Title: A territorial diagnosis tool which uses serious games to address health and environmental inequalities: Equit‘Game

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Abstract

Background: The territorial diagnosis is prerequisite for local actions concerning public health and the reduction of social, environmental and health-related inequalities. To orient local programs or initiatives targeting health inequalities, the policy maker need simulation territorial diagnosis tools. Yet, very few platforms have been developed for the purpose of guiding public authorities as they seek to reduce these social inequalities.

Objective: Our study aimed to describe the design and methods of the development process of the territorial diagnosis tool based on serious game named “Equit’Game” which put learners at the heart of the territorial diagnosis process, asking them to review the current health, environmental and socioeconomic state of their territory.

Methods: The realistic situations employed in our serious game should encourage players, in a fun and playful manner, to (1) appropriate the data of their own territory, (2) apply their methodological knowledge in a practical way, (3) reflect on the most pertinent statistical and/or spatial tools for their situation and, (4) ultimately, to acquire new knowledge and skills in the use of territorial diagnosis tools with a spatial dynamic.

Results:
Equit’Game was deployed over the course of a week’s training and structured into 4 levels: Level 1: ‘Dataminer’ (identifying relevant information to respond to the question); Level 2: ‘Analyst’ (selecting the appropriate method of analysis), Level 3: ‘Atlas’ (mapping the data), Level 4: ‘Cluster’ (extraction of statistical and spatial information). Equit’Game has also been designed as a sort of ‘virtual campus, creating a fun learning environment in which each door represents a level. Users can access Equit’Game via a platform compatible with tablets, PCs and smartphones.

Conclusion: Equit’Game was developed to help learners the techniques of territorial diagnosis, with the aim of creating an “innovative tool for public health” capable of conveying educational messages and providing a structure for training.
Introduction

Public policy on health and social matters insists that territorial diagnosis be a prerequisite for all territorial procedures and, on a more general level, for all local development actions [1]. This process involves stakeholders with interests and decision-making powers which are different but complementary; coordinating their actions is one of the key factors determining the success or the failure of local projects.

Furthermore – in order to more effectively steer local actions concerning public health and the reduction of social, environmental and health-related inequalities – it is crucial that we fully understand the socio-territorial constructions which serve to perpetuate or even aggravate health-related inequality.

A review of the extant research conducted with the direct or indirect involvement of local authorities (metropolitan areas or regions) leads us to the following observation: faced with socio-territorial health inequality, territorial stakeholders (elected official and institutions) run up against the same obstacles, particularly the absence of tools for more effectively scheduling and targeting actions on the ground.

For instance, in France, its evaluation of France’s second National Health and Environment plan (PNSE2), the High authority for Public Health (Haut Conseil de Santé Publique) clearly highlighted the lack of sufficient tools to help territorial authorities to prioritise and to target their actions on the ground, and thus effectively reduce social and environmental inequality.

Researchers also have a role to play in this field, because the absence of tools and methodologies enabling concrete and efficient responses to these local priorities is a significant problem. Moreover, an increasing number of research projects have documented the existence of social inequalities in health [2,3] and, to a lesser extent, the existence of environmental inequalities [4–6]. And yet, very few platforms have been developed for the purpose of guiding public authorities as they seek to reduce these social inequalities. It appears to us that establishing a full and precise social and health-related diagnosis at the local level is a crucial requirement if we want to optimise and prioritise the use of resources, directing them towards those categories of citizens who accumulate multiple risk factors.

As such, the dissemination of research findings and the transfer of knowledge to establish training and educational targets and to simulate situations which closely reflect reality appear to be a pertinent and promising strategy for spreading the techniques of territorial diagnosis.

It was in this spirit that the ‘Equit’Game’ tool was created; it forms part of the Equit’Area project (http://www.equitarea.org) focusing on the issue of social inequalities in health.
The main objectives of *Equit’Game* are as follows: on the one hand to teach the methods and approaches required to perform territorial analysis, and on the other hand to put learners in life-like situations. The idea is to put learners at the heart of the territorial diagnosis process, asking them to review the current health, environmental and socioeconomic state of their territory while completing a number of compulsory ‘level’; these levels ensure that all of the key steps in the process of territorial diagnosis are covered.

