

The Hybrid I4Ts Game

PLEIADE Intellectual Output no.2

Project No. 2020-1-IT02-KA201-080089





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Project ref. number	2020-1-IT02-KA201-080089
Project title	PLEIADE - PLayful Environment for Inclusive leArning Design in Europe
Document title	The Hybrid I4Ts Game
Document Type	Intellectual Output [accompanying document]
Document version	1.1, 30 April 2021
Previous version(s)	1.0
Planned date of delivery	30 April 2021
Language	English
Dissemination level	PU
Number of pages	26
Partner responsible	OpenLab
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Abstract	This is the accompanying document of the second Intellectual Output of the Erasmus+ project "PLayful Environment for Inclusive leArning Design in Europe" (PLEIADE), the I4T game.
	According to the project proposal, the I4Ts game is a hybrid (paper+digital) board game that provides guidance to teachers in the conceptualisation (i.e. the initial design stage) of collaborative, inclusion-oriented learning activities for their students. In other words, the game is aimed at supporting groups of teachers in the design of collaborative and inclusive activities for their students.
Keywords	Hybrid game, Learning design, inclusion, collaboration, practice sharing

DOI	https://doi.org/10.17471/54010
How to cite	Bicocchi, M., Ceregini, A., Persico, D., Polsinelli, P., Pozzi, F., Sarti, L. (2021). <i>The hybrid I4T game</i> (PLEIADE Intellectual Output No. 2). <u>https://doi.org/10.17471/54010</u>

Internal project peer review process

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1. Executive summary

This is the accompanying document of the second Intellectual Output of the Erasmus+ project "PLayful Environment for Inclusive leArning Design in Europe" (PLEIADE), the I4T game. It provides a description of the output as well as instructions to download the software component (section 2.4.1).

According to the project proposal, the I4Ts game is a hybrid (paper+digital) board game that provides guidance to teachers in the conceptualisation (i.e. the initial design stage) of collaborative, inclusion-oriented learning activities for their students. In other words, the game is aimed at supporting groups of teachers in the design of collaborative and inclusive activities for their students.

Theoretically speaking, the need for this game is determined by the intrinsic complexity of the design task when inclusive, collaborative and technology-enhanced learning interventions are the desired outcomes (Lakkala, 2007). The variables at play in the decision-making process and their interactions require thorough consideration of pros and cons of all the design choices made. Thus, the Hybrid I4Ts interactive game helps teachers deal with this complexity and make them more aware of intended and unintended consequences of their design choices.

Within the project, the game will be used by 75+ teachers involved in the Blended Training Activities.

The project will produce the English version of this output; the software will also be predisposed for easy localisation and, if needed, translated in different languages.

Before describing the game, some theoretical background is needed, that is provided in the section below.

2. Introduction

The game is built upon a theoretical model, called "4Ts model" (Pozzi et al., 2013), that is briefly explained below.

The 4Ts model defines and frames collaborative learning activities in terms of four elements: TASK (activity that students are requested to carry out); aggregation in TEAMs (student groupings for tackling tasks), TIME (task phases and scheduling), and TECHNOLOGY (the environment in which the activity takes place, with its tools and resources).

Any time a teacher starts designing a collaborative activity, they need to define the intended learning objectives to be achieved by the students, to identify the contents to be addressed and to analyse the context (in terms of contextual constraints and characteristics of the target population).

Then, they will need to choose a Task to be assigned to students, the Technologies that will be used to accomplish the Task, the social structure of the class (organization in Teams), as well as the Time schedule.

As represented in Figure 1, any choice made on one of the variables impacts on all the others, so the design process is iterative in nature.



Figure 1 - The 4Ts model (Pozzi & Persico, 2013)

Examples of Tasks include:

- Preparing a document (textual or hyper medial)
- Reading and studying
- Preparing a presentation
- Preparing a list of questions
- Commenting others' work
- Carrying out an assignment
- Solving a problem
- Making an interview (to an expert...).

Examples of Teams include:

- Individual learner
- Dyad
- Small group

- Medium sized group
- Large group
- Plenary.

Examples of Technologies include:

- Forum
- PowerPoint/Prezi, or other presentation tools
- Wiki
- Whiteboard
- Video-conference
- WWW
- Text/video editor.

The Time component includes: duration (hours, days, months, etc.) and organization in phases (one phase, two phases, more phases, etc.).

