The Hybrid I4Ts Game - PLEIADE Intellectual Output 2
(Revised version)

"PLayful Environment for Inclusive
leArning Design in Europe"
"PLEIADE"
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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 Hybrid I4Ts 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.
	In this document, which is intended as a User Guide for teachers/players, the game is described in its 3 formats: paper, digital and hybrid version. Instructions on how to set up the game and how to play with it are provided.
	To be noted that this document is accompanying the second release of the software: the first release was delivered at month 8, while the second release is provided at month 25, after use by the teachers involved in the project.
	The game is Open Source and available in English, Italian, Bulgarian and Greek. The game is also easy to be localised into other languages.
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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 Hybrid I4Ts 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**.

In this document, which is intended as a **User Guide** for teachers/players, the game is described in its 3 formats: paper, digital and hybrid version. Instructions on how to set up the game and how to play with it are provided.

To be noted that this document is accompanying the second release of the software: the first release was delivered at month 8, while the second release is provided at month 25, after use by the teachers involved in the project.

The game is Open Source and available in English, Italian, Bulgarian and Greek. The game is also easy to be localised into other languages.

2.   Introduction

Aim of this document

This is the revision of the accompanying document of Intellectual Output 2 (IO2) of the Erasmus+ project "PLayful Environment for Inclusive leArning Design in Europe" (PLEIADE), the **Hybrid I4Ts 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.

In line with the project Gantt, IO2 was released in its first version at M8, while this is the revised version, due at M24, which will be released with one month delay (M25).

To be noted that, while, according to the proposal, the IO2 is the game in itself, it was decided to accompany it with a document describing the game and its main features (this document). This implies this document should NOT be intended as a deliverable in itself or a complete technical documentation, it does not contain the overall description of the design and development process, nor it contains the theoretical background underlying the game. It is intended, instead, as a document targeting the game users (sort of User Guide), to give information on how the game works and how to set it up to support first use.

Nonetheless, for completeness sake, some basic technical information about the system architecture is provided in this document. In addition, the main technical information will be provided as part of Intellectual Output 6 'Amplification kit', which is the project document intended to allow up-taking of the main PLEIADE IOs from people external to the project; thus in IO6 all the necessary information will be provided to allow transferability and re-use of the game in contexts different from the original one.

<u>Structure of this document</u>
Given that the document is a revision of the first version[1], first of all it contains a section where details are provided regarding the changes done to the I4Ts game and to the document itself. Then the document continues with a brief description of the 4Ts model underlying the game and then a description of the game is provided, divided into 3 sub-sections: the paper game, the digital game, the hybrid game. A brief technical section follows, with information about the main system components.

3. Evaluation of the first release and main revisions done

According to the project proposal, the game was intended to be used during the training phase (at the SJSTEs) by the teachers to design the collaborative learning activities they would enact in their classes in the subsequent phase of the project.

As already described in the Annual Project Management Report and project Interim Report, unfortunately, using the hybrid game during SJSTE1 (June 2021) was impossible, as the event was held fully online due to the pandemic, while the hybrid setting requires face-to-face interactions of teachers. Besides, as this version of the hybrid game was still a prototype, its hardware setup still required technical support, which was unfeasible at a distance. At that time, we hoped we would have the opportunity to use the hybrid game during the SJSTE2 (October 2021), but this SJSTE also had to be shifted online, for the same reason. However, during SJSTE2 teachers needed to start the design process and hence game use could not be further postponed. Thus, it was decided to use the paper and digital formats only, which were both easily manageable at local level by the schools, while use of the hybrid game was (once again) postponed to SJSTE3 (currently scheduled in October 2022), hoping it will be in presence.

This means up to now the game (paper and digital versions) has been used overall by the teachers involved in the SJSTE2 (N=68), while its hybrid version was used by the participants (N.=36) in the project international Multiplier Event (held in Sestri Levante, in April 2022).

In both occasions data was collected to gather users' feedback and evaluate the game. The results of such evaluation will be reported in IO6 'Amplification kit', but they constituted the backbone for revising the app. Moreover the feedback provided by the project Internal Evaluator, Prof. Yannis Dimitriadis, also constituted a very useful trigger to refine the game and revise the present document.

Below is the list of the main changes made to the I4Ts game in respect to the first release:
- the integration of the paper and digital versions, to form the hybrid game, has been further improved in respect to the first release; minor bugs in the knowledge base

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[1] Bicocchi, M., Ceregini, A., Persico, D., Polsinelli, P., Pozzi, F., Sarti, L. (2021). The hybrid I4T game (PLEIADE Intellectual Output No. 2). https://doi.org/10.17471/54010

have been fixed, the user interface has been improved, to make the game experience more fluent for the player and the switch between the digital and the hybrid formats smoother (see Section 5.3.3);
- the saving functions allowing persistence of the designs produced and their retrieval for reuse has been further improved;
- the bespoken "inclusion features" (i.e. the inclusion-oriented tips aimed to help teachers choose cards in consideration of inclusion purposes) that were developed within the project, have been further enhanced and refined (and are extensively described in Sections 5.1.4; 5.2.5; 5.3.5 of this document);
- the game mechanics comprising three levels of difficulty (i.e., basic, advanced and expert) that were developed in the first release, have been extensively tested and further improved, in terms of functions, interface, usability, etc. This applies especially to level 2 and level 3 which had been less tested at the first release;
- the feedback messages provided by the system (digital and hybrid) in case of errors, have been improved, in such a way that the feedback is now more informative and allows the player to better understand what is wrong with the current design (see Section 5.2.1);
- exemplar scenarios have been added in the game, to trigger use of Level 1 (see Section 5.1.3). At the time of writing, these have not yet sufficiently experimented and constitute only an embryo of possible, future scenarios. Instead, "twists" cards (cards bringing about unexpected events, disrupting the original context of design) that were under discussion at the time of first release and were not promised in the project proposal, were not developed in the end;
- the present accompanying document has also been revised, to reflect the changes done to the app and to make it more complete and clear, according to our Project Evaluators' suggestions. In particular, the changes made to the document in response to the Project Evaluator's suggestions are synthesised in the table below.

Project Evaluator's suggestions	*Revisions made*
….However, the report is probably **too brief** and does not provide sufficient background information, connection to the related literature, explanations and discussions of the innovative features, or even the inclusion features that are at the core of the proposal, while it does not clarify the status of some features under discussion. On the other hand, the **technical information is clearly incomplete**, regarding analysis, design and development, or even the links to the eventual Github site with the open-source code, and the troubleshooting and maintenance aspects.	This text is an accompanying document to IO2 (i. e. the game) and is intended as a User Guide; for this reason it was conceived as a practical and brief text and was not enriched with theoretical background. Nonetheless, in consideration of the comments raised, we have enriched the text. In particular, regarding the technical information, additional text has been introduced in Section 6 (including the link to the github repository). In any case, most of the information targeting developers and allowing them to take the game up will be released in IO6, i.e the Amplification kit.
The **digital version** mentions the use of a knowledge base that provides feedback regarding completeness, consistency, or cards to be used. However, the report <u>does not provide a complete description of the knowledge base</u>, neither at a conceptual nor	In Section 6 we have provided a description of the knowledge base developed in Prolog. This is a basic information, aimed to allow a user to superficially understand how the knowledge base works. Further information for developers will be provided in IO6.

at a technical level. This is an important requirement to be resolved, since it may show the extent to which these affordances were developed or could be extended, and eventually shed light on the added value with respect to the literature and the paper-based version.	
The **hybrid version** is also very succinctly presented, mentioning that both versions are merged, but without even providing information on how such integration is made and what is the expected flow of the game.	The text now fully describes the hybrid version (Section 5.3). Moreover, some technical information is provided in Section 6.
This version also adds **various levels of complexity** with decreasing scaffolding, as the user becomes proficient. This is an interesting feature that may have some impact, but <u>its description is insufficient</u> in both conceptual and technical terms.	The 3 levels of the game have been more extensively described in Sections 5.1.3, 5.2.4 and 5.3.4).
Furthermore, the inclusion elements seem to be reduced to tips / cards related to this dimension.	Actually, in the game the inclusion features are implemented only in the form of "inclusion tips" on the cards. Given that these were not extensively described in the previous version of the document, now we have extended their description (see Sections 5.1.4, 5.2.4 and 5.3.5), hoping this will allow a better understanding of their role and functioning in the game.
Finally, some **other interesting features, such as those related to initial context or unexpected events**, are mentioned to be "under discussion" but they are not further presented, and therefore <u>it is unclear whether they were finally included in the design and development process</u>.	A description of the exemplar scenario available at the moment is provided. No other gamification mechanics have been introduced.
…there is <u>no link to the eventual Github site</u> in which the code could be found and used. On the other hand, the <u>technical information is seriously incomplete</u> without analysis, design, and development documentation, or even regarding bugs and troubleshooting, besides the already mentioned lack of information regarding the Knowledge Base. This **<u>lack of information may seriously threaten</u>** the reliability, extensibility and maintenance of the tool.	As already mentioned, this information has now been provided in Section 6 and other more technical details will be provided in IO6, to allow developers to localise, extend, and maintain the game.
Overall, the final IO2 report may be updated regarding the technical information and the corresponding text should be included in the IO6 deliverable, so that the game might be adapted, personalised or extended by third parties. Similarly, it is expected that the technical issues may be resolved on time, so that the game can be used in the	The technical issues have been fixed and the hybrid game is now ready to be (hopefully) used in Autumn 2022 at the last SJSTE.

| remaining project, especially taking advantage of the eventual f2f meetings due to the better Covid-19 pandemic conditions. | |

4. The 4Ts model

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, to support this complex design process, 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 (organisation 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.
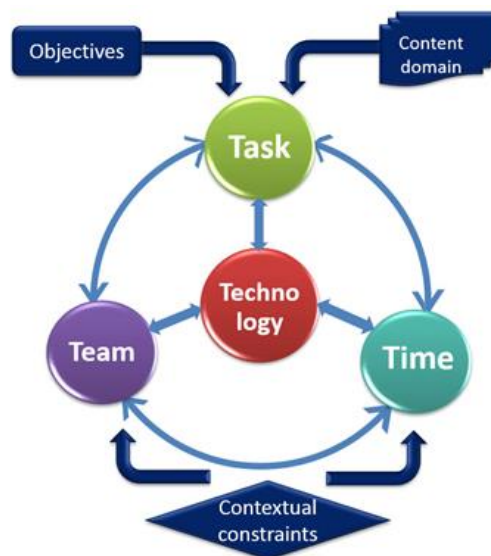
Figure 1 - The 4Ts model (Persico & Pozzi, 2013)

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 organisation 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'[2] (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
- Jigsaw
- Pyramid.

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[2] 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)..

Any collaborative technique can be described in terms of the 4Ts (Task, Time, Team, Technology). As an example, in Figure 2 you can see a Jigsaw described using the 4Ts model. It should be noted that, for each Technique mentioned above, the deck contains one card for each phase needed to carry out the whole technique. In Appendix 1, you can find the descriptions of a number of collaborative techniques that are used in the game.

Figure 2 - 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 it is explained in the sections below.

5.   The I4Ts game

As already mentioned, the I4Ts game is a means to engage teachers in an interactive, social process of: (a) co-decision making centred 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 (as the "I" in "I4T" stands for "inclusion").

The game has been developed (and can be played) in 3 different formats:
- a paper game
- a digital game
- the hybrid game (which is composed of the integration of the paper + digital versions).

