jigsaw Method'
- Computer-assisted teaching and learning in collaborative environments
- A tangible digitally-enhanced environment for collaborative learning
- The Dynamic Group Environment for Collaborative Learning (DGE/CL)
- Conclusions and future work

Steps of employed jigsaw activity

- Each group member receives a different piece of the information.
- Students change groups and form topic groups (experts) in order to master the material.
- Students return to their original group and share the information with the others.
- Each student prepares an assignment or completes a part of a group project. This is aimed at demonstrating each person's synthesis of information possessed by the group.

Computer-assisted learning in collaborative environments

Institutionally-based education, including that using Computer Supported Collaborative Learning (CSCL), has difficulty into accounting for variations in:

- class sizes,
- teaching styles and objectives,
- learner preferences,
- cultural practices, and
- administrative constraints.

Computer-assisted learning in collaborative environments

A collaborative teaching system should be easily modified by teachers:

- to suit required teaching constraints and objectives,
- to take into account diverse types of activities,
- to support group management of students learning with the system, and
- to allow incorporating the use of computers into the curriculum of communicative group tasks.

A digitally-enhanced environment for collaborative learning

We have developed a teaching method that uses *digitally-enhanced paper materials* and Cluster Pattern Interface (*CLUSPI*) readers to provide :

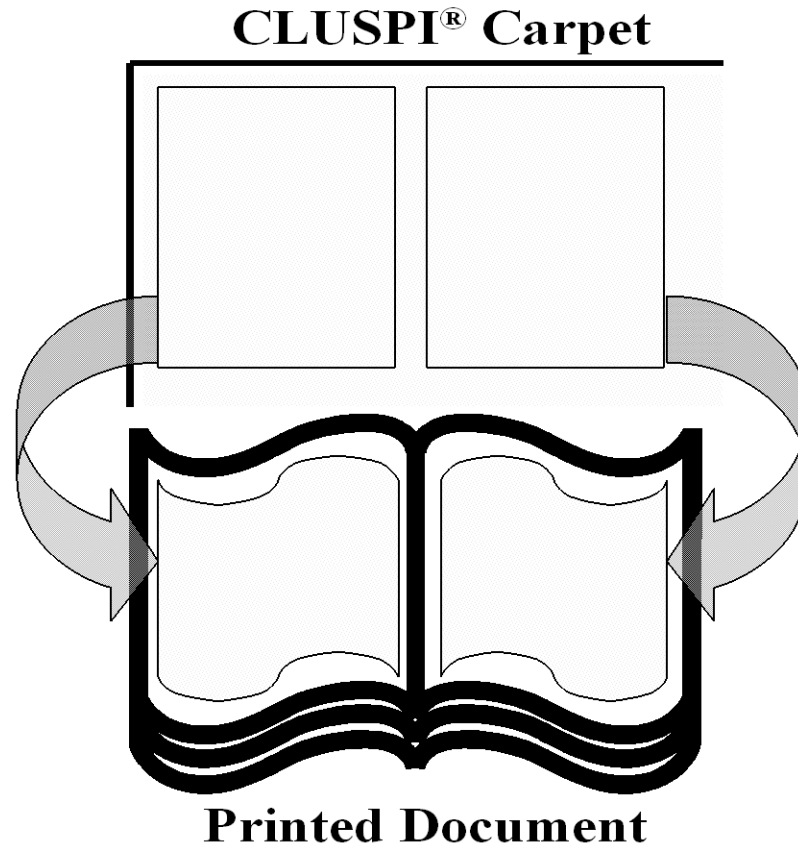
- a flexible organizational structure,
- additional learning content,
- multi-dimensional learning activities, and
- reasons for students to discuss the content with each other.

A digitally-enhanced environment for collaborative learning

In order to fulfill the requirements of our teaching method, we needed a technology that would blend with the principle support medium (i.e. paper).

Relaxation of the rigid structures associated with traditional barcodes is possible through graphical object and **cluster-based surface encoding** methods. CLUSPI[®] for example, is a cluster pattern-based encoding scheme that has been specifically designed to blend seamlessly with printed document content.