This professionally-oriented teaching will provide a theoretical framework of realistic situations derived from the Equit’Area research programme [7,8], preparing learners to contribute to the creation of similar projects in their own territories.

This article is divided into several sections: Section 2 reviews the existing literature on the use of serious games to promote health, Section 3 provides more details on the methods used, the participants and the design of the game, and Section 4 details the technical results. Last but not least, Section 5 contains our conclusions and perspectives for future additional development.

**Background**

The literature review dealing with the serious games reveals a multitude of definitions and classifications which reflects the diversity of approaches and perspectives found in the different sectors concerned (education, media, health, simulators etc.). Nevertheless, the most widely shared definition seems to be that one written by game designers Sande Chen and David Michael: “*These games have an explicit and carefully thought-out educational purpose, and are not intended to be played primarily for amusement.*”

In the definition offered by Lelardeu et al.[9], the various objectives of these serious games can be divided into three main categories: *i)* spreading a message *ii)* providing training (e.g. Exergames) and *iii)* promoting the exchange of data (e.g. Datagames).

Among serious games designed to spread a message, we can identify several types of message: teaching and education (e.g. Edugames), sharing information (e.g. Newsgames) and also more marketing/persuasive messages intended to influence or induce certain behaviour (e.g. Advergames).

Since the concept of serious games was first developed, this form of learning has been deployed for users from different sectors, from military personnel to teachers and healthcare professionals [10]. In the healthcare sector, since 2002, several serious games have been created focusing on physical activity, rehabilitation, cognitive stimulation, surgery, or emergency care for both patients and professionals [11-13].
The majority of serious games developed in recent years are designed to help teach effective decision-making in healthcare matters, making them “an innovative tool for public health.”

As such, modelling of health information may play a role in the creation of tools to be used both for training and decision-making, for example a serious game which can be used to make diagnoses.

This harks back to the definition offered by Abt et al. [14] over forty years ago in their work Serious Games: “A game is an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context.”

The tools we are dealing with, place learners within a given defined context, obliging them to make choices and take decisions (Bobillier-Chaumon, 2003); the aim is to push users to adapt their responses to certain situations and then, conduct them to transfer these lessons to their day-to-day professional activities.

In order to make the game environment as realistic as possible, some serious games seek to incorporate data and results based on scientific research, presented in a format which is sufficiently accessible and comprehensible to be used in the decision-making process. One illustration of this approach is the Time After application, developed by Reichlin et al. in 2011.

An increasing number of public institutions are taking the decisive step to commission serious games; for example, the WHO's Yellow fever epidemic application aimed at healthcare professionals. This application lets players manage various resources and perform actions to control yellow fever epidemics. The review of the existing literature conducted by Ohannessian et al. explain clearly that serious games focusing on vaccination could be an useful educational tools for decision-makers [15].

In France, serious games are beginning to gain traction with territorial authorities. One recent example is the serious game named Ecoville (http://ecovillelejeu.com) developed by the Agency for the Environment and Energy Management (ADEME: l’Agence de l'environnement et de la maîtrise de l’Energie) which invites users to create their own environmentally-friendly town, and to reflect on the consequences of urban sprawl and mixed habitats while learning about the importance of energy management and respecting the environment. A recent addition, again from ADEME, is the application Réflexe planétaire (http://www.ademe.fr/particuliers/jeu2/ADEME/sommaire.html), which aims to educate users in an entertaining way about simple, everyday actions which can help protect the environment.