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

5.1 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 goals, the contents and the context (see Figure 3).
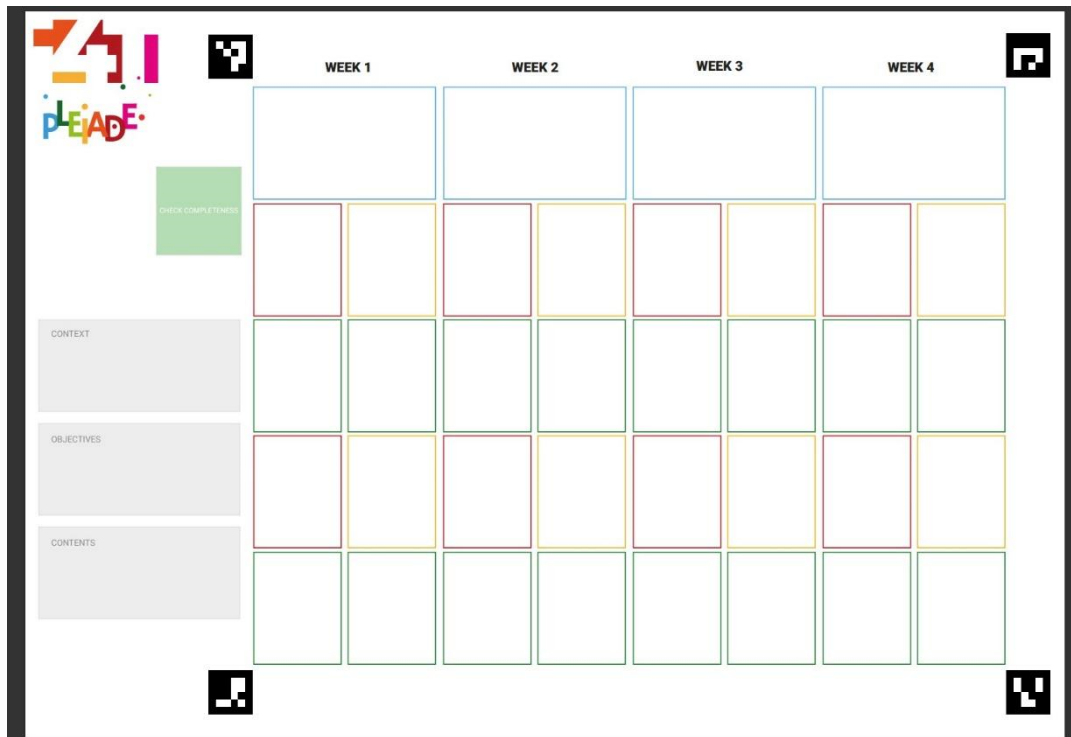
Figure 3 - The board of the paper game

The decks contain cards for the Tasks, the Teams, the Technologies and the Techniques. A complete list of the cards is available in Appendix 2.
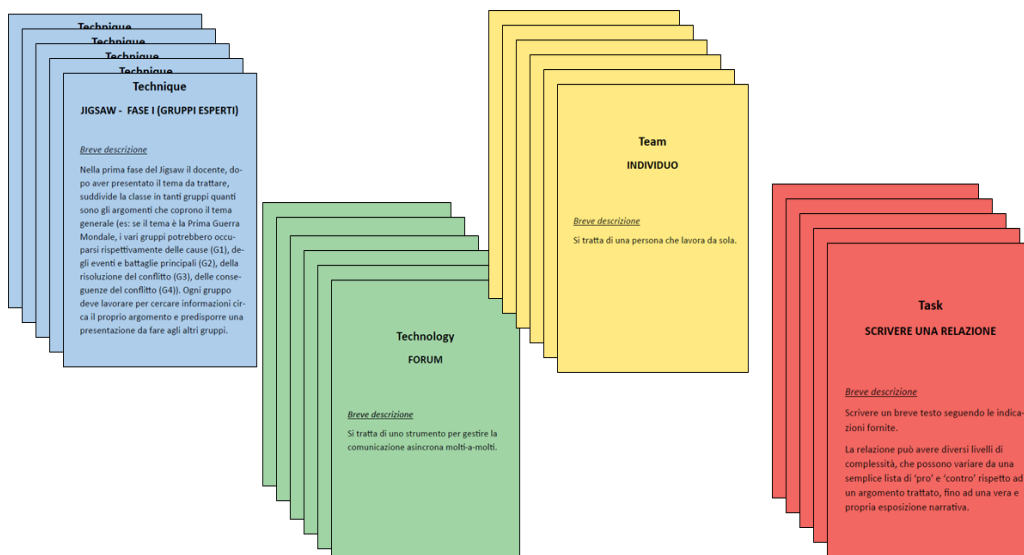
Figure 4 - Cards in the paper game

Each card contains a definition and indications as far as possible connections/relationships with other cards (see Figure 5).

Figure 5 - Example of front and back of a technique card

5.1.1 Paper game setting

To play the paper game, you need to print the board and the cards.

Cards are in English, but there are other languages available[3]. To generate the board and cards to be printed, you can use the Card Generator: https://open-lab.com/out/pleiade/

To change the language, you need to change the SheedID (just cut and paste it into the field of the Card Generator) as it follows:

<u>If you want to print the Italian cards</u>: 1A46tpqm7rP24SZpSakSmB9c8RGi9jU-66ZGv_GCrYVs
<u>If you want to print the Greek cards</u>: 1muXXluXDopua8chs8LjAO1-l5txbw6z3Vb0Lw6HsFVU
<u>If you want to print the Bulgarian cards</u>: 1o6psb1HE4F5Vd2Cd_eH-o53kZph1wF5JtRfTnU1wKLg

For detailed information about how to print the cards and the board see Appendix 3.

5.1.2 Playing with the paper game

To play the game, groups of teachers (from 2 to 8 persons) (from now on, 'players') sit around the board[4] 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 conceptualising their collaborative activity (Figure 6). The game is played in real time; there is no 'turn taking' and all the players are free to contribute to the discussion as they like.

Figure 6 -Players playing with the paper game

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[3] The translation of cards was originally envisaged in the proposal only for Italian, but – given the language barriers experienced in the project – the partners agreed to translate them also in the other two languages of the project (Bulgarian and Greek) so, now, the cards are available in four languages: English, Italian, Greek and Bulgarian.
[4] The board can be printed on paper, but printing it on vinyl or textile is also an option, because it lasts longer. The textile one is more portable.

Players need to READ the contents of the cards and follow the indications, so to make decisions regarding (Technique[5]), Task, Teams and Technology (Figure 7).
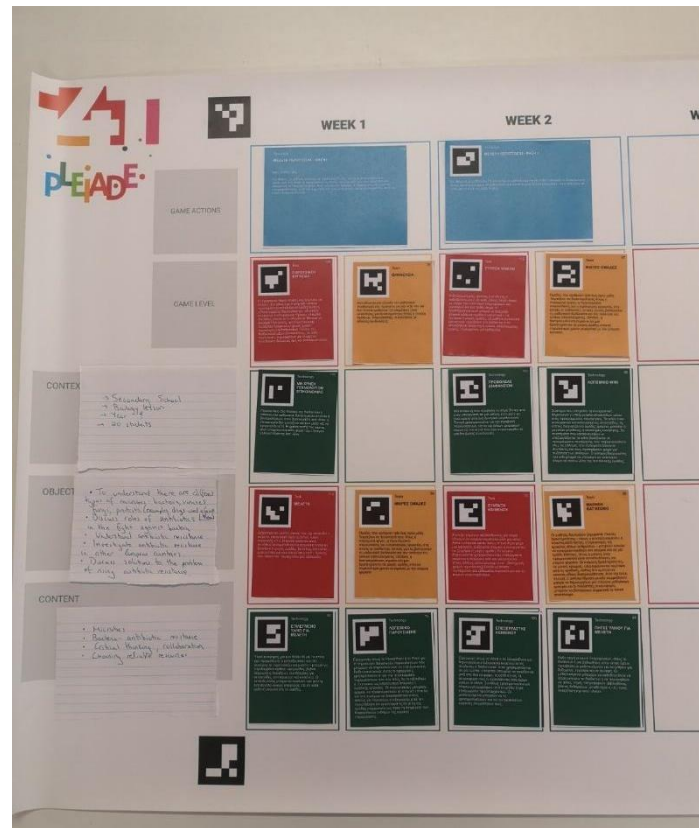

Figure 7 – Example of a paper board with Technique

5.1.3 Gamification mechanics in the paper game

The game is featured with 3 levels of difficulty:

- Level 1 (entry level) is quite scaffolded and implies using (and starting the design process with) the Techniques deck.
- Level 2 (advanced level): is less scaffolded and implies skipping the Techniques cards and playing directly with the Task/Team/Technology decks.
- Level 3 (expert level): is not scaffolded. The system does not provide feedback at this level. Wild cards are also available at this stage, to allow users to add new cards.

Level 1 is recommended for student teachers and teachers who need to become familiar with the Techniques. Level 2, instead, allows for more flexible designs. Level 3 is completely free. It is recommended that at a first use the choice of the level is suggested by the tutor (if the game is used for example in the context of a training imitative).

The use of levels can be triggered through 'guessing games' that can be provided to players on paper sheets. For example, to trigger Level 1, players can be assigned (or be asked to pick up) a guessing game sheet, where they will find their guessing game, asking them to

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[5] Only in Level 1 of the game

guess how a fictitious Master Teacher would design one of the Techniques of the game (see Figure 8).

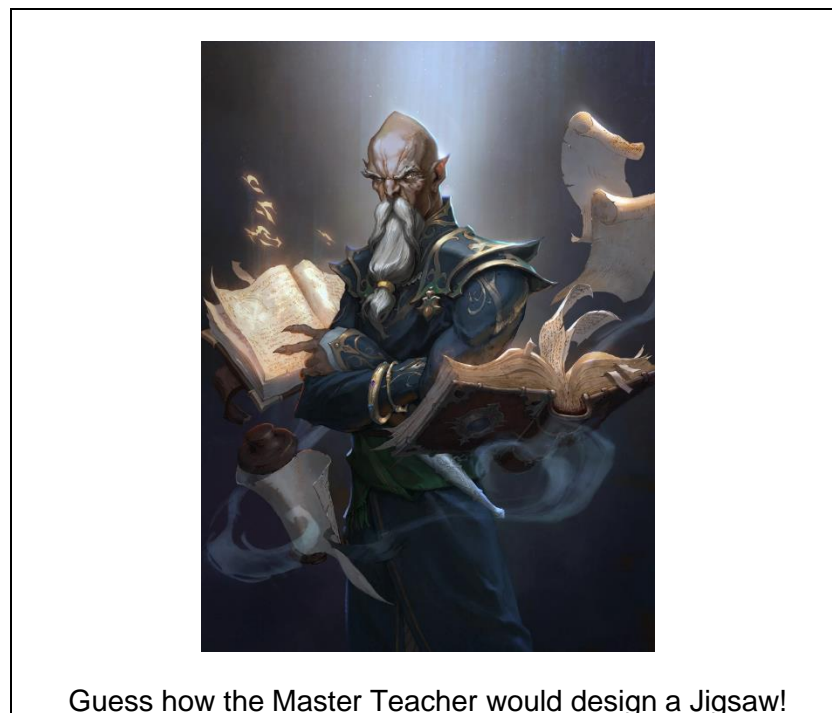Guess how the Master Teacher would design a Jigsaw!

Figure 8 – Example of a guessing game to trigger use of Level 1 in the paper game

5.1.4 Support to 'inclusive design' in the paper game

As already mentioned, the game is intended to support the design of collaborative activities oriented to inclusion. While the 4Ts model supports the collaborative approach, there was a need to provide guidance also in terms of inclusiveness.

To this aim, cards have been featured with 'Inclusion tips': on the back of each card, players can find specific hints and suggestions supporting more informed choices in terms of inclusiveness (see Figure 5).

While all the Team, Technology and Task cards contain the inclusion tips, not all the Technique cards do. In fact, only the first phase of each Technique contains the inclusion tips for that Technique.

To be noted that the Inclusion tips concern pros and cons of choosing that particular card to enhance inclusiveness of the overall design. For example, the inclusion tips of the Techniques cards suggest when it is appropriate to use that Technique, by pointing out strengths and weaknesses of the Technique in terms of inclusion. Similarly, the Technology cards' inclusion tips advise the teachers on the consequences of adopting that technology, and those of the Teams will point out ways in which teams can strengthen or widen social bonds in the class. To some extent, given that the Teams cards only differ for the size of the Teams, the inclusion tips compensate for this limitation by also providing advice on their composition, and the way teams can be formed.

In the table below (Table 1) you can find examples of inclusive tips for each card type:

Table 1 - Examples of inclusive tips for each card type

Card type	Title of card	Inclusion tips
Technique	PYRAMID (FOR LIST PREPARATION) - PHASE I	It favours a gradual appropriation of the knowledge and encourages individuals to defend their own opinions. The change in team configuration does not help consolidation of social bonds but the effect is mitigated by the incremental way groups are aggregated.
Team	SMALL GROUPS	Small groups are ideal to favour socialisation among students, because they get to know each other quite closely. Groups can be formed by the teachers or by the students themselves. If the teacher forms the groups, he/she can use them to alleviate some problems (e.g. teams internally diverse in terms of abilities, gender, linguistic command, or to make sure that members can help each other in several ways). If the students are free to form the teams, the teacher should make sure that they do not form cliques or systematically avoid some of their peers.
Technology	VIDEO CONFERENCING SYSTEM	These systems can replace face-to-face communication when it is impossible. They can be used to facilitate interactions between geographically dispersed students and make diverse realities meet, to include students who cannot be in the classroom (e.g. hospitalised students) or to reach out for experts far away. When the lack of broadband connection or appropriate devices hinders participation, less demanding technological choices might be advisable.
Task	PRESENTING WORK	Presenting a piece of work is usually a very rewarding activity that makes students proud (and defensive) about their work. If the work was a collaborative endeavour, then teachers could encourage the students to make multi-voiced presentations, so that all have their share of glory and responsibility. The use of multiple channels for the presentation makes it easier for peers to understand, so it should be encouraged.