A digitally-enhanced environment for collaborative learning



Imagine the CLUSPI[®] carpet as a large transparent sheet. Then cut a piece that fits to your document size and paste it over a printed page. The transparency carries the CLUSPI[®] code, but does not obscure the underlying page content.

CLUSPI[®] code can also be directly embedded in the document and printed together with the document content.

A digitally-enhanced environment for collaborative learning

In contrast to other methods, CLUSPI® uses ***groups, or clusters, of graphical objects*** for the digital-encoding of data, while individual graphical objects do not necessarily carry direct digital information.

The notion of cluster here is not bound to any explicit property, such as distance or color or shape and ***can be redefined to meet specific application requirements.***

A digitally-enhanced environment for collaborative learning

The CLUSPI[®] encoding scheme allows for different types of digitally-encoded information to be easily and efficiently embedded in ***multiple layers*** of clustered graphical objects. Consequentially the carpet encoding appears to be:

- quite regular,
- with no special margins or blocks,
- no markers that stand out, and
- the ink covered area is only a small percentage of the total area.

The Dynamic Group Environment for Collaborative Learning (DGE/CL)

The main goals of the CLUSPI[®]-enhanced dynamic group environment are:

- to provide reading assistance on the basis of individual need,
- to help students to understand content, genre and text features, and
- to provide a dynamic group environment which engages students in a reading activity.

Content database and content management

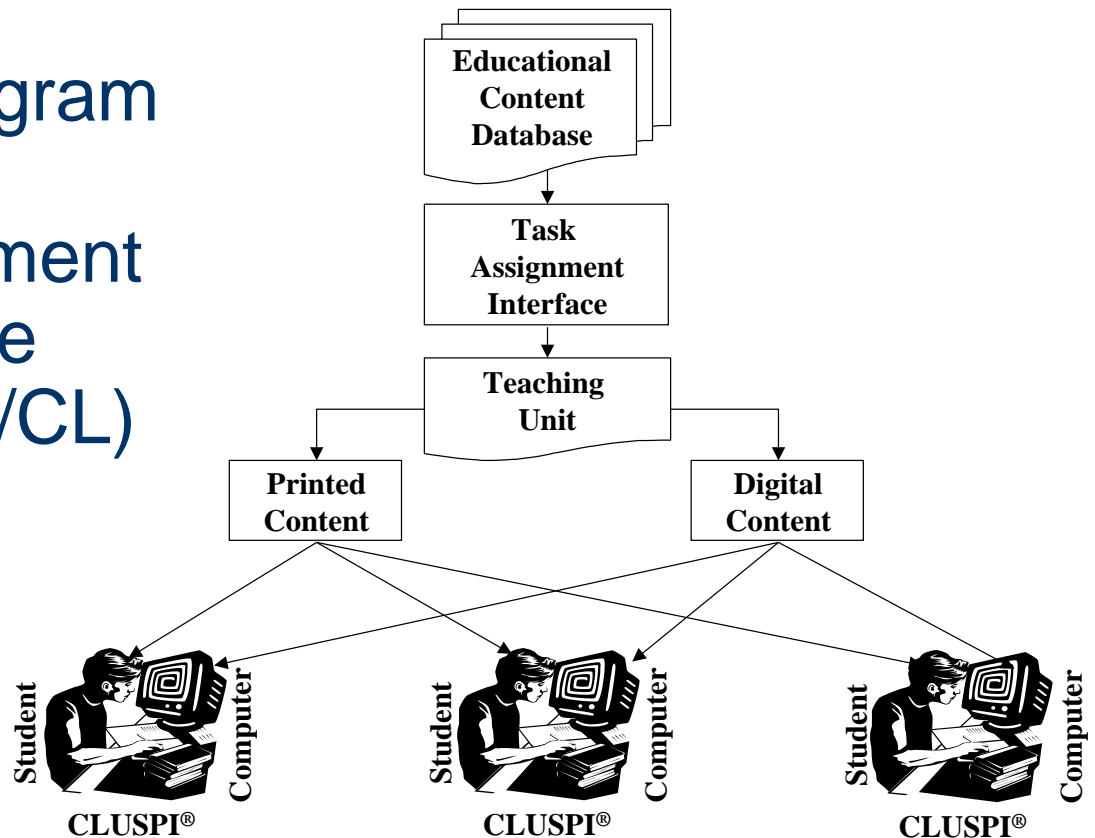
Encouraging group activities, through ***multiple view representations of information entities***:

- Different teachers would naturally use different wording and different supporting materials when introducing a new notion.
- If every student would initially have access to only one of the many aspects or views of the new notion, embarking on the path to deeper understanding naturally leads to the exchange of information with other students and working in groups.