In order to support teachers when they are not yet familiar with the notion of collaborative learning, it is possible to use 'collaborative Techniques'¹ (Pozzi & Persico, 2011) that are patterns, or models, of already existing collaborative activities. They are content-independent and can be taken up and adopted to specific contexts.

Examples of these collaborative Techniques include:

- Brainstorming
- Discussion
- Peer Review
- Case study
- Role Play

¹ In the scientific literature this notion is also referred to as: collaborative scripts (Dillenbourg & Hong, 2008; Dillenbourg & Jerman, 2007; Kollar et al., 2006; Weinberger et al., 2004; Fischer et al., 2007) or Collaborative Learning Flow Patterns (Hernández-Leo et al. (2005).

- Jigsaw
- Pyramid.

Any collaborative technique can be described in terms of the 4Ts (Task, Time, Team, Technology). As an example, below you can see a Jigsaw described using the 4Ts model.

Time	2 phases								
	Phase 1	Phase 2							
Task	 Individual studying of materials to cover one aspect of the problem Collaborative preparation of a presentation 	 Collaborative problem solving, basing on the competences each member of the jigsaw groups has acquired in phase 1 (expert groups) 							
Team	Individual learner (for studying) "Expert groups" (small groups) (for the preparation of the presentation)	"Jigsaw groups" (small groups)							
Technology	Studying materials Forum	Forum							

Table 1 - Example of a Jigsaw according to the 4Ts model

All the notions mentioned above (Task, Team, Time, Technology and Technique) are used in the I4Ts game, as explained in the sections below.

3. The Hybrid I4Ts game

As already mentioned, the Hybrid I4Ts Game is a means to engage teachers in an iterative, social process of: (a) co-decision making centered on the four elements (the four Ts) and the relationships among them in a learning path; and (b) consideration of and reflection on the many variables at play when socio-economic and/or cultural differences are present in the class (the "I" in "I4T" stands for "inclusion").

The game has been developed (and can be played) in 3 different formats:

- a paper game²;
- a digital game³
- the hybrid game (which is composed of the integration of the paper + digital versions)⁴.

In the sections below, each version of the game is briefly described.

3.1. The paper game

The paper game is composed of a board and 4 decks of cards.

The board represents the Time component (4 columns = 4 weeks) and has also room for the definition of the learning objectives, the contents and the context (see Figure 2).

WEEK 1						v	VEEK	2			. 1	WEEK	3			2	WEEK	4		٦	
415	м	т	W	т	F	м	т	w	т	F	м	т	W	т	F	м	т	W	т	F	
CONTEXT																					
GOALS																					
CONTENT																					

Figure 2 - The board of the paper game

The decks contain cards for the Tasks, the Teams, the Technologies and the Techniques.

² The paper game was developed and tested before the beginning of the PLEIADE project, it does not contain any "inclusive oriented" functions and it is therefore called "4Ts game"

³ A prototype of the digital game, which did not contain any "inclusive oriented" functions and was not road tested, existed before the PLEIADE project. This version has been enhanced with inclusion oriented tips and it is called "I4Ts game".

⁴ This has been developed specifically for the PLEIADE project, and includes inclusion-oriented features: it is called the "Hybrid I4Ts game"



Figure 3 - Cards in the paper game

Each card contains a definition and indications as far as possible connections/relationships with other cards (see example in Figure 4). For a complete list of cards, see Appendix 1.



Figure 4 - Example of front and back of a technique card

To play the game, groups of teachers (4-6 persons) sit around the board and discuss to define the context, the goals, as well as the contents of the activity. They need to write down on a piece of blank paper their decisions and put the papers down, to fill the specific fields in (left side of the board).

Then, they can start looking at the cards, manipulate and read them, discuss pros and cons and make decisions together about which cards to put on the board, thus conceptualizing their collaborative activity (Figure 5). Unlike other games, there is no 'turn taking' and all the teachers are free to contribute to the discussion as they like.



Figure 5 -Teachers playing with the paper game

Teachers can choose to play the game by using the Technique cards (which provide more scaffold in terms of decision making) (see Figure 6), or to skip those cards and play with only Task, Teams and Technology cards (see Figure 7), as well as the board representing Time.



Figure 6 - Playing with the Technique cards



Figure 7 - Playing without the Technique cards

In case teachers need a Technology, Task or Team which is not included in the available decks, they can use Wildcards, i.e. blank cards that they can fill in, to create new Tasks, Technologies and Teams.