5.2 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 players in front of a touch-screen Interactive Whiteboard (IWB).

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 9).
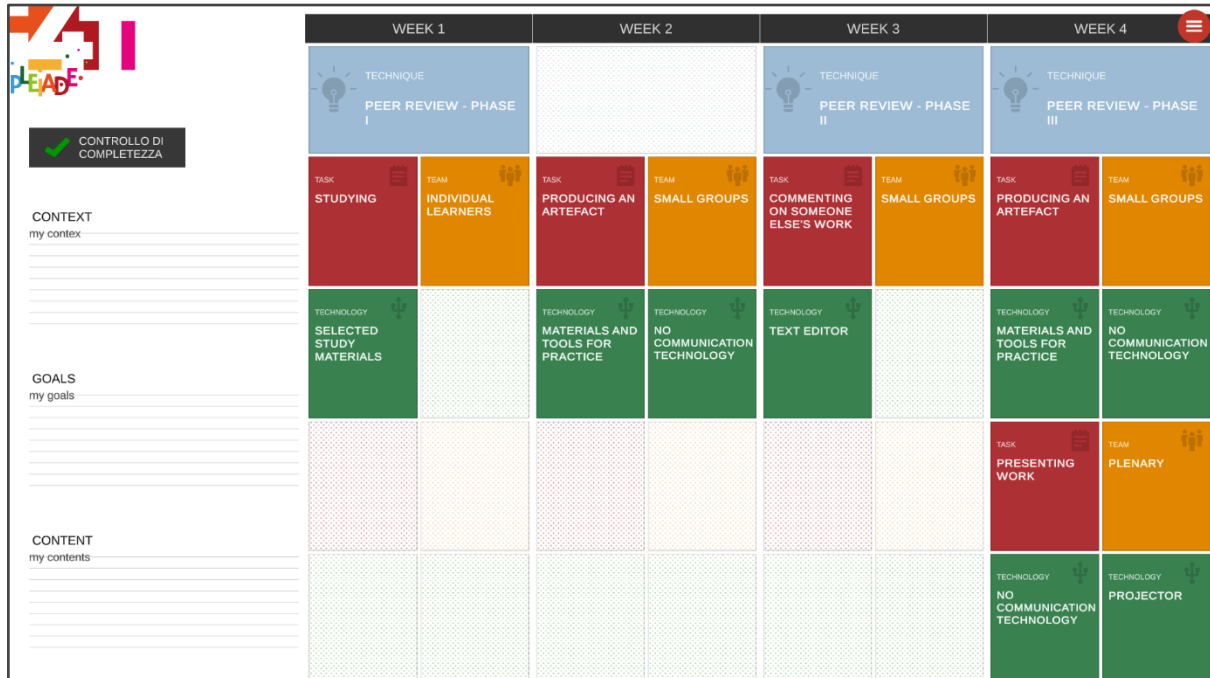

Figure 9 - Interface of the digital game (board and cards on it)

The added value of the digital game is that behind its interface there is a knowledge base, i.e. a software engine which knows all the possible relationships among cards and provides the interface with the information needed to provide feedback to the player about the wrong combinations of cards.

5.2.1 Feedback provided by the digital game

The game provides feedbacks regarding:

1. Completeness of the design (Figure 10). In this case, the yellow triangles alert players that the design is incomplete (according to the Technique card chosen).
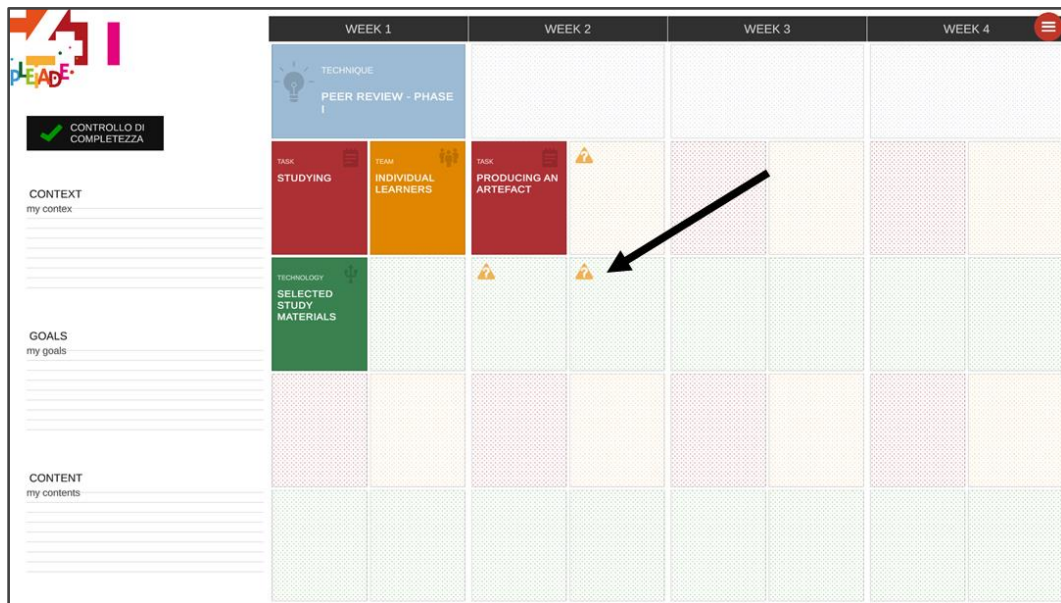
Figure 10 - Feedback in terms of completeness

2. <u>Suggestions on how to proceed with the design</u> (Figure 11). Players can get indications on possible cards that can be chosen for the selected slot.
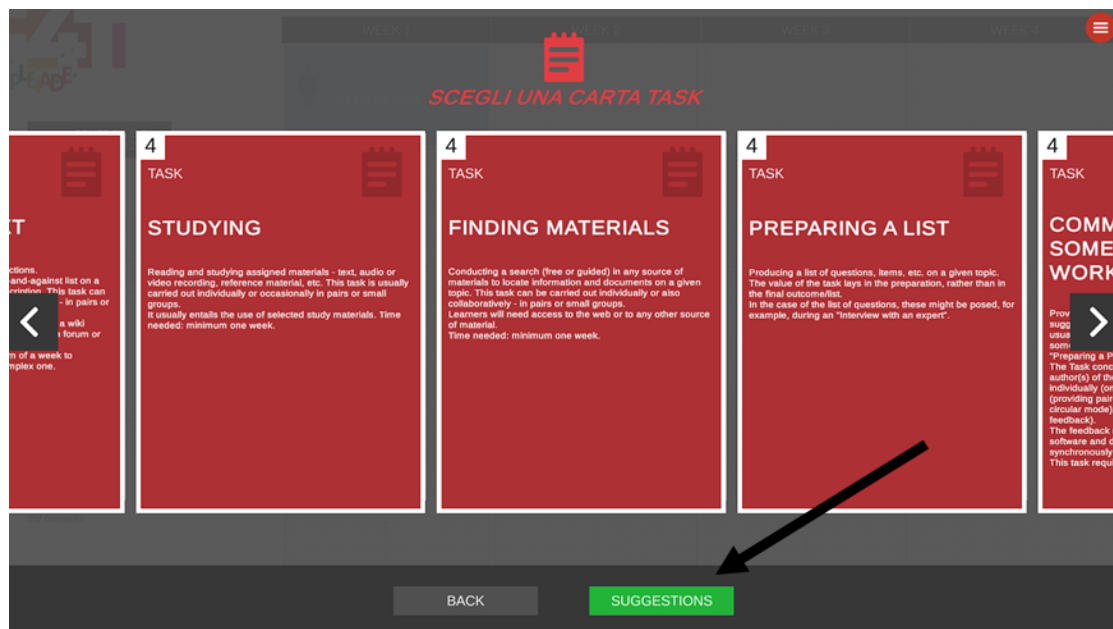

Figure 11 - Suggestions

3. <u>Inconsistency of a new card</u> (Figures 12 and 13). In this case, the system alerts players that the chosen card is inconsistent with the rest of the cards on the board. A red triangle appears on the inconsistent card (Figure 12) and, soon after, an error message window appears (see Figure 13), to provide advise about the specific error and to give suggestions about how to correct it.

Players need to remove the inconsistent card before making a different choice.

In the case of Figure 12, for example, the inconsistency is due to the fact that the Task "Preparing a list" cannot be associated with the Technology "Selected study materials" (you will need a Text editor to write down the list).
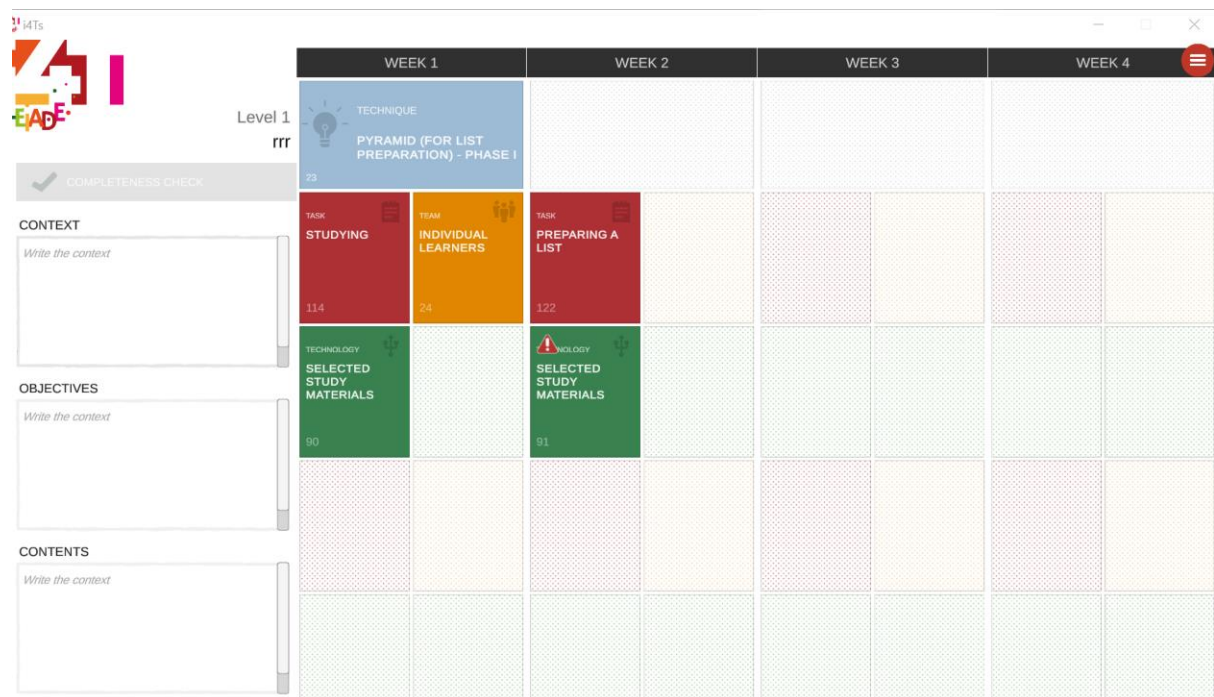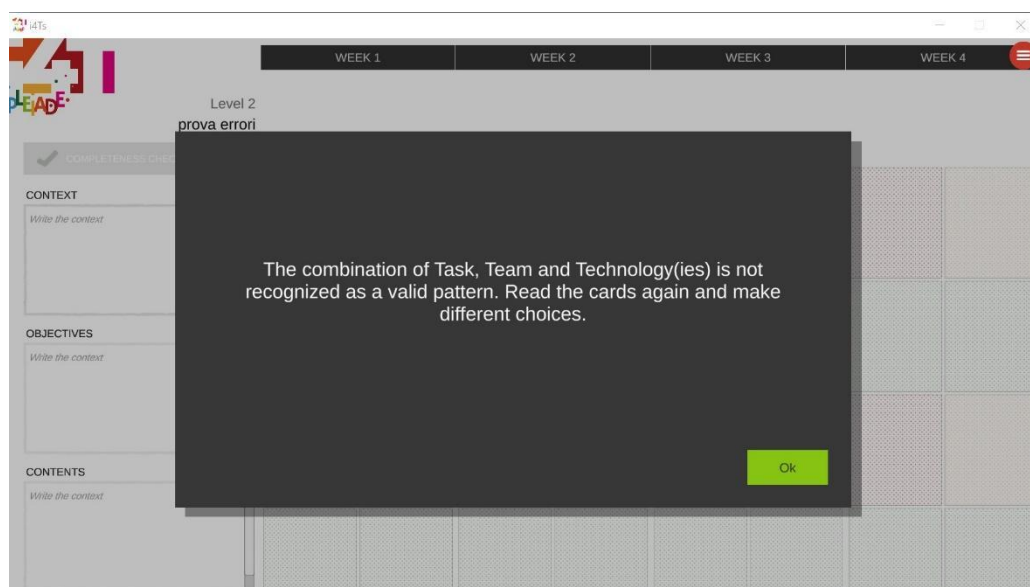