In partnership with the National Association for the Prevention of Alcoholism and Addiction (ANPAA: l'Association nationale de prévention en alcoologie et addictologie), the National Territorial Health Insurance Fund (la Mutuelle Nationale Territoriale) has developed an application called Territorial City,
available to local authorities since September 2015 (http://www.serious-game.fr/territorial-city-le-serious-game-de-la-mnt/), designed to help with the decision-making process. The scenario proposed to players involves coordinating local personnel and resources in response to an incident linked to the consumption of psychoactive substances. This simulation helps to: i) Equip decision-makers with the tools they need to prevent and manage risky behaviour involving the consumption of psychoactive substances at work and ii) Encourage decision-makers and their teams to launch preventive actions in real life.

However, as far as we are aware, no serious game had yet been developed to support and help local authorities and regional healthcare agencies in their efforts to reduce social inequalities in health (SIH).

Our contribution to this process, as researchers, involves the operational development of a ‘research and training’ tool fuelled by accessible, comprehensible data derived from our own research [7,8]. Our serious game creates a learning environment which encourages players to think about space, territories and collective learning for effective action.

Materials and methodology

Description of the experiment: During the development of this project, an initial meeting was organised in order to determine the most appropriate manner of proceeding. Several key points were discussed, including i) how to best adapt this serious game to the various requirements outlined and ii) how to define the role of the various stakeholders in the development process. The second phase involved the creation of the different characters and graphical environments contained in the game, as well as the game’s structure (decision tree). The third step was to create the associated educational materials, in various formats: videos, interviews, animated PowerPoint presentations, simulations etc. The last phase was all about finalising the design, assembly and settings of the game using Ludiscape©.

Technological methodology

The system is composed of two databases: one used to edit the game, developed in XML and a second database for data are sent over the internet which is available via the Online Platform (type: LMS Moodle) developed in MySQL.

A programming language known as Hypertext Markup Language (HTML JavaScript CSS) was used in conjunction with PHP to develop the activities included in the online system.

- Hardware
This serious game is designed to work on various devices: tablets, PC and smartphones. Thanks to the *Ludiscape* engine, designed for compatibility with all of these devices, no further development was required. This engine is also compatible with all operating systems currently available on the market (Windows, MACINTOSH, LINUX, TABLETTE iPad & Android, Firefox, Chrome...).

- **Game design elements**

The creation of our serious game involved different processes, technologies and specialists. We used the conceptual model developed by Wattanasoontorn et al., 2013 to illustrate the core components of Equit’Game (Figure 1).

![Game design elements diagram](image)

**Figure 1: Game design elements**

Legend-We use the conceptual model developed by Wattanasoontorn et al., 2013 to illustrate the core components of Equit’Game.
**Development team**- The creation of our serious game brought together a large panel of contributors from different disciplines: scientists, *software engineers*, graphic designers, *simulation analysts* and educators. The multi-disciplinary expertise of this team enabled us to produce an innovative game featuring interfaces and graphical environments designed to fulfil the Equit'Game objectives.

**Tools**- The development of Equit'Game was based on two essential elements: application design software and the game engine. The design software we used is called *Ludiscape*©, created and developed by Damien Renou ([http://www.ludiscape.com/](http://www.ludiscape.com/)).

*Ludiscape* is a collection of integrated tools designed to help users create training content, e-learning modules and serious games. This technology allows users to create a variety of educational content simply by using the *Ludiscape* resource library. Each object in this library provides quick access to properties and settings, requiring no prior experience of programming (Figure 2). Full integration of *JavaScript* with the *Ludiscape* engine and its extensions ensures maximum flexibility and production speed. Plug-ins are invisibly integrated into the educational production environment in such a way that they are easy to use.

The *Ludiscape* environment allows users to incorporate educational material in various formats (JPG, WAV, M3, MP4, PTT…) into a unique project which becomes the game engine. The game engine can then be exported in different formats (HTML, JS, CSS, SCORM, EXE, IOS) towards different platforms (PC, MAC, SMARTPHONE, TABLET, PHABLET, LMS, MOODLE, DOKEOS). This unique project contains all of the codes required to control the game, as well as all of the databases which feed into the game. It is this game engine which the graphical user interfaces (GUI) will open when the user launches the application. Based on the decision tree (constructed in one of the first step of the project), the rules (including the various stages) which announce the success is presented to the learner/player: i.e. the levels to be completed in order to finish the game. When a set of targets has been met, an interface appears to inform the user that the ongoing level is complete and that they can move onto the next level.
Content - As part of their decision-making process, regional healthcare agencies and local authorities apply national strategies at the regional and/or local scale to develop targeted local actions. To do this effectively, decision-makers require a comprehensive territorial diagnosis based on study, cross-comparison and precise analysis of the available data.