The field-tests conducted with the paper game in real settings provided evidence that the use of tangibles mediates and supports engagement in the decision-making process and also fosters teacher creativity and motivation (Pozzi, Ceregini, & Persico, 2016).

3.2. The digital game

The digital game is an application that reflects the paper version of the game. It is supposed to be used by groups of teachers, interacting through a video-conferencing system.

In this case, one teacher needs to act as a 'Gamemaster', i.e. s/he will have the game installed on their computer and will share the screen with their colleagues. This way, the group will discuss and when a decision is taken about what card to put on the board, the master player will do it. As in the paper game, there is no 'turn taking', all the teachers are free to contribute to the discussion as they like.

In terms of interface, the digital game reflects the paper version. There is a board, quite similar to the paper one and the same sets of cards (see Figure 8).

	WEI	EK 1	WE	EK 2	WE	ЕК 3	WEEK 4 😑		
		E EVIEW - PHASE				E EVIEW - PHASE	TECHNIQUE PEER REVIEW - PHASE III		
CONTEXT my contex	TASK STUDYING	TEAM NOT	TASK PRODUCING AN ARTEFACT	TEAM THE	TASK COMMENTING ON SOMEONE ELSE'S WORK	TEAM ()) SMALL GROUPS	TASIK PRODUCING AN ARTEFACT	TEAM LỘI SMALL GROUPS	
GOALS my goals	TECHNOLOGY SELECTED STUDY MATERIALS		TECHNOLOGY MATERIALS AND TOOLS FOR PRACTICE	TECHNOLDGY NO COMMUNICATION TECHNOLOGY	TECHNOLOGY		TECHNOLOGY MATERIALS AND TOOLS FOR PRACTICE	TECHNOLOGY NO COMMUNICATION TECHNOLOGY	
CONTENT							TASK PRESENTING WORK	TEAM TOP	
my contents							TECHNOLOGY NO COMMUNICATION TECHNOLOGY	TECHNOLOGY	

Figure 8 - Interface of the digital game (board and cards on it)

The added value of the digital game is that behind it there is a knowledge base, which knows all the possible relationships among cards and is thus able to provide feedback to the players.

The feedback is in terms of:

1) completeness of the design (Figure 9)

	WEEK 1		WEE	EK 2	WEEK 3	WEEK 4
		W - PHASE				
COMPLETEZZA CONTEXT my contex	TASK STUDYING	NVIDUAL ARNERS	TASK PRODUCING AN ARTEFACT	A		
GOALS my goals	TEORIDADOV SELECTED STUDY MATERIALS		A	<u> </u>		
CONTENT						
my contents						

Figure 9 - Feedback in terms of completeness

In this case, the yellow triangles alert teachers that the design is incomplete (according to the Technique card chosen).



2) Suggestions on how to proceed with the design (Figure 10)

Figure 10 - Suggestions

Teachers can get indications on possible cards that can be chosen for the selected slot.

- WEEK 1
 WEEK 2
 WEEK 3
 WEEK 4

 Image: Contents
 Image: Contents
 Image: Contents
 Image: Contents

 Image: Contents
 Image: Contents
 Image: Contents
 Image: Contents

 Image: Contents
 Image: Contents
 Image: Contents
 Image: Contents

 Contents
 Image: Contents
 Image: Contents
 Image: Contents
- 3) Inconsistency of cards (Figure 11)

Figure 11 - Inconsistency of cards

In this case, the system alerts teachers that the chosen card is inconsistent with the rest of the cards on the boards. Teachers need to remove the inconsistent card and then make a different choice. In this case, for example, the inconsistency comes from the fact that the Task "Producing an artifact" cannot be associated with the Technology "Presentation software" (e.g. PowerPoint), as an artifact usually requires materials and/or tools for practice.

The digital game, besides offering feedback, allows for persistence of the designs produced and for their retrieval and reuse.

3.3. The hybrid game

The hybrid game is the integration of the paper and digital game. It leverages the advantages of both the tangible (face to face continuous interaction based on cards manipulation by the players) and digital (e.g., possibility of providing immediate feedback on the choices made and 'saving' the state of the final board for future use) versions of the 4Ts game.