DGE/CL

Content management

A structural diagram of the Dynamic Group Environment for Collaborative Learning (DGE/CL)



DGE/CL

Task assignment interface

Available teacher controls and functionality:

- to set the parameters for the activity,
- to assign the appropriate content variables,
- to choose a learning objective of the task assignment, and
- to determine the content and activities, which will be available at each stage of the task.

DGE/CL

Task assignment interface

Partitioning capabilities for different types of activities:

- **Teacher-determined** – this feature would be used if teachers wanted students to remain always with the same group members.
- **Content-determined** –to complete a component of the task, students randomly interact amongst class members to find the information required to complete the task.
- **Student-determined** – pre-defined groups are either not necessary, or can be self-assigned by the students.

DGE/CL

Task assignment interface

The CLUSPI® device sharing requirements depend on the group partitioning choice.

- **Teacher-determined** - individual CLUSPI® devices could be distributed to each group in advance.
- **Content-dependent and student-dependent** - predetermined assignment of CLUSPI® devices is not possible.

We have combined a CLUSPI® device and an RFID reader in a single handheld unit that allows dynamic device allocation, based on immediate user identification.

DGE/CL

Combined CLUSPI®/RFID unit

The combined CLUSPI®/RFID handheld unit, can be used for pointing and clicking on digitally enhanced printed materials as shown on the right.



DGE/CL

The CLUSPI[®] print-based interface

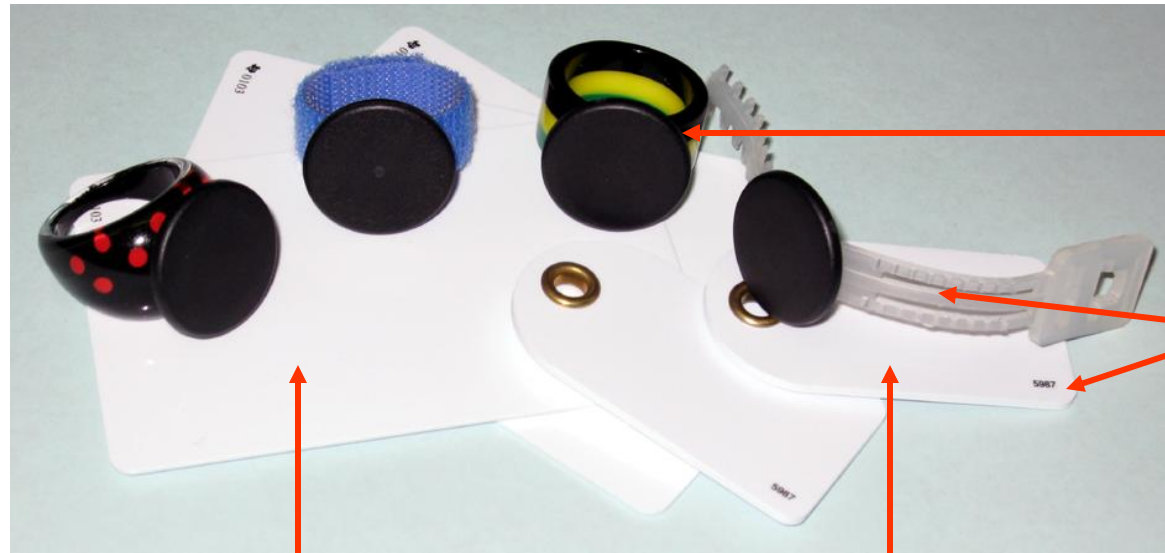
From a user perspective, the combined unit functions as a standard CLUSPI[®] device, so no additional training is required.