We therefore decided to base our interactive serious game, Equit’Game, on the idea that a comprehensive territorial diagnosis combining health, environmental and social perspectives would represent an invaluable resource in the decision-making process, helping to boost collective action at territorial level. To achieve this objective, we need to understand and master the different stages involved in the creation of a territorial diagnosis.

All of the data collected by the Equit’Area project from the City of Paris, involving a fine scale of geographical detail, was used in the development of Equit’Game.

As such, at different level in the game, we provide players with information and tools developed by scientists and experts. These resources take various forms: statistical indicators, maps, results of analyses etc.

In order to describe the state of healthcare in Paris, the infant and neonatal mortality rates between 2004 and 2009 are displayed. Thereafter, the average annual levels of nitrogen dioxide (NO₂), and particles with a diameter equal to or smaller than 10 µm (PM₁₀) – as modelled by the agency responsible for monitoring air quality in the Greater Paris (AirParis) – are used to visualise the spatial distribution of environmental hazards in Paris (air pollution is only one of the factors used to measure environmental hazards). To finish, the population census data are analysed in order to profile the neighbourhood socioeconomic deprivation.
**Technology:** In creating this game, we opted to use virtual reality technology; this means creating a simulation which gives players the impression that they are present in a real or imaginary environment. These different environments were created by designers and graphical experts to represent: *i)* virtual spaces such as: a university campus, a conference centre, a classroom, an office etc. *ii)* real spaces such as: conferences by well-known figures, interviews with experts etc.

**The Equit’Game tool:**

Like the majority of serious games in the healthcare sector, Equit’Game aims to reach several objectives: spreading a message which is informative and educational, while also getting across marketing/persuasive messages intended to induce/influence behaviour; in this case, encouraging players to take action and conduct their own territorial diagnosis.

More specifically, the realistic situations employed in our serious game should encourage players, in a fun and playful manner, to (1) appropriate the data of their own territory, (2) apply their methodological knowledge in a practical way, (3) reflect on the most pertinent statistical and/or spatial tools for their situation and, (4) ultimately, to acquire new knowledge and skills in the use of territorial diagnosis tools with a spatial dynamic. These 4 objectives structure our game into 4 levels, as follows:

- Level 1: ‘Dataminer’ (identifying relevant information to respond to the question)
- Level 2: ‘Analyst’ (selecting the appropriate method of analysis)
- Level 3: ‘Atlas’ (mapping the data),
- Level 4: ‘Cluster’ (extraction of statistical and spatial information)

The serious game is deployed over the course of a week’s training, and structured in such a way that each learner should complete one level per day. The experience involves a combination of teaching scenarios delivered by a computerised application, and can be used with or without an instructor as part of classroom training, distance learning or a combination of the two.

**Game formats** – The game offers a number of different learning mechanisms, a variety of approaches combined in Equit’Game and corresponding to the various objectives set for each level. In order to help players to appropriate the data of their study territory, there are various ‘hidden areas’ which allow players to interact with the territory. There are also crosswords and ‘drag and drop’ exercises which allow players to apply their methodological knowledge in practical and concrete ways. We also included ‘Quiz’ sections and dialogues involving virtual
interaction via text zones, in order to stimulate reflection on the most appropriate statistical
and/or spatial tool. Equit’Game also incorporates educational simulations designed to help
players acquire new knowledge and skills. Players are allowed to run the simulations several
times, using different input data each time.

Users/platforms: our serious game aims to reach several target groups, including employees of
local authorities and regional health agencies. Thanks to the diversity and richness of the
educational material included in each level, Equit’Game can also be used wholly or partially as
part of Master’s programmes in public health and/or environmental health.