According to the project proposal, the hybrid game has been featured with additional game mechanics. In particular, the game has been structured into three levels, including a basic level, an advanced level and an expert level. At the basic level, the design process is highly scaffolded (i.e. at this level users need to start the design from the Technique cards and the system provides feedback); at the intermediate level users get some scaffolding (i.e. the user doesn't use the Techniques any more, but the system provides feedback about the Task, Team and Technology cards only; at this level the users is also awarded with more cards, which allow for more complex designs); the expert level acts as a sandbox for the now-experienced player as the system does not provide any more feedback and other cards are awarded, including Wildcards (i.e. blank cards that the user is free to personalize, to add new Tasks, Teams or Technologies, as s/he likes as it already happens in the paper game).

As soon as the user plays the game and becomes familiar with the design of collaborative activities, the system allows them to switch to the following level, allowing more freedom, but at the same time intensifying the complexity of the task.

Moreover, the hybrid game has been enriched with "inclusion features", i.e. the texts of the cards have been enhanced with inclusion-oriented tips, aimed to help teachers choose cards in consideration of inclusion purposes.

To be noted that other features to be added to the game are under discussion in the partnership, i.e. the possibility to include "scenarios" cards (cards providing an initial context for an hypothetical design), as well as "twists" cards (bringing about unexpected events, disrupting the original context of design).

Below, you will find the User Manual with all the instructions to use the game, as well as the Technical Manual (for developers).

3.4. User manual

3.4.1. Technical setting - Requirements

Digital Game

The I4T game can be installed both on macOS and on Windows platforms.

Requirements:

macOS:

OS 10.15.x (Catalina or +), 8GB ram

500 MB Disk Space

A stable internet connection to connect to the KnowledgeBase Server

The macOS application can be downloaded from here:

https://open-lab.com/out/pleiade/i4T macOS.zip

Windows:

Windows 10, 8GB ram

500 MB Disk Space

A stable internet connection to check the KnowledgeBase Server

the Windows application can be downloaded from here:

https://open-lab.com/out/pleiade/i4T win.zip

Hybrid Game

To play I4T in its Hybrid version you need:

- A 2K webcam
- A laptop or a PC macOS or Windows with the latest OS and with at least 8GB of ram with installed on the i4T game
- An arm or a tripod to install the webcam perpendicular to the game table at a distance of about 120 cm.



Figure 12 - Setting for the hybrid game

3.4.2. How to print the board and cards

The hybrid game works with a 70x100 cm real board and with 4 deck of cards (Technique, Task, Team, Technology).

Open Lab realized an online tool that can display, paginate and print all the cards of the decks in the correct size and with all the cards definition. You can save them as PDF and print all the cards yourself or at any print service. Cards can be saved in black and white or in color versions and they have the correct size for the 70x100cm board.



Figure 13 - Printed cards

On this tool page you can also find a link to download the 70x100cm I4T board in PDF format: Online Card Tool: <u>https://open-lab.com/out/pleiade/</u>



Figure 14 - Printed board

3.4.3. How to install the game (both digital and hybrid)

For both macOS and Windows applications you need to download the corresponding .zip file from the provided links. Once downloaded, double click on it to expand the i4t.app on a macOS and the i4T folder containing the i4T.exe file on Windows. Put the unzipped file in the Applications folder.

! On macOS platforms the first run of the i4T must be done using the contextual menu otherwise you'll receive an alert that prevents the app from running because it is not certified by Apple. To do that, right click on the app icon and choose "Open" from the menu. This will open a window from where you can authorize the app to be used on your computer.

3.4.4. How to play the game

Digital Game

At the first play, before starting the game, the player needs to insert a nickname as a unique identifier to let the system save the gameplay state. The player needs to type the name in the field and then click on "Start a new game". The buttons "level 1", "level 2" and "level 3" identify the 3

levels of the game (i.e. basic level, advanced level and expert level; see Section 3.3). Please note that when starting the first game, only Level 1 is active.

Alternatively, if the player wants to continue an already saved game, then s/he will click on the corresponding "Play" button and the game will resume at the state it was left. A saved game can also be deleted.

Note that on the right top side of the screen, there is a link pointing to the online sheet generating the cards in English (see Section 3.4.2). Usually players do not need to change this link, but if a translation of the cards is available, then it is possible to change the link, to point to the translated sheet that will generate cards in a different language.