To activate the CLUSPI[®] device, a pre-registered RFID tag has to be brought within the sensing range of the RFID reader.

Users properly wearing their tags would not even notice the new, immediate user identification functionality.

DGE/CL

The CLUSPI[®] print-based interface



Coin type RFID

Wrist wearable

Card type RFID

Label type RFID

RFID tags with different sizes and shapes

DGE/CL

The CLUSPI[®] print-based interface

From a system perspective, the RFID reader and the CLUSPI[®] device are seen as two independent components with their own interfaces and operating software.

Software functionality steps:

1. Determine the presence of a valid RFID
2. Establish an appropriate user context
3. Enable the CLUSPI[®] reader accordingly

Conclusions and future work

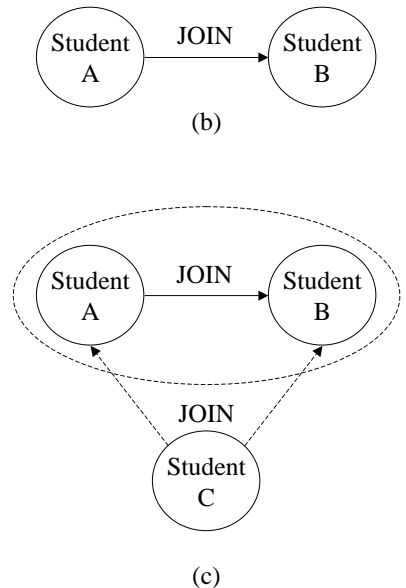
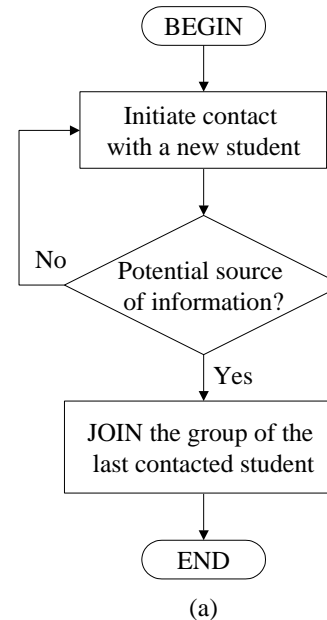
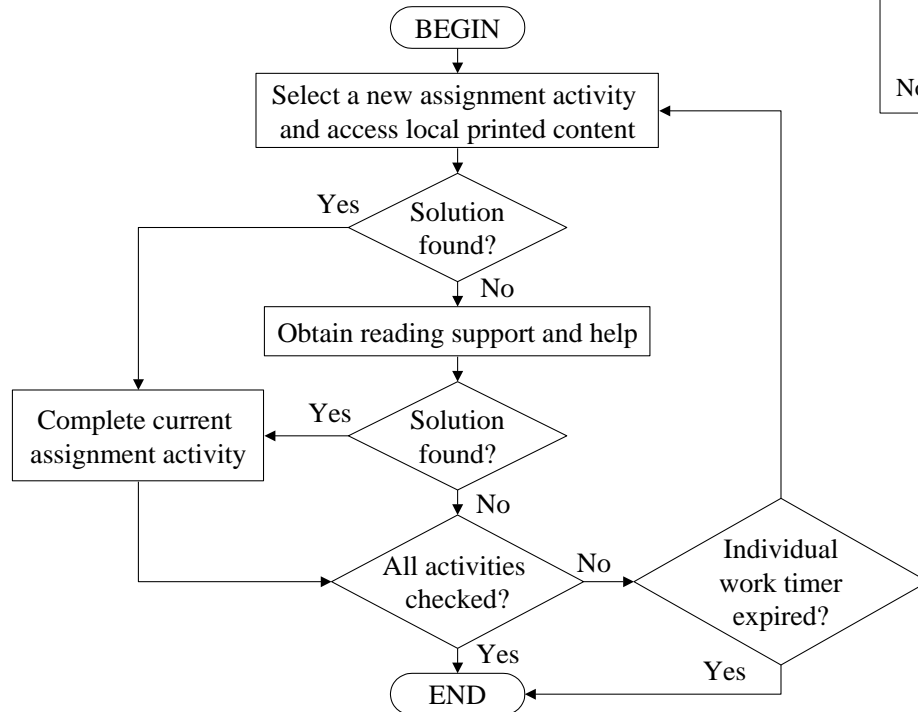
- Considered collaborative learning in a dynamic group environment mainly from organizational and teacher perspective.
- Need a thorough study of the learner's view of the system and particularly the CLUSPI[®] based interactions from the user perspective.
- Planning an in-depth exploration of the CLUSPI[®] based direct point-and-click functionality and its potential in other areas.