Figure 12 - Inconsistency of cards

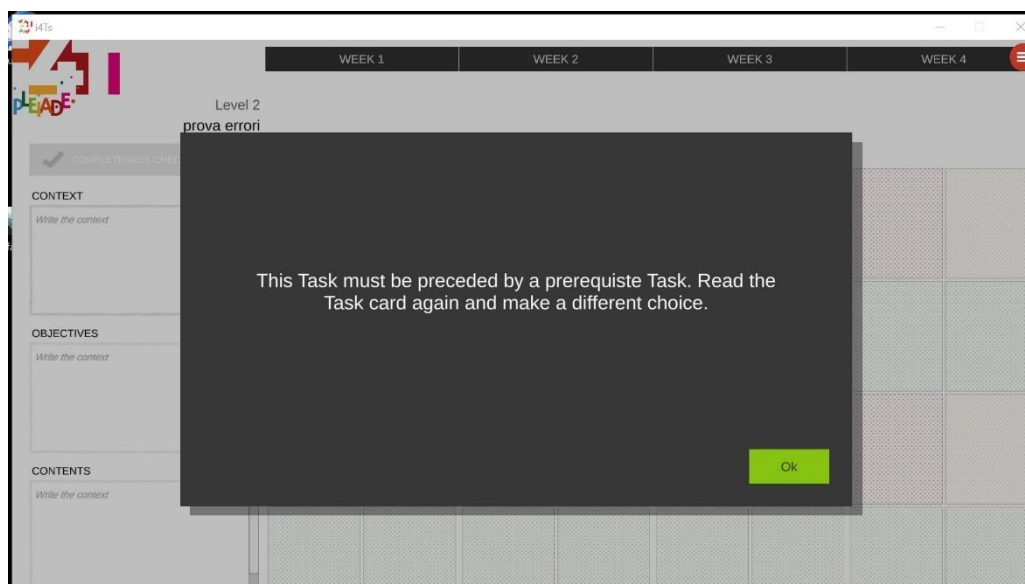Figure 13 shows a couple of examples of error messages.

Figure 13 – Examples of error messages displayed in case of inconsistent cards

5.2.2 Technical requirements & digital game setting

	Mac	**Windows**
Internet	a stable internet connection to connect to the KnowledgeBase Server	
System	macOS 10.15.x (Catalina or newer), 8Gb RAM	Windows 10 or newer, 8Gb RAM
Disk Space	At least 500Mb	
Install the game	Download the zip carrying the game files from: **https://open-lab.com/out/pleiade/i4T_win.zip** Double click it to expand the **i4t.app** application and move this into your mac Application folder.	Download the zip carrying the game files from: **https://open-lab.com/out/pleiade/i4T_macOS.zip** Double click it to reveal the **i4T_win** folder and extract it somewhere on your local disk.
Running the game	To play the game just double-click on the i4t.app application in your mac Application folder. **Note**: the very first time you launch the game you have to do that by the contextual menu, otherwise you'll receive an alert that prevents the app from running. To do that, right click on the app icon and choose "Open" from the menu. This will open a window from where you can authorise the app to be used on your computer.	To play the game just open the i4T_win folder and double-click on the **i4Ts.exe** file. If you're presented with a warning about the game not being safe, don't worry and proceed anyway: the system only does this because it can't certify (yet) the software's origin.

IWB Instruction

If your setting is equipped with a touch-screen enabled interactive whiteboard, you can play the i4T game straight on its surface (see Figure 14). To do this, it is necessary to connect the IWB to the laptop running the game and calibrate the interactive whiteboard's screen, so that it recognizes finger pressure on your screen.

Since this procedure can vary greatly depending on the model of the IWB in use, we will provide general guidelines, recommending that you carry out these operations with a technician or an expert:

- Use the right video cable (generally a HDMI cable on Windows laptops, or a DisplayPort cable on Macs) to send the video signal from the laptop to the IWB;
- To calibrate the screen of the IWB use the drivers provided by the IWB itself or download the relevant software (i.e. for SMART boards it is necessary to use the SMART drivers and software) and connect the IWB to the laptop running the game
  - Note: generally, it's better and easier to use a USB cable to do this, rather than using a wireless connection, but this greatly depends on your specific setup.

5.2.3 Playing with the digital game

Groups of players (4-5[6]) will stay around an IWB, look at the cards and discuss, to take decisions together. The game is real time; there is no 'turn taking' and all the players are free to contribute to the discussion as they like.
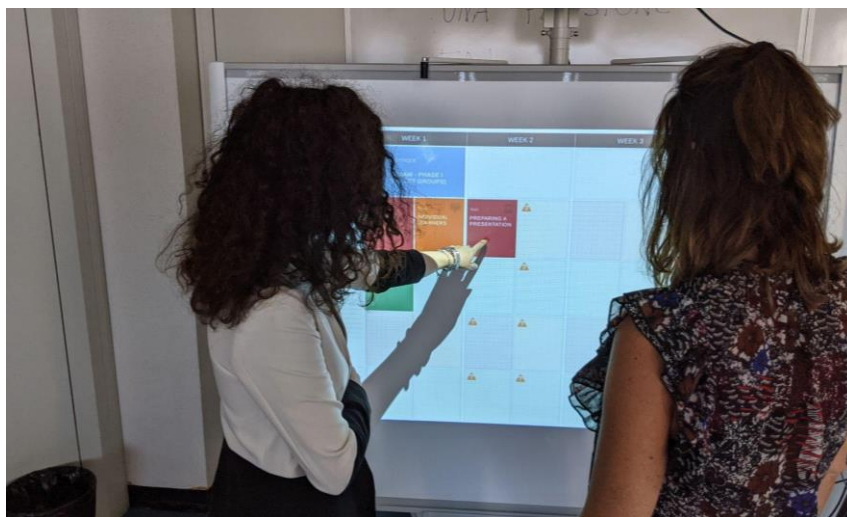

Figure 14 -Players playing with the game through IWB

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[6] While for the paper game, a table usually allows for 7-8 persons to sit around it in a comfortable way, the setting with the IWB allows for less people to stand in front and easily read the contents of the displayed cards. To increase the number of people playing with the digital game, you can consider printing the cards and let people read them while they are also shown on the screen.

!IMPORTANT TIP: Note that in the Start screen of the game (see Figure 15), on the top right side, you can choose the language of the cards. Currently the available languages are: English, Italian, Greek and Bulgarian[7].

It is also possible to create and use other languages. To create new translations of the cards, you should refer to IO6 "Amplification kit".

At the first gameplay, upon starting the game, the players need to insert a design-name as a unique identifier to let the system save the gameplay state. The players need to type the name in the field and then click on "Start a new game". This will make the design retrievable for subsequent gameplay.

To continue a previously saved design, players should click on the corresponding "Play" button and the game will resume at the state it was left. A saved design can also be deleted.

The buttons "level 1", "level 2" and "level 3" identify the 3 levels of the game (i.e. entry level, advanced level and expert level). Please refer to section "3.2.4 Gamification mechanics in the digital game" to see how levels work in the digital game. Players need to choose the level they want to play with.
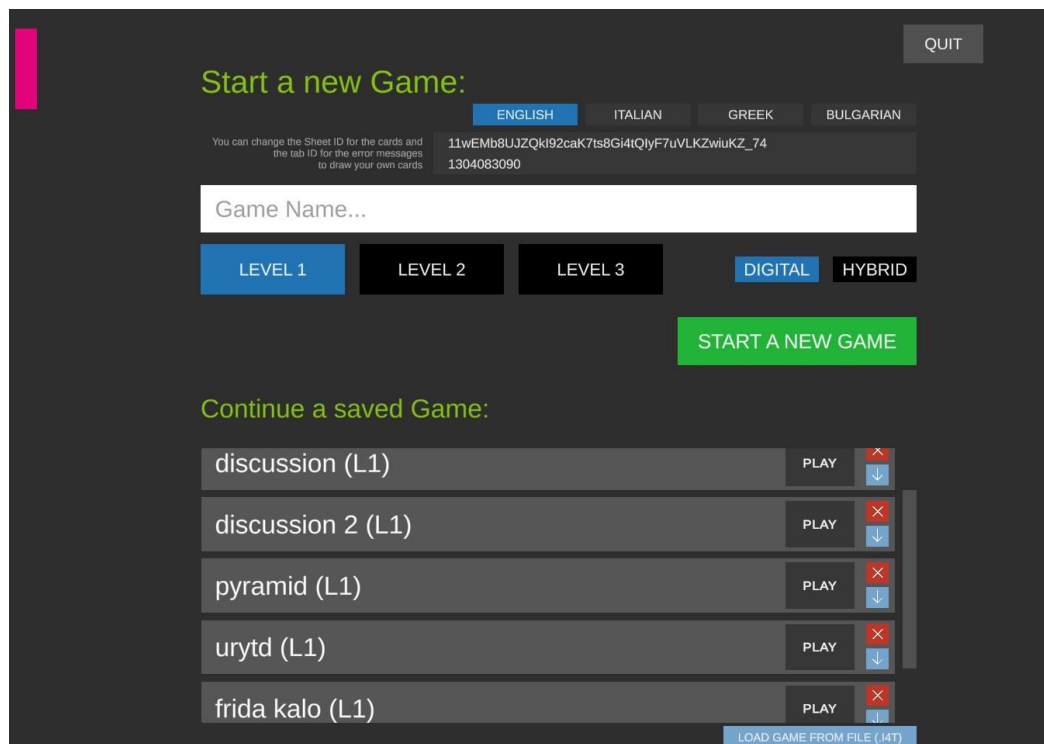

Figure 15 - Start screen of the game

 Once the game is running the board is displayed in full screen (Figure 16).