Start a new Game:	QUIT
You can change the Sheet ID to draw your own cards 11wEMb8UJZQkI92caK7ts8Gi4tQlyF7uVLK	ZwiuKZ_74
Game Name	
LEVEL 1 LEVEL 2 LEVEL 3	
	START A NEW GAME
Continue a saved Game:	
test	PLAY 🔽
Download the ga	me play
Upload the game play	LOAD GAME FROM FILE (.14T)

Figure 15 - Start screen of the game

The player can also download locally on his/her computer each of the saved game as file and load it later to continue the gameplay. This is useful to transfer the game play from a computer to another.

Once the game is running the I4T Board is displayed in full screen.

	WEEK 1	WEEK 2	WEEK 3	WEEK 4 📋
	JIGSAW - PHASE I (EXPERT GROUPS)			
CONTEXT this is the context				
GOALS these are the goals				
CONTENT				
these are the contents				

Figure 16 - Full screen board

Similarly to the paper game, teachers will need first to identify context, goals and contents of the activity and type to fill the specific fields in (left side of the screen).

Then, teachers can click on the card slot to display the list of the cards of the slot category (Technique, Task, Team, Technology). Choose one of the displayed cards to add it to the board.

Once the card is added, the board will be checked via the KnowledgeBase server to verify the state.

If an error is returned, the user must correct the card before continuing playing (Figure 11 - Inconsistency of cards).

Teachers can also ask for card suggestions from the card list display (Figure 10 - Suggestions).

Moreover, at any time, teachers can ask for a check of completeness (button on the left top of the board) and the system will provide feedback about cells where cards are still missing (Figure 9 - Feedback in terms of completeness).

To quit the game, just click on the red circle at the top right of the screen. The game will be automatically saved and can be retrieved from the list on the start screen (Figure 15 - Start screen of the game).

Hybrid Game

If teachers want to play with the Hybrid game, they can open the settings panel, from the button available on the top right corner (red circle), and from there switch to the Hybrid mode.

Prefere	nces			
	Off	Hybrid Moo	de is ON	
	Available w	ebcams		
	Epoc	Cam	Videocamera HD FaceTime (integrata)	
	SHOW CAM			
	RESTART	Go to the s	start screen	
	QUIT	Quit the ap	plication	

Figure 17 - Setting panel

A list of the available connected webcams, if available, will be displayed and you will be able to choose from one of them.

To check if the webcam is correctly displayed on the board, teachers can switch on the camera view and see what the camera is watching at that moment. The application will display a log on the right of the screen with, possibly, some advice for the cam view calibration. If one or more of the corner markers of the board are not well visible by the cam or if the Cam is not well aligned with the board, the system will display an alert with a message to help you correct the position.

		SET HWARA'T	SETTIMAT	NPA-2	OLT HIMMINA O	SETTIMA
	10				-	HIDE CAM
	WEEK 1	WEEK 2	WEEK 3	WEEK 4	analyzing the	board
Jacob Fr						
T 21 Di sufi Freinsmert						
for Inclusive IsAming Design in Europe						
	1					
GAME LEVEL						
CONTEXT						
					4	
OBJECTIVES						
1 1 1 1						
UTC						
CONTENT						
7-11						
	DUARD: 45 X 70 (30				
		en e				

Figure 18 - Camera view

Once the Hybrid calibration is done, you can close the camera view and start playing your cards on the board.

The first card that should be placed on the board is the "Activation Card" which actually starts the hybrid system and "tells" the system to keep track of the cards placed on the board from that moment on.



Figure 19 - "Activation card"

If that card is present on the board, then any card you will place on the cells will be tracked by the system and displayed on the digital board too. Any time the card is displayed on the digital board, the Knowledge Base Server is called to check the consistency of the play. This means teachers can play with the paper game and look at the screen of the laptop/PC to check if there is any feedback from the system (in terms of consistency).

The Completeness check can be performed by replacing the "Activation Card" with the "Completeness Check" one on the board. Doing that all the missing cards will be displayed on the virtual board (see Figure 9).

To ask for suggestions playing on the real board, players can place the "Suggestion" card on the slot for which he needs help. The available cards for that slot will be displayed on the PC screen (Figure 10). Removing that card the window on the PC will be closed.

3.5. Technical information

The I4T Game is made using **Unity3D** version 2019.4.9f1 (https://unity.com).

The source code is written in C#. It is realized under GPL license and it is Open Source.

The Hybrid game is developed using the open source **"OpenCV"** ArUco markers Library (<u>https://docs.opencv.org/master/d5/dae/tutorial aruco detection.html</u>) ported for C# and Unity (<u>https://github.com/NormandErwan/ArucoUnity</u>) by Erwan Normand.