Users can access Equit’Game via a platform compatible with tablets, PCs and smartphones, and
have to enter their user identification to log in. The platform also allows instructors to monitor
the progress of each player within the game, systematically and in real time, thanks to the
indicators and intermediate scores recorded by the platform.

Results

1- Tool design

High-Level System Diagram - Equit’Game is composed of 3 blocks (2 principal components and
an interface layer) and includes 2 databases in XML and MySQL format.

As Figure 3 shows, the structure used allows the Equit’Game administrators to edit the game via
the first block, using an XML database implemented within the Ludiscape software. The game
can then be exported as a SCORM.js layer. The SCORM.js interface will be deployed on LMS
Moodle or a similar online platform, which operates via the MySQL database and allows players
to access Equit’Game.

Access to Equit’Game, regardless of the device used (PC, Tablet, Smartphone), therefore
requires connection to the online platform with personal user ID codes. This final block is where
players can save their data to the server via MySQL database. Instructors can track the progress
of players via plugins installed on the Moodle platform, which keep records of different
indicators and parameters as users move through the game (time spent on the game, score on
each level etc.). Analysis of these indicators, virtually in real time, allows the instructor to follow
players though each level of the game and, where necessary, to adapt subsequent training to
address any concepts which learners do not seem to have fully understood.
Figure 3: System Architecture

Open and Edit the project _Ludiscape_
2- Designing our serious game

This serious game is part of the process of translating the results of the Equit’Area research programme into training tools. It was designed and developed for the purposes of training users to realise a territorial diagnoses. Equit’Game is thus based on the following key elements: i) understanding the needs of a territory in the three complementary areas of health, environmental exposure and neighbourhood socioeconomic deprivation, and ii) learning to handle the data which best characterises the territory, including data collection, transformation and analysis, as well as graphical representations and maps.

In order to fully satisfy the definition of a serious game, ‘Equit’Game’ meets the following criteria:

- Accompaniment in the form of texts and voice messages, guiding the user
- Use of realistic elements to simulate real cases
- Clear and easy interfaces
- No time limits, as users progress at different speeds.
- Congratulations at the end of each level, encouraging players and facilitating the learning process
- Lack of animation and sound effects, to keep players' attention focused.

Equit’Game has also been designed as a sort of ‘virtual campus’, creating a fun learning environment (Figure 4) in which each door represents a level. The game environment also incorporates an additional space where learners can look back over previous levels in order to improve their performance, consult the previous learning materials and save the information they require.

As shown in Figure 4 (screen capture), we have used a colour code to clearly identify the four levels which make up Equit’Game: Level 1 is yellow, 2 is blue, 3 is green and the 4<sup>th</sup> and final level is orange. In order to mimic the structure of a diagnosis focusing on social and/or environmental inequalities relating to health, players can only move onto the next level when they have completed the current one, and cannot go backwards (Figure 4).

Players encounter different characters throughout the game: the first character, the elegant Marie, welcomes and guides players around the campus at the start of each new level, colour-coded accordingly (Figure 5). A second character, Robert the robot, helps players to get to grips with methods and learn how to handle data.

In order to make Equit’Game more realistic, expert interviews, feedback and video clips, staged in realistic surroundings, examine the following issues: social health inequalities, environmental inequalities and health inequalities relating to perinatal health.
2.1 A game constructed around 4 levels and 2 scenarios: gameplay

Players are presented with two scenarios: i) a diagnosis focusing on socioeconomic factors and health or ii) a diagnosis focusing on environmental factors and health. They must make a choice based on the information provided at the outset of Equit’Game, and the way that the game plays out will change accordingly. For example, if a player decides to focus on environmental inequality, they will have access to the relevant environmental and health data but not the socioeconomic data, and vice versa.

The structure of each level is described below.
LEVEL 1 (Figure 6):

In this first level, the goal is to identify pertinent data and to collect the information which is available and necessary to achieve the stated objective. Players define their objective on the basis of the territory under consideration and the existing literature, justifying their choice.