---

[7] The translation of cards was originally envisaged in the proposal only for Italian, but – given the language barriers experienced in the project – the partners agreed to make the translations also in the other languages of the project.
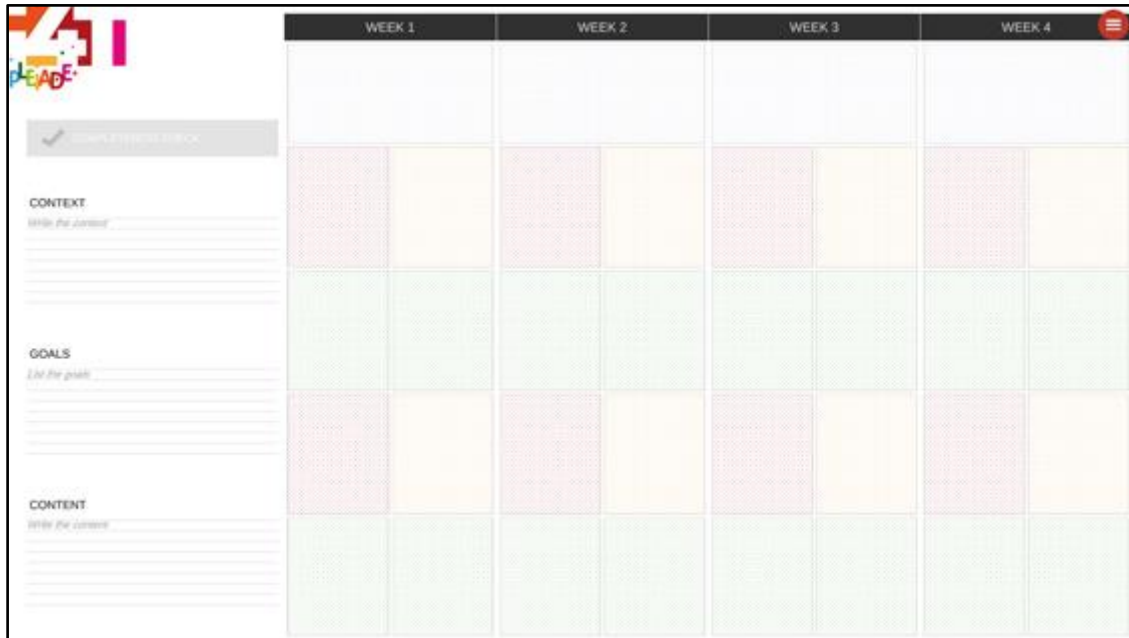
Figure 16 - Full screen board (empty)

As with the paper game, players will need first to identify Context, Goals and Contents of the activity and fill the specific fields in (left side of the screen) by typing the relevant text. To be able to type directly on the IWB screen (see Figure 17), you need to activate the virtual keyboard functionality on the laptop running the game. To do this:

- **On Windows**, go to Start, then select Settings > Ease of Access > Keyboard, and turn on the toggle under Use the On-Screen Keyboard.
- **On Mac,** go to the Apple menu then open System Preferences; from there go to the Keyboard preference panel, and then choose the Keyboard tab. Finally check the box next to Show Keyboard & Emoji / Character Viewers in the menu bar. Finally pull down the newly visible Keyboard menu and choose Show Keyboard Viewer.
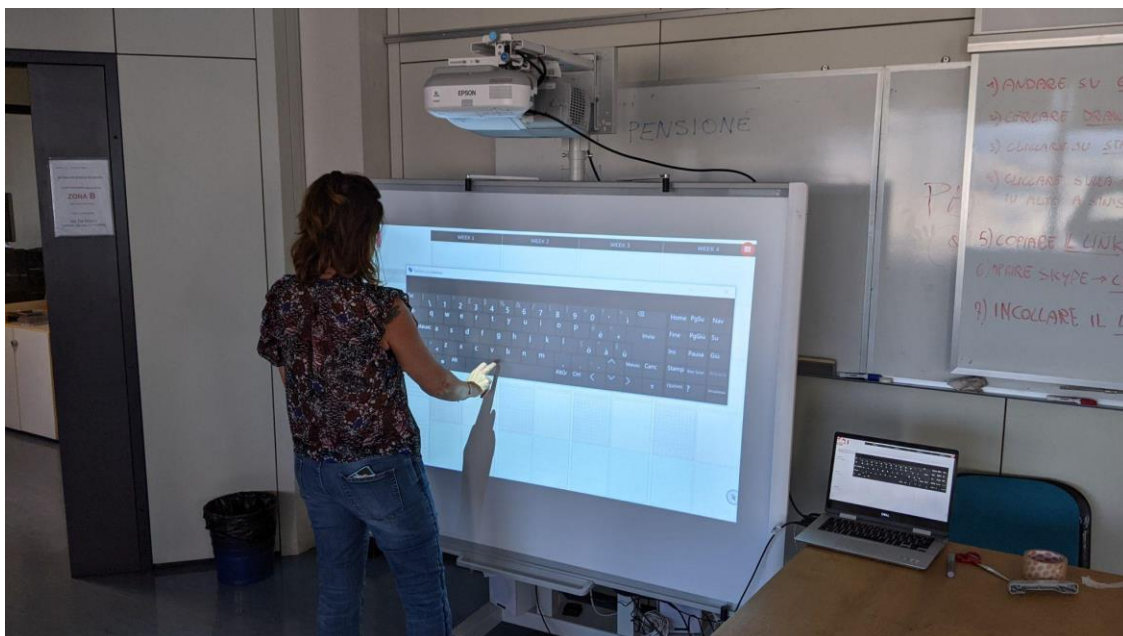

Figure 17 - Use of the virtual keyboard on a IWB to fill the Context, Goals, Contents fields in

After this preliminary definition of context, goals and contents of the design, players need to select a slot on the board to browse the cards that can be played in that slot and READ the indications contained inside.
Once they agree to choose one card, they just need to click on it to put it down on the board.

Then, following the indications contained on the card, they will make decisions regarding (Technique), Task, Teams and Technology (again, in order to browse all the available cards for each card category, click on the related slot, navigate the cards and then click on the one you choose).

Every time a card is added, the board is checked by the system to verify its state. As already explained in Section 5.2.1, the feedback provided eoncmpasses the following:
- Inconsistency of cards: if an error is returned, the user must correct the card before resume playing (Figures 12 and 13).
- Suggestions: Players can ask for suggestions in single slots (Figure 11).
- Check for completeness: at any time, players 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 10).

! IMPORTANT TIP: in the Technology deck, there are 3 cards related to the communication modes among students (i.e.: Forum, Video-conferencing system, No Technology). Be aware that in the digital game they determine the duration of the Task, like the following:

- Forum – implies an asynchronous communication mode; in the game the related Task will take one week.
- Video-conferencing system – implies an online, synchronous communication mode; in the game the related Task will take a few hours.
- No technology - implies a face-to-face, synchronous communication mode; in the game the related Task will take a few hours.
  ATTENTION: if you are designing a face-to-face activity and the Task envisages interactions among students, it is mandatory to use the NO TECHNOLOGY card, to indicate interaction is not happening online.

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

5.2.4 Gamification mechanics in the digital game

The game is featured with 3 levels of difficulty:

- Level 1 (entry level) is quite scaffolded and implies using (and starting the design process with) the Techniques deck. The system does provide feedback at this level.
- Level 2 (advanced level): is less scaffolded and implies skipping the Techniques cards and playing directly with the Task/Team/Technology decks. The system does provide feedback at this level.
- Level 3 (expert level): is not scaffolded. The system does not provide feedback at this level. Wild cards are also available at this stage, to allow users to add new cards.

Level 1 is recommended for student teachers and teachers who need to become familiar with the Techniques. Be aware that Level 1 is quite rigid, as the aim is to allow players to understand the structure of Techniques. Level 2, instead, allows for more flexible designs, but still there are combinations that are not accepted by the game. Level 3 is completely free; any card combination is possible.

The game level needs to be chosen at the beginning of the gameplay, by clicking on the related button in the Start screen (see Figure 15). Once players start the game, depending on the chosen game level, they will start by defining Context, Goals and Objectives (that can be typed using the keyboard) and then by <u>clicking on the top left light-blue slot for the Technique cards (Level 1)</u> to display the full list of the Technique cards, or by <u>clicking on the top left light-red slot for the Task cards (Level 2)</u>, to display the full list of the Task cards**.**

5.2.5 Support to 'inclusive design' in the digital game

As already mentioned, the game is intended to support the design of collaborative activities oriented to inclusion. While the 4Ts model supports the collaborative approach, there was a need to provide guidance also in terms of inclusiveness.

To this aim, cards have been featured with 'Inclusion tips': on the back of cards, players can find specific hints and suggestions supporting more informed choices in terms of inclusiveness (see Figure 5).

See Section 5.1.4 for a detailed description of this feature and Table 1 for examples of inclusion tips.

However, the Inclusion tips are only "suggestions", so there are no right or wrong combinations of cards implemented in the game Knowledge Base. As a consequence, the game does not provide feedback to players if they make choices that do not respect the advice provided in the Inclusion tips.

5.3   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.

To play the hybrid game, you need to print cards and board as for the paper game, but also you need to install the software on a PC, as it is illustrated in Section 3.3.1.
Both the printed board and cards are featured with QR codes (see Figures 5 and 18): they allow the system to detect the board position on the table, as well as to detect the cards that will be placed on the board during game playing.
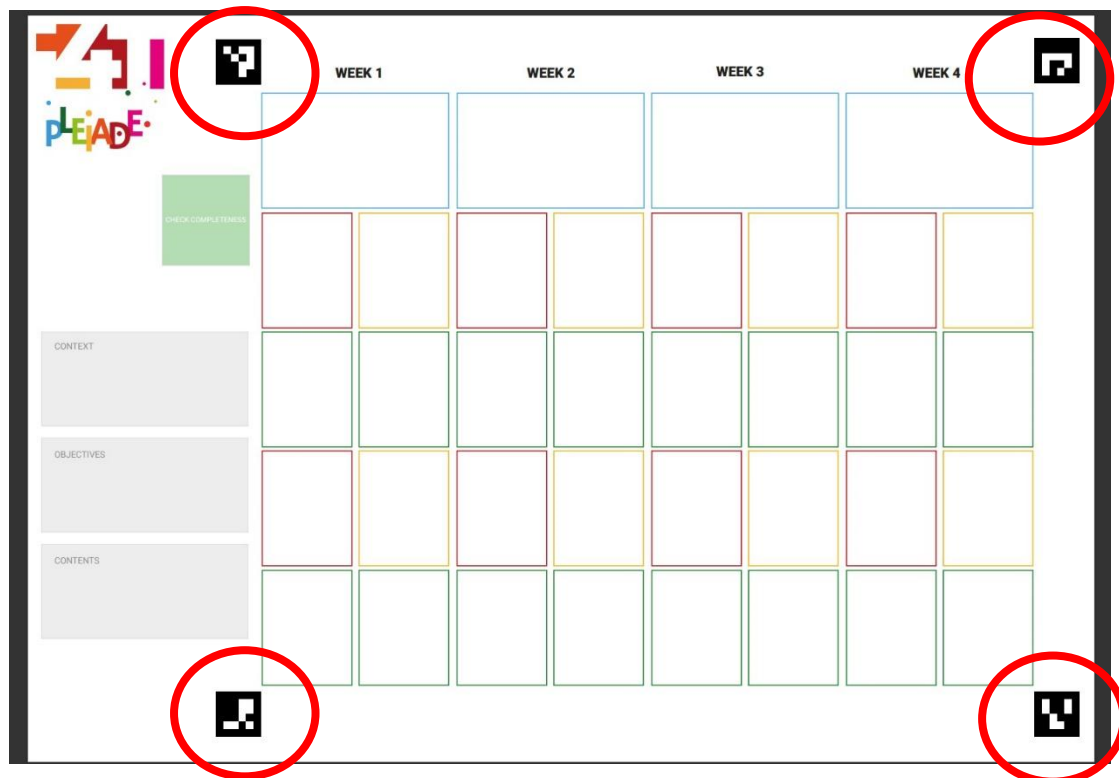
Figure 18 – QR codes on the board for the hybrid game

5.3.1 Feedback provided by the hybrid game

The hybrid game provides the same feedback of the digital version (see Section 3.2.1), in terms of: Completeness of the design, Suggestions on how to proceed with the design, Inconsistency of cards.
As soon as cards are placed on the tangible board, the screen will show the pertinent feedback (if any). When players remove the errors from the tangible board, the error messages will disappear from the screen. Unlike in the digital game, obviously the hybrid version cannot prevent the players from ignoring the error messages and continue playing even if the board contains a wrong combination of cards. For this reason, players should pay attention to the sound produced by the system to signal any mistake on the board.

5.3.2 Technical requirements & hybrid game setting

To play the game in its hybrid version you need:

- A table of about 140 cm. x 70 cm.
- A good quality webcam (2K preferred but not required)
- 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 75/80 cm (Figure 19)
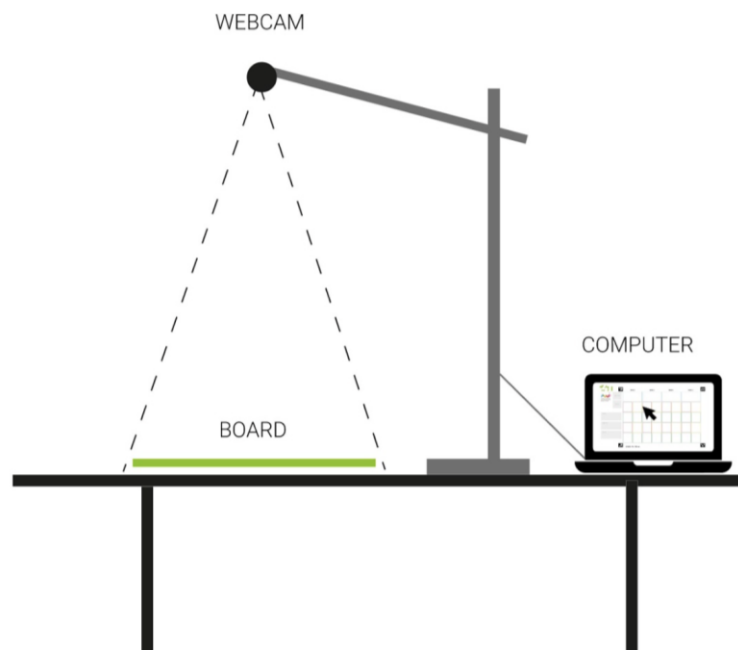- The printed board and cards.