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Thank You!

DGE/CL Schematic Diagrams

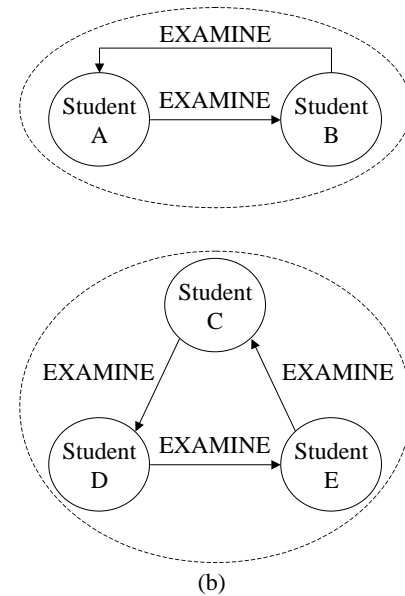
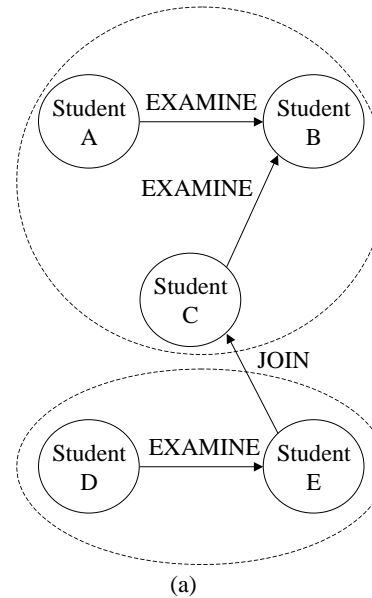
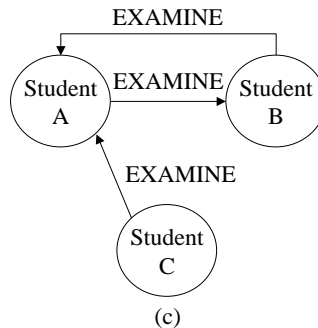
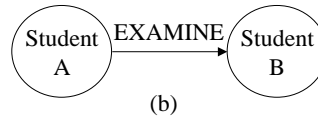
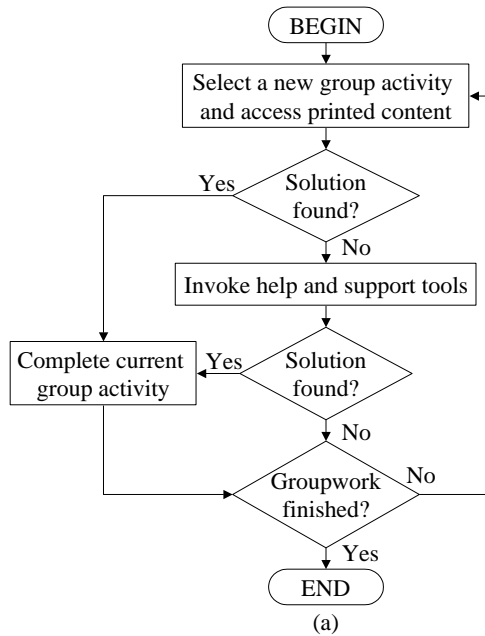
Individual work



Formation of groups

DGE/CL Schematic Diagrams

Groupwork stage



Group interactions and reforming