To this end, the level is broken down into a series of interrelated steps:

Upon first connecting to Equit'Game, learners are greeted by Marie (a key character in the game) and taken to a virtual conference where they see several videos. Players must then take part in a sort of ‘board game’ exercise, which functions as an evaluation test of knowledge, before leaving the conference. They then set off to ‘hunt down’ the necessary information, taking the train to Paris to gather information on the ground. Back on the campus, they must learn to store this data within a workspace laid out like an office. Various simulations and learning models are available to help learners to construct databases which are understandable and usable for multiple contributors.

Players thus move between 3 game environments (the conference, Paris and their office, cf. Fig. 3), completing 30 challenges (crosswords, drag-and-drop, puzzles etc.) along the way in order to complete this first level. By the time learners reach the end of the first level, they should be capable of choosing the diagnosis they wish to conduct for the Paris-city, and identifying the type of data required to achieve this diagnosis.
Figure 6: The structure of Level1 “dataminer” of Equit’Game
LEVEL 2 (Figure 7):

The goal of the second level is to learn how to summarise information using appropriate statistical tools, selected among the available statistical indicators, tables and graphs. The level is structured as follows:

Back on campus, Marie (the game’s learning companion, cf. Fig. 2) guides the learners towards a blue door which symbolises the start of the next level: ‘Analyst’. Players thus move into a new learning environment, accompanied by blue Marie, and learn about basic statistical methods and the different indicators they can use for territorial diagnosis. Robert is on hand to help learners as they watch 3 tutorials on how to use the statistical software STATA and its main analytical functions. They then get to grips with the software’s various functions and statistical features with the help of crosswords, drag-and-drop exercises and puzzles.

To finish off, learners use the various simulation tools to begin processing the data that they themselves collected in Level 1, with a view to producing pertinent statistical indicators, constructing graphs and conducting the necessary statistical analyses (such as variance analysis or a mean comparison test). With Robert’s help, the learners then analyse their results using tools including a quiz and a virtual dialogue session.

Players thus move between 2 game environments (cf. Fig. 4): theoretical statistical learning (much like an actual lecture) and the virtual office (which corresponds more closely to practical work, conducted with or without the help of an instructor).

To complete the level, learners must complete numerous challenges (crosswords, drag-and-drop, puzzles etc.). By the end of this level, learners should be able to conduct and interpret statistical analyses on the data they have collected, as well as presenting the information clearly.
Figure 7: The structure of Level 2 “Analyst” of Equit’Game
LEVEL 3 (Figure 8):

The aim of level 3 is to learn how to present data using appropriate Geographical Information Systems (GIS), and how to interpret the resulting mapping. In order to achieve this objective, the level is structured as follows:

As in the previous level, Marie guides learners across the virtual campus to a green door which opens onto the 'Atlas' level.

In this new learning environment, green Marie (cf. Fig. 5) accompanies players as they learn about GIS, their use and their importance for territorial diagnosis. Thereafter, Robert (cf. Fig. 5) guides players through 5 tutorials focusing on the ARCGIS software and its function in term of spatial analysis, geomatic and cartographic features. They then familiarise themselves with the use of the various geomatic and spatial mapping functions and features with the help of exercises including crosswords, drag-and-drop exercises and puzzles.

To complete the level, learners must use the various simulation tools at their disposal to map and interpret the data they collected in Level 1, producing their own maps to visualise the health spatial distribution and also the environmental or socio-economic spatial distribution according to their initial choice. With Robert’s help, the learners then analyse their maps using tools including a drag-and-drop test, a virtual dialogue session and a puzzle.

Players thus move between 2 game environments: lessons on the geographical tools (much like an actual lecture) and the virtual office (which corresponds more closely to practical work, conducted with or without the help of an instructor).