Figure 19 - Setting for the hybrid game

You can print the board and the cards in the same way as for the paper game.

Cards are in English, but there are other languages available[8]. To generate the board and cards to be printed, you can use the Card Generator: https://open-lab.com/out/pleiade/

To change the language, you need to change the SheedID (just cut and paste it into the field of the Card Generator) as it follows:

If you want to print the Italian cards: 1A46tpqm7rP24SZpSakSmB9c8RGi9jU-66ZGv_GCrYVs
If you want to print the Greek cards:
1muXXluXDopua8chs8LjAO1-l5txbw6z3Vb0Lw6HsFVU
If you want to print the Bulgarian cards: 1o6psb1HE4F5Vd2Cd_eH-o53kZph1wF5JtRfTnU1wKLg

---

[8] The translation of cards was originally envisaged in the proposal only for Italian, but – given the language barriers experienced in the project – the partners agreed to make the translations also in the languages of the project.

For detailed information about how to print the cards and the board see Appendix 3.

5.3.3 Playing with the hybrid game

Similarly to the paper game, groups of players (from 2 to 5[9]) sit around the board.

In order to play with the hybrid game, you need to open the settings panel of the digital app, from the button available in the Start screen (see Figure 20).
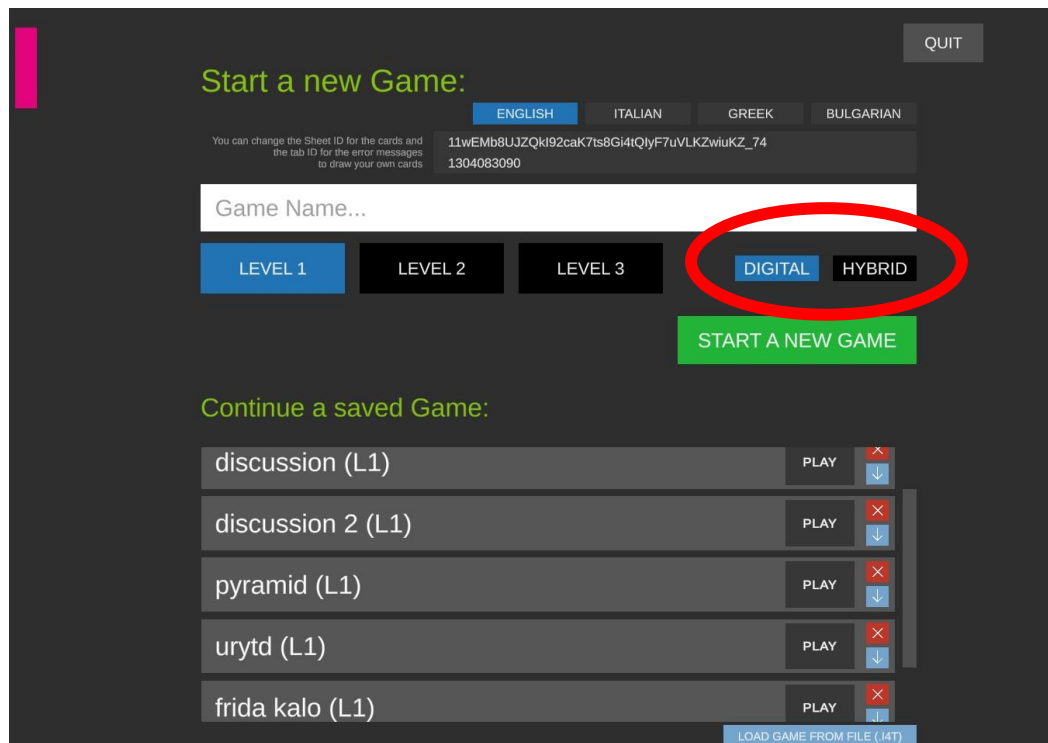

Figure 20 - Switching to the Hybrid mode

This will open a setting panel, where you will be able to calibrate the web camera. A list of the available connected webcams 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, players can switch on the camera view and see what the camera is watching at that moment (Figure 21). The application will display all the cards that the hybrid game is detecting, along with a log on the right of the screen with, possibly some advice for the cam view calibration.
In the following cases, the system will display an alert:
- If one or more of the corner markers of the board are not well visible by the cam
- If the cam is not well aligned with the board.
To be able to play properly, you need to fix the problem(s).

---

[9] Unlike the paper game, with the hybrid version it is recommended to have maximum 4-5 people sit around the table, because the setting with the arm or tripod needs stability and if there are too many people around the table, depending on the arm, the stability might be at risk.
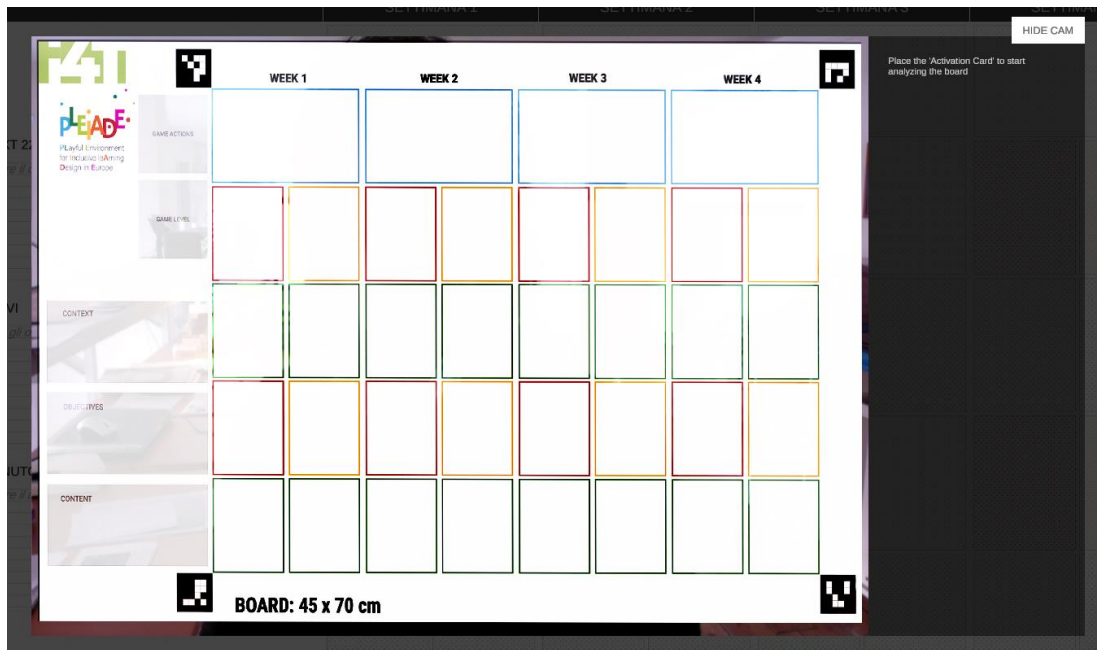
Figure 21 - Camera view

Once the hybrid calibration is done, you can close the camera view and start playing the tangible cards on the physical board.

Please be aware that once you have started a game play in the hybrid mode, there is no way to commute it into a digital play and vice versa. Moreover, any hybrid game play, once closed and saved, will be accessible ONLY as a digital one (i.e. it is not possible to continue an hybrid game with the hybrid version, once you have closed the game session).

Thanks to the card QR codes, any card placed on the tangible board is detected by the system and displayed on the digital board too. Any time a card is displayed on the digital board, the consistency of the play is checked. If there are errors, they are displayed on the screen, exactly as for the digital game.

This means players 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 system is built in such a way that players do not need to interact with the laptop/PC: any action can be done directly on the tangible side and the screen will automatically reflect what is going on the board. Even in case of errors, the related messages displayed will automatically disappear from the screen, as soon as the inconsistent cards are removed from the tangible board.

The Completeness check can be performed by placing the "Check completeness" card on the board on the dedicated, green slot at the top left side. All the slots with missing cards will be displayed on the virtual board (see Figure 10).

To ask for suggestions playing on the real board, players can place the "Suggestions" card on the slot for which they need help. The available cards for that slot will be displayed on the PC screen (Figure 11). Removing the "Suggestions" card from the physical board, will make the list of suggested cards disappear on the PC.

Figure 22 shows the "Check completeness" and "Suggestions" cards.
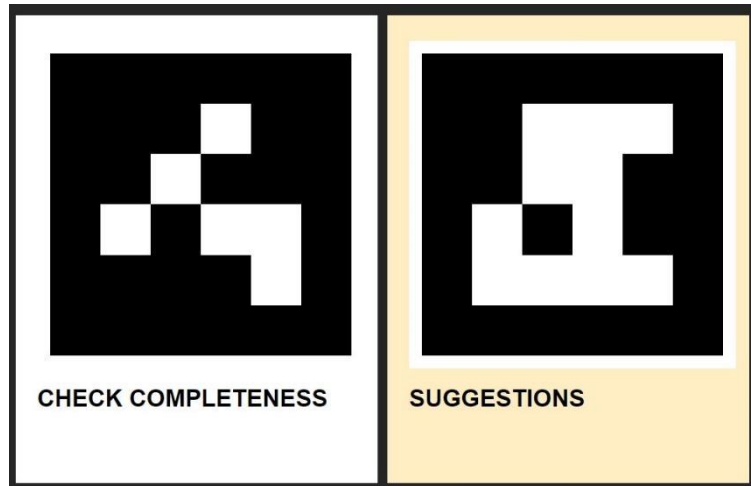
Figure 22 – The two special cards of the hybrid game

5.3.4 Gamification mechanics in the hybrid game

The game is featured with 3 levels of difficulty:

- Level 1 (entry level) is quite scaffolded and implies using (and starting the design process with) the Techniques deck. The system does provide feedback at this level.
- Level 2 (advanced level): is less scaffolded and implies skipping the Techniques cards and playing directly with the Task/Team/Technology decks. The system does provide feedback at this level.
- Level 3 (expert level): is not scaffolded. The system does not provide feedback at this level. Wild cards are also available at this stage, to allow users to add new cards.

Level 1 is recommended for student teachers and teachers who need to become familiar with the Techniques. Be aware that Level 1 is quite rigid, as the aim is to allow players to understand the structure of Techniques. Level 2, instead, allows for more flexible designs, but still there are combinations that are not accepted by the game. Level 3 is completely free; any card combination is possible.

The game level needs to be chosen at the beginning of the play, by clicking on the related button in the Start screen (see Figure 15). Once players start the game, depending on the chosen game level, they will start by playing a Technique card (Level 1) or a Task card (Level 2).

5.3.5 Support to 'inclusive design' in the hybrid game

As already mentioned, the game is intended to support the design of collaborative activities oriented to inclusion. While the 4Ts model supports the collaborative approach, there was a need to provide guidance also in terms of inclusiveness.

To this aim, cards, like in the paper and digital formats, have been featured with 'Inclusion tips': on the back of cards, players can find specific hints and suggestions supporting more informed choices in terms of inclusiveness (see Figure 5).

See Section 5.1.4 for a detailed description of this feature and Table 1 for examples of inclusion tips.

However, the Inclusion tips are only "suggestions", so there are no right or wrong combinations of cards implemented in the game Knowledge Base. As a consequence, the game does not provide feedback to players if they make choices that do not respect the advice provided in the Inclusion tips.

6. Technical information

The application is a client native application that connects online at startup and during service (http call) to a web based server for cards and validation, and can optionally connect to an online repository for updates on labels.

It has been built so as to be as stable as possible, compatible with generic hardware (Windows, Mac) and resilient to low definition printed markers.

The client development tool (Unity) is a commercial product but is available with a full free version. The web service servicing the cards and their logic is built on a Prolog backend (see Section 6.1).

For a technically skilled user: full sources of all the modules composing the application (Unity project, C# code, Prolog backend, card service) are available through a public Git repository (https://github.com/4Ts-game/4Ts-public-repository), allowing the customization and branching of the application. If you are interested in the full technical documentation, see IO6 "Amplification kit".

The **I4T Game client** is developed with **Unity3D** version 2019.4.9f1 (go to downloads at https://unity.com); the source code of the client is written in C#. It is released under GPL licence and it is open source.