The Online Card service is developed in PHP, javascript, CSS and HTML.

It uses a Google sheet as a datasource converting it into a JSON object to retrieve and display the cards' data.

Markers are produced based on the card ID using the **ArUco Marker generator** realized by Oleg Kalachev (<u>https://github.com/okalachev/arucogen</u>).

Markers dictionaries are taken from this URL:

https://raw.githubusercontent.com/opencv/opencv_contrib/master/modules/aruco/src/predefin ed_dictionaries.hpp.

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Appendix 1 - Complete list of cards

The deck is composed of 142 cards.

Technique Cards		(Tot. 19 cards)
\rightarrow	JIGSAW – Phase I (Expert Groups)	(x1)
\rightarrow	JIGSAW – Phase II (Jigsaw Groups	(x1)
\rightarrow	PEER REVIEW – Phase 1	(x1)
\rightarrow	PEER REVIEW – Phase II	(x1)
\rightarrow	PEER REVIEW – Phase III	(x1)
\rightarrow	CASE STUDY – Phase I	(x1)
\rightarrow	CASE STUDY – Phase II	(x1)
\rightarrow	PYRAMID (FOR LIST PREPARATION) – Phase I	(x1)
\rightarrow	PYRAMID (FOR LIST PREPARATION) – Phase II	(x1)
\rightarrow	PYRAMID (FOR LIST PREPARATION) – Phase III	(x1)
\rightarrow	PYRAMID (FOR PROBLEM SOLVING) – Phase I	(x1)
\rightarrow	PYRAMID (FOR PROBLEM SOLVING) – Phase II	(x1)
\rightarrow	PYRAMID (FOR PROBLEM SOLVING) – Phase III	(x1)
\rightarrow	ROLE PLAY – Phase I	(x1)
\rightarrow	ROLE PLAY – Phase II	(x1)
\rightarrow	DISCUSSION – Phase I (ALL CASES)	(x1)
\rightarrow	DISCUSSION (TOWARDS ASSIGNMENT) – Phase II	(x1)
\rightarrow	DISCUSSION (TOWARDS ARTEFACT) – Phase II	(x1)
\rightarrow	DISCUSSION (TOWARDS REPORT) – Phase II	(x1)

Task	Cards	(Tot. 52 cards)
\rightarrow	WRITING A TEXT	x4)
\rightarrow	STUDYING	(x4)
\rightarrow	FINDING MATERIALS	x4)
\rightarrow	PREPARING A PRESENTATION	(x4)
\rightarrow	PREPARING A LIST OF QUESTIONS	(x4)
\rightarrow	COMMENTING ON SOMEONE ELSE'S WORK	(x4)
\rightarrow	PRESENTING WORK	(x4)
\rightarrow	CARRYING OUT AN ASSIGNMENT	(x4)
\rightarrow	SOLVING PROBLEMS	(x4)
\rightarrow	INTERVIEWING AN EXPERT	(x4)
\rightarrow	ASSUMING ROLES	(x4)
\rightarrow	PRODUCING AN ARTEFACT	(x4)
\rightarrow	DEBATING	(x4)
Technology Cards		(Tot. 44 cards)
\rightarrow	FORUM (x4)	
\rightarrow	PRESENTATION SOFTWARE	(x4)
\rightarrow	WIKI SOFTWARE	(x4)
\rightarrow	INTERACTIVE WHITEBOARD	x4)
\rightarrow	VIDECONFERENCING SYSTEM	(x4)
\rightarrow	SELECTED STUDY MATERIAL	(x4)
\rightarrow	SOURCE OF MATERIALS FOR LEARNING	(x4)
\rightarrow	TEXT EDITOR	(x4)
\rightarrow	PROJECTOR	(x4)
\rightarrow	NO-TECHNOLOGY	(x4)
\rightarrow	MATERIALS AND TOOLS FOR PRACTICE	(x4)
Tean	n Cards (Tot. 24 cards)	
\rightarrow	INDIVIDUAL LEARNERS	(x4)
\rightarrow	PAIRS	(x4)
\rightarrow	SMALL GROUPS	(x4)

\rightarrow	MEDIUM-SIZED GROUPS	(x4)		
\rightarrow	LARGE GROUPS	(x4)		
\rightarrow	PLENARY	(x4)		
Other cards				
Activation card		(x1)		
Call for suggestions card		(x1)		
Check for completeness card		(x1)		