To complete this third level, learners must complete a total of 40 challenges (crosswords, drag-and-drop exercises, puzzles etc.). By the end of this level, learners should be able to summarise information using appropriate mapping tools, and present essential information clearly.
Figure 8: The structure of Level 3 "Atlas" of Equit’Game
LEVEL 4: (Figure 9)

The aim of Level 4 is to learn how to cross-compare data using appropriate geographical tools and correctly interpret their spatial distribution. In order to achieve this objective, the level is structured as follows:

Back on campus, Marie guides the learners towards a orange door which symbolises the start of the next level: 'Cluster'.

In this new learning environment, orange Marie (cf. Fig. 7) guides players as they learn the theoretical foundations of clustering techniques, their use and their importance in order to establish a territorial diagnosis. Robert (cf. Fig. 7) then accompanies them as they watch four tutorials on the SatScan software (for scan statistics analysis) and its spatial analysis functions.

To complete the level, learners must use the various simulation tools at their disposal to analyse the data they collected in Level 1, identifying the most vulnerable areas of Paris-city and disseminating results of the territorial diagnosis. With Robert’s help, the learners then interpret these spatial analyses using tools including a quiz and a virtual dialogue session.

Players thus move between 2 game environments: a learning environment focused on spatial learning (much like an actual lecture) and the virtual office (which corresponds more closely to practical work, conducted with or without the help of an instructor).

To complete this fourth level, learners must complete a total of 35 challenges (crosswords, drag-and-drop exercises, puzzles etc.). By the end of this level, learners should be able to produce a spatial representation of the data using appropriate geographical tools, and present the resulting territorial diagnosis.
Figure 9: The structure of Level 4 “Cluster” of Equit’Game

- Guides the learners towards an orange door.
- Orange Marie welcomes in “cluster” level.
- Orange Marie accompanies players as they learn the theoretical foundations of clustering techniques, their use and their importance in territorial diagnoses.
- Orange Marie presents three expert interviews about clustering analysis.

- Back on campus.
- Player should be able to produce a spatial representation of the data using appropriate geographical tools, and present the resulting territorial.
- Player analyses and interprets the spatial analyses using tools including a quiz and a virtual dialogue session.
- Various simulation tools at their disposal to process the data, identifying the most vulnerable areas of Paris and establishing an opposite territorial diagnosis.
- Crosswords, drag-and-drop exercises and puzzles.
- Robert is on hand to help learners as they watch 4 tutorials.
**Organisation and management of the serious game « Equit’Game »**

The diagram below gives a schematic representation of the structure of Equit’Game, comprising a main block (dispositif.ludiscape) which contains the game's four levels along with external files which contain smaller .ludiscape blocks for each level.

The main block contains all of the levels which make up Equit’Game, including all resources, databases and videos as well as the tests and quiz modules.

The external files contain the tutorials, videos and simulation modules, incorporating large databases which have been deliberately separated from the main block in order to reduce the size of the game, facilitating updates and speeding up the handling of the various game scenarios.

**Conclusion**

Equit’Game was developed to help learners the techniques of territorial diagnosis, with the aim of creating an “innovative tool for public health” capable of conveying educational messages and providing a structure for training. Equit’Game provides a fun learning environment in which players learn how to approach a territory and conduct spatial analyses using a combination of methods, tools and data, ensuring that information is not misinterpreted. This educational tool can be adapted to other territories, and the approach adopted in this project is transposable in other public health issues.
Author's contributions:
Séverine DEGUEN and Wahida KIHAL had the original idea for this serious game named “Equit’Game”. Damien RENOU carried out the application development. Séverine DEGUEN, Wahida KIHAL and Damien RENOU carried out the game development. Séverine DEGUEN, Wahida KIHAL, Damien RENOU, Arnold Magdelaine, William Harang and Denis ZMIROU-NAVIER had work to adapt the development of the application to the needs of the final users more easily. All the authors drafted the manuscript, and approved the final one.

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Conflict of interests:
The authors have declared that no competing interests exist. Damien Renou is a member of Ludiscape. The authors declare that this company did not play a role in the study design, data collection and analysis, decision to publish or preparation of the manuscript.
References list