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

The Online Card service (https://out.open-lab.com/pleiade) 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** made by Oleg Kalachev (https://github.com/okalachev/arucogen).

Markers dictionaries are taken from this URL:
https://raw.githubusercontent.com/opencv/opencv_contrib/master/modules/aruco/src/predefined_dictionaries.hpp.

Below you can find a description of the Knowledge Base service.

6.1. The Knowledge Base service

The Knowledge Base (KB from here on) service is an HTTP based service implemented in Prolog and run through the SWI Prolog environment.

KB is accessed by the I4Ts game client through HTTP requests. KB responds by providing validation results for the current game board, as well as suggestions when requested by the user through the use of special cards.

Notice that the I4Ts game client and KB services don't need to be co-located; the KB service can be run on nodes which are remote to the I4Ts game client, as long as the client is able to submit HTTP requests to KB.

The following figure (Figure 23) provides a high level description of the communication flow between the I4Ts game client and KB.
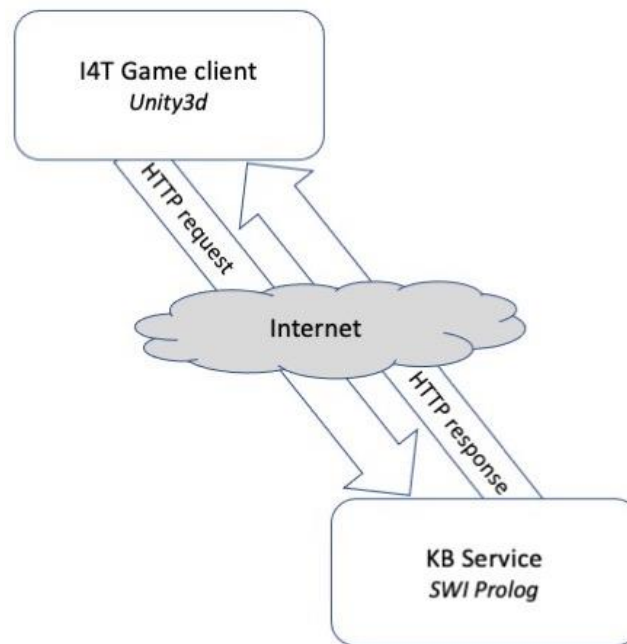

Figure 23 - Description of the communication flow between the I4Ts game client and KB

A typical request to KB contains:
- the game level currently in use (entry or advanced)
- the current placement of the cards on the board
- whether KB should check the board for completeness or not.

The request details are specified as parameters of the HTTP request (the verb of the request - GET/POST or else, it doesn't matter).
KB responds with an XML structure which contains the validation results and, if requested, suggestion cards.

Internally KB's behaviour changes significantly depending on the game level currently in use.

For "entry" (L1) level, KB's main task is to match the provided board layout against one of the board templates which have been compiled as "valid" (i.e. the collaborative techniques); that's where the use of a language like Prolog comes in very handy, as Prolog is particularly well suited for performing pattern matching of that kind.

For "advanced" (L2) level, KB performs a number of atomic operations - like performing a finer grain pattern match against known good patterns to verify that specific individual combinations of tasks/teams and technologies are valid, but also a number of lighter weight checks which grant more flexibility to the overall patterns that a user may be specifying.

In both cases, KB provides as many details as possible about detected errors and communicates them back to the caller through error code numbers and a default description.

The following Figure (Figure 24) provides an example of how KB "reasons" through a client request.
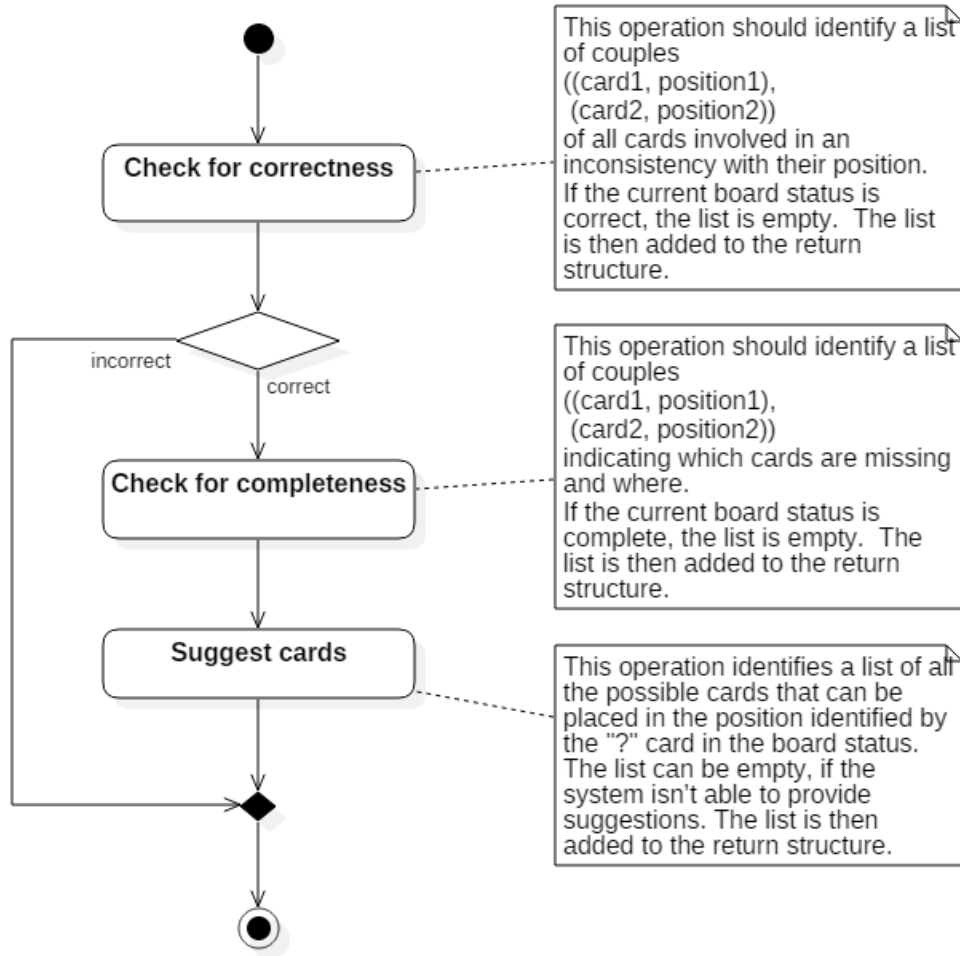
Figure 24 - An example of how KB "reasons" through a client request

7. Conclusions

In this document we have provided a description of the I4Ts game, which is the Intellectual Output 2 of the PLEIADE project.

This document was not originally envisaged in the proposal, but - as we released the first version of the game - we thought it was useful to feature it with a sort of User Guide, i.e. a text guiding the player and supporting first use of the app.

Thus the document contains a full description of the paper, the digital and the hybrid versions of the game, along with a description of its game mechanics (i.e. the levels of the game) and its 'inclusion-oriented' features. Moreover, a technical description of the game is provided with a section dedicated to the description of the knowledge base. More detailed

technical information will be provided in IO6, oriented to support uptaking, personalization and maintenance of the app even outside the project boundaries.

The game is now ready yo be fully tested during SJSTE 3 in Autumn 2022, hoping that this event will take place in a face-to-face setting.

8. References

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Pozzi, F., Persico, D. (2013). Sustaining learning design and pedagogical planning in CSCL. Research in Learning Technology, 21: 17585. DOI 10.3402/rlt.v21i0.17585

Pozzi, F., Persico, D. (2011). Techniques for Fostering Collaboration in Online Learning Communities. Theoretical and practical perspectives. Hershey, NY: IGI Global. DOI: 10.4018/978-1-61692-898-8

Appendix 1 - Description of collaborative techniques

Introduction

This Appendix contains the description of a set of collaborative learning techniques that are used by the PLEIADE teachers to design inclusive collaborative activities.

The following description is based on the 4Ts model, that sees the design of collaborative activities as a decision making process involving, mainly, 4 variables: the Task to be carried out, the Time allotted for that task, the dimension and composition of the Teams and the Technology necessary for to carry out the task. The I4Ts game too refers to these techniques.

Techniques

In the following, we use the term "technique" to refer to patterns or schemes that can be used to design and scaffold students' collaboration while teaching any type of content. They can therefore be applied to the teaching of maths, physics, history, literature, geography, foreign languages, music, etc. Techniques usually entail different phases of work, each described by defining the task, time, technology and teams. So, in the following, the techniques are described by explaining, phase by phase, what the students should do (Task), how long for (Time), with what technology (Technology) with what kinds of groups (Teams). Needless to say, techniques should not be intended as rigid "cages" for designing collaborative activities. Rather, in teaching practice, teachers can adapt these techniques to their needs and also create new ones.

Jigsaw

This technique entails two phases with different student groupings: a first phase where so called "expert" groups are formed and a second phase carried out by "jigsaw groups". During the first phase, the Task of the expert groups will be to study in depth a different aspect or facet of a given general topic (or case or problem) and produce a synthesis or a presentation concerning that aspect. In the second phase, each jigsaw group should include at least one member for each of the expert groups. The task of the jigsaw groups will be to produce an artefact (e.g. a written or oral presentation), reflecting all the different facets of the problem studied in the first phase by the expert groups. Thus, each expert of the jigsaw will bring to the group the competence acquired in the first phase and his/her contribution will be essential to produce a comprehensive artefact.

This method lends itself very well to deal with topics that can be studied under different facets or subtopics. For example, if the class is studying living cells, in the first phase the teacher can divide the class in expert groups, each tasked to study one sub-topic: one group of students learns about the nucleus, another learns about the mitochondria, another learns about the cell wall, and so on. The groups are then reconfigured into jigsaw groups; where

each child is an expert of the sub-topic studied in the first phase and thus contributes to the jigsaw group work by bringing the knowledge of that sub-topic, so that the final artefact reflects the whole topic, that is, in our example, the living cell (from https://www.teachervision.com/group-work/jigsaw-groups-for-cooperative-learning). The jigsaw is also frequently used in geography and history, to analyse a war in terms of its different facets (causes, effects, main event, people involved, etc) or a place (territory, economy, agriculture, culture, etc). Putting together the expert knowledge in the final artefact allows the student to gain a global view of the whole subject.

Below you can find an example of a Jigsaw organised in class. In the game you can also opt for another variant of the Jigsaw (i.e. the online Jigsaw) and choose whether to have it synchronous (with Videoconferencing system) or asynchronous (with Forum).

Peer review

This technique usually involves three phases; in the first phase the students produce an artefact (e.g. a document, a map, an oral presentation); in the second students are asked to provide feedback on the artefact produced by someone else in the first phase, in the third and last phase students modify their original artefact based on the feedback received. The peer review is based on "reciprocal teaching" principles, according to which it is essential that students compare the product of their work to that of their peers. The reflection triggered by the comparison (during the second phase) has a positive impact on self-assessment skills, especially when a rubric is provided, in the form of a list of criteria informing the feedback. Learning is therefore the compound outcome of the self-assessment engendered

by both the feedback received and the feedback given. With this technique, there is a wide range of choices concerning team arrangements: students can work individually, in dyads or in teams in all the phases, or even work in teams in the first phase and then provide individual feedback to one or more of the teams and then come back to the original teams in the last phase. Crinon (2012), reports an example of peer review carried out with primary school students aged 9 to 11. The students were required throughout the year to write several episodes of an adventure novel, which they then exchanged via email with another group of students, providing reciprocal feedback so that the authors could revise their work in the last phase.

Below you can find an example of a Peer Review organised for small groups and in class (No communication technology). In the game you can also opt for another variant of the Peer Review (i.e. the online Peer Review). Moreover, you can choose different team sizes, provided that you keep them coherent among the phases.

Role Play

With this technique, participants "play a role", i.e., they put themselves in the shoes of someone else (whose perspective on the content may be different from their own) so that they better appreciate their point of view. There are two phases to this technique: the first phase entails role uptake and study of materials (keeping an eye on the role taken), the second entails producing a common artefact by negotiating with peers its content from the perspective previously assumed. This technique can be useful, for example, for language learning: students are assigned a role, given materials to study and a problem to solve (e.g. finding their way in a foreign city). Simulating interactions with local people, students practice

the use of the language in context and acquire relevant terminology (see for example Kasim, 2015). The Role Play technique is also frequently used in WebQuests[10], an inquiry-oriented lesson format in which most or all the information that learners work with are web based.

Below you can find an example of a Role Play organised online (in a mixed mode, i.e. asynchronously and synchronously). In the game you can also opt for another variant of the Role Play (i.e. in class).

Pyramid

This technique usually has at least three phases and it is used when there is a need for convergence of a large group on a shared solution for a wicked problem, i.e. one that does not have only one right solution. In the first phase, each student devises a solution to the problem. In the second phase, dyads or groups of three work together by comparing the individual solutions and working out a better one by negotiating between the individual solutions. In the subsequent phases, groups merge and participants build new "shared" solutions based on those elaborated during the previous phase, until the whole cohort of students produces a single solution progressively built on top of the pre-existing ones. For example, if you want your students to prepare an interview for an expert or a privileged witness, in the first phase you can ask learners to study individually some materials and then prepare a draft containing a list of questions to be asked. In the second phase students in dyads or small groups will have the task to share their lists, merge and re-organize them and produce a new comprehensive list. In the third phase students will be organised in

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[10] https://en.wikipedia.org/wiki/WebQuest

progressively larger groups and merge the lists produced by the previous teams. The final phase will be when the whole cohort has to produce a list agreed upon by all participants. In some variants, the list is provided at the beginning and the task is to order the list items according to some given priority criteria.

Below you can find an example of a Pyramid (for problem solving) organised online in asynchronous mode and envisaging the following "team flow": individual->pairs->small groups->plenary. In the game you can also opt for other variants, choosing different group sizes, provided that you keep them coherent among the phases. Moreover, in the game there is another instance of the Pyramid (for list preparation), which differs for tasks in respect to the previous one.

Discussion[11]

This technique has a low degree of structuredness, and can thus be enacted in many different ways. Here, we propose to make sure that discussion is grounded on knowledge of the topic and that it is not open ended, but oriented to produce an artefact, because this is considered an important factor to facilitate interactions. In this view, we can distinguish two main phases: in the first phase students are asked to study learning material concerning a

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[11] In this context, we use the two terms "discussion" and "debate", which, in English, have very similar meanings, to refer to two different concepts. We use "discussion" to refer to the collaborative technique described here and "debate" to identify one of the possible tasks assigned to the students, that of debating about something. This distinction is useful, precisely, to distinguish when we are referring to the collaborative technique (which will necessarily lead to the production of a shared artefact) and when we are referring to the debate task carried out by the students.

given problem (or case or topic) assigned by the tutor, while in the second they work in groups to negotiate their solution to the problem and produce an artefact reflecting the negotiation results. The discussion technique lends itself to tackling complex problems where critical thinking, reflection and creativity can be fostered through peer interactions. For example, if a class is studying a debatable issue, like the responsibilities of the different countries involved in a war or the different positions about euthanasia, in the first phase the teacher can provide to the students some documents explaining the different points of view, in the second phase the task will be to debate and produce a synthesis of the team position, by elaborating a text or a presentation concerning the different facets or shared view about the issue.

Below you can find an example of a Discussion (towards text) to be held in class. In the game you can also opt for another variant of the Discussion (i.e. the online Discussion). Moreover, you can choose different Tasks, thus creating other variants of the Discussion (i.e. towards artefact, towards assignment).

Case study

Case studies in education can be used in many different ways, here we propose a possible structure oriented to support problem solving. In Phase 1 of a Case Study, the teacher presents a topic - typically a problem - and provides learners with material for them to study, containing information needed to solve the problem. Then the learners, in pairs or small groups, are asked to solve that problem and produce a possible solution. In Phase 2, the

learners individually examine the different solutions and then debate in plenary the pros and cons of each solution.

Below you can find an example of a Case Study to be carried in a mixed mode (i.e. part online and part in class). In the game you can also opt for the full online or the full in class variants.

References of Appendix 1

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Appendix 2 - Complete list of cards

One deck is composed of 145 cards.

Technique Cards	(Tot. 19 cards)

- JIGSAW – Phase I (Expert Groups) — (x1)
- JIGSAW – Phase II (Jigsaw Groups) — (x1)
- PEER REVIEW – Phase I — (x1)
- PEER REVIEW – Phase II — (x1)
- PEER REVIEW – Phase III — (x1)
- CASE STUDY – Phase I — (x1)
- CASE STUDY – Phase II — (x1)
- PYRAMID (FOR LIST PREPARATION) – Phase I — (x1)
- PYRAMID (FOR LIST PREPARATION) – Phase II — (x1)
- PYRAMID (FOR LIST PREPARATION) – Phase III — (x1)
- PYRAMID (FOR PROBLEM SOLVING) – Phase I — (x1)
- PYRAMID (FOR PROBLEM SOLVING) – Phase II — (x1)
- PYRAMID (FOR PROBLEM SOLVING) – Phase III — (x1)
- ROLE PLAY – Phase I — (x1)
- ROLE PLAY – Phase II — (x1)
- DISCUSSION – Phase I (ALL CASES) — (x1)
- DISCUSSION (TOWARDS ASSIGNMENT) – Phase II — (x1)
- DISCUSSION (TOWARDS ARTEFACT) – Phase II — (x1)
- DISCUSSION (TOWARDS TEXT) – Phase II — (x1)

Task Cards	(Tot. 52 cards)

- WRITING A TEXT — (x4)
- STUDYING — (x4)
- FINDING MATERIALS — (x4)
- PREPARING A PRESENTATION — (x4)
- PREPARING A LIST OF QUESTIONS — (x4)
- COMMENTING ON SOMEONE ELSE'S WORK — (x4)
- PRESENTING WORK — (x4)
- CARRYING OUT AN ASSIGNMENT — (x4)
- SOLVING A PROBLEM — (x4)
- INTERVIEWING AN EXPERT — (x4)
- ASSUMING ROLES — (x4)
- PRODUCING AN ARTEFACT — (x4)
- DEBATING — (x4)

Technology Cards	(Tot. 44 cards)

- FORUM — (x4)

- VIDEO CONFERENCING SYSTEM   (x4)
- NO COMMUNICATION TECHNOLOGY   (x4)
- PRESENTATION SOFTWARE   (x4)
- WIKI SOFTWARE   (x4)
- INTERACTIVE WHITEBOARD   (x4)
- SELECTED STUDY MATERIAL   (x4)
- SOURCE OF MATERIALS FOR LEARNING   (x4)
- TEXT EDITOR   (x4)
- PROJECTOR   (x4)
- MATERIALS AND TOOLS FOR PRACTICE   (x4)

Team Cards	(Tot. 24 cards)

- INDIVIDUAL LEARNERS   (x4)
- PAIRS   (x4)
- SMALL GROUPS   (x4)
- MEDIUM-SIZED GROUPS   (x4)
- LARGE GROUPS   (x4)
- PLENARY   (x4)

Other cards	(Tot. 6 cards)

- CHECK FOR COMPLETENESS CARD   (x1)
- SUGGESTIONS CARD   (x1)
- WILD CARDS (ONLY FOR L3)   (x4)

Appendix 3 - How to print the board and cards

The hybrid game works with a 70x100 cm real **board** and with 4 **decks of cards** (Technique, Task, Team, Technology).
Open Lab realised 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 colour versions and they have the correct size for the 70x100cm board.
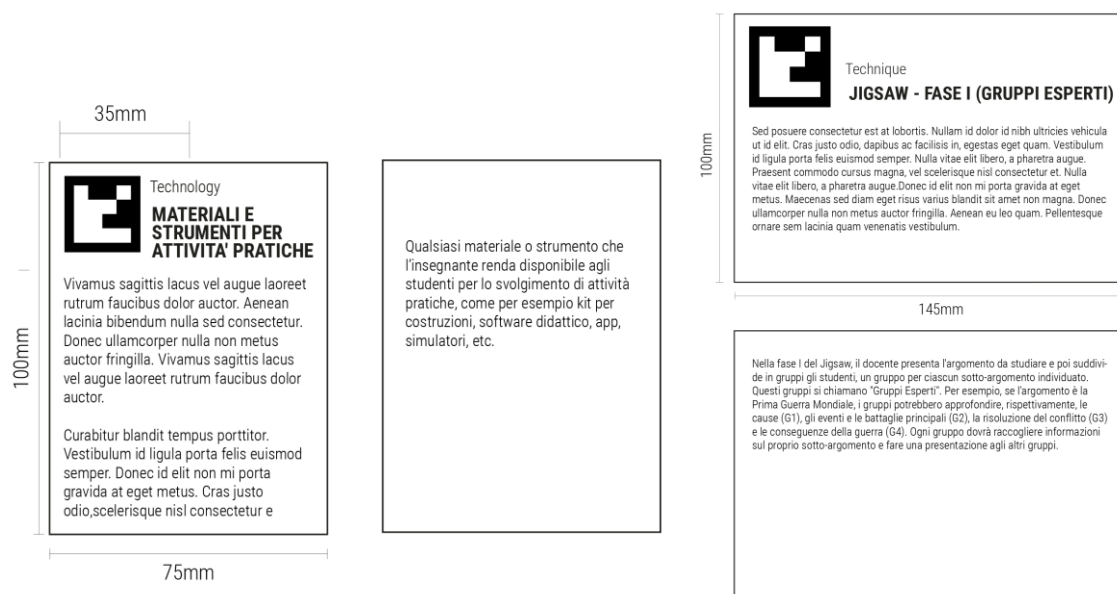

Figure 1 - Printed cards

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

As you can see, the generator allows you to print two .pdf files, one for the card fronts and one for the card backs (see attached files: ENG-front.pdf and ENG-back.pdf). Of course, given that the front and back need to be perfectly aligned, you will need to set margins of the .pdf, which may change depending on your printer.
For example, in the attached .png picture we have set the following margins: [6 2 0 0]mm; you need to make sure you set margins that fit with your own printer.

At this point, using any .pdf editor (for example we are using https://www.sejda.com/alternate-mix-pdf) you should build a new .pdf, where each back immediately follows its own front (see attached file: ENG-all.pdf). You can easily check backs and fronts by looking at the ID card (little number at the top right corner of each card).
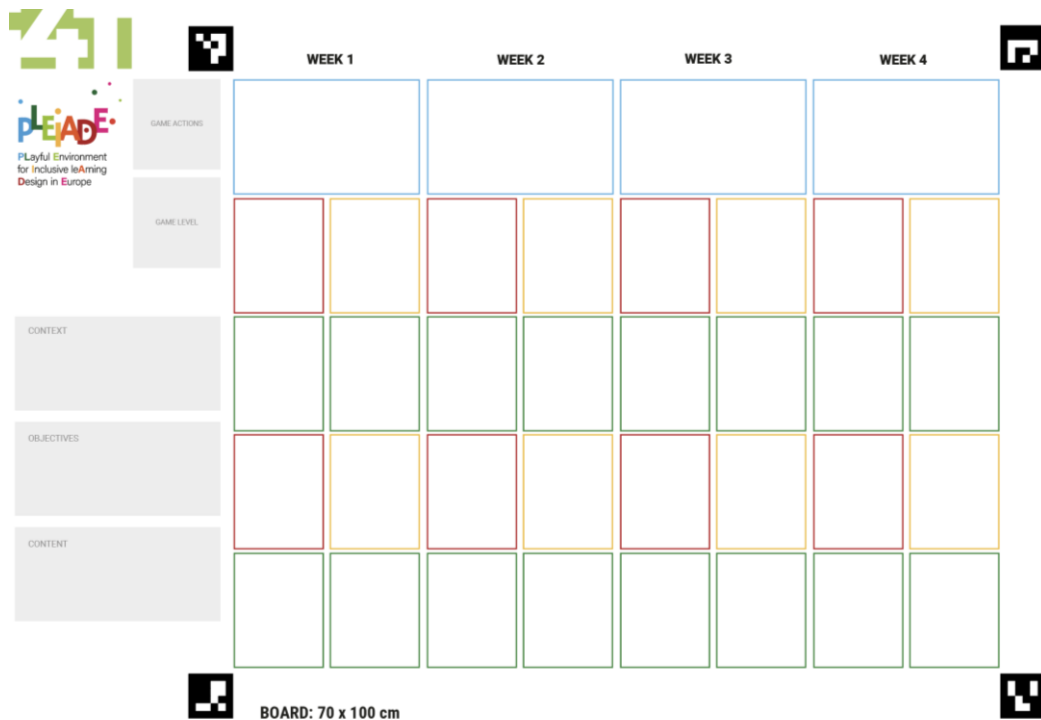
Figure 2 - Printed board