WHOLODANCE

Whole-Body Interaction Learning for Dance Education

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Deliverable 6.4

Final Report on the resulting extension and integration of the ASTE[1] engine in WhoLoDancE

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Executive summary

The current document describes the tools that have been implemented and integrated for the personalized approach in the WhoLoDancE project. The personalized approach considers the conceptual framework, needs analysis and other outcomes of WP1, the semantic representation in WP3 and the results of the first formative evaluations of the tools in WP7.

In particular, we describe the WhoLoDancE Educational Platform (WEP), a web-based application, which organises the recordings into meaningful "learning units" such as Courses and Activities, and allows to browse through them depending on the dance genre, movement properties (e.g., principles, qualities, actions, or syllabi), available hardware, focus (e.g., choreographic research vs. learning forms), level of expertise etc. and recommend particular courses based on the profile of the user. We present the ontology-based architecture, data management approach and ontology (Section 2.2, 2.3 and 2.4) which serves to take advantage of the available metadata, and experts' annotations of the recordings and create related knowledge that is needed to organise the recordings from an Educational perspective. In Section 2.5 we present in detail an interface and its functionalities, explaining the design decisions and corresponding requirements that are met.

The second part of this deliverable (Section 3) presents the Choreomorphy tool, which allows a personalised view of the pre-recorded movements, using a variety of devices ranging from a desktop viewer to a mixed reality, whole-body interaction experience, depending on the motion sensing and motion capture devices available. Through a simple interface, the user can change in real time avatars, motion effects such as traces, and virtual environments. Section 3.1 and 3.2 present a general description of the Choreomorphy tool and its architecture and setting. Section 3.3 reports on the User Interface while sub-sections 3.4, 3.5 and 3.6 present in detail the different avatars, perspectives (cameras) and environments that have been integrated in this tool. Last but not least, at the end of the main Sections describing WEP and Choreomorphy a brief reference is given to the evaluation and iterative design process, that is mainly described in other deliverables and published papers and summarizes some conclusions about the current state of the tools and potential future enhancements and exploitations.

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1 Introduction

WhoLoDancE deals with dance learning, focusing on four different dance genres: ballet, contemporary, Greek folk and flamenco, targeting tools for adult practitioners and professionals such as students, performers, choreographers, and teachers. As described in detail in previous deliverables such as D1.4 Definition of Learning Scenarios **Errore. L'origine riferimento non è stata trovata.**, D1.7 User Profiling [10] a nd D6.3 First Report on the resulting extension and integration of the ASTE engine in WhoLoDancE [14], the combination of different dance practices and user groups suggest that there is no one solution to fit all needs. WhoLoDancE has resulted with a large movement repository of multimodal dance recordings as well as a variety of tools that each one of them is focusing on particular aspects of learning. These aspects include movement parameters such as principles, actions and qualities, syllabi, and modalities e.g., visualization vs. sonification. In addition, the WhoLoDancE tools vary in terms of required hardware, ranging from web-based, desktop applications, to lower-end, portable and affordable devices, to higher-end cut edge technologies of motion capture and Augmented, Virtual and Mixed Reality (AR, VR &MR) technologies. The personalized Dance Education Experiences, implemented through the WEP and Choreomorphy tools, as well as the ontology are built upon the Conceptual Framework of WhoLoDancE [1][2] aiming at embracing the similarities and differences of each dance genre, proposing common Movement Principles and Qualities, that are potentially applicable to any kind of dance or movement activity, while also acknowledging the fact that there is no one solution to fit all in dance learning, teaching and making, taking into account the variety of dance practices, learning approaches, needs, philosophies, aesthetical choices and cultural contexts [4].

2 WhoLoDancE Educational Platform

2.1 General description

The WhoLoDancE Educational Platform consists of a web-based platform which aims to organise the recordings and content that was created during the project, to propose courses and activities that suggest the use not only of the content itself, but also of the variety of tools that have been created during the project. The WEP platform sets a proof-of-concept for personalized paths to dance learning, by allowing the user to browse and be guided through a variety of activities, depending on preferences, educational level, dance genre, focus, movement properties that one wants to work on and enhance. These preferences also include available devices, starting from the simple requirement of having a personal desktop, laptop, tablet or a Kinect device to more complex devices such as motion capture and AR/VR or MR hardware, including some that are not widely available in the market for wider use such as the Microsoft HoloLens. Due to the limitations of current devices, as well as the enormous demands on bandwidth, and limitations for potential users to get this kind of hardware because of complexity and cost, the platform at its current version do not integrate those scenarios, but all of them have been developed, applied, tested and evaluated with users in lab settings and the WEP platform represents a vision for assisted teaching for dance in the future. Additionally, the WEP platform organizes the content through the ontology and puts the basis for offering personalised recommendations according to preferences and needs. Figures 1 and 2 show two result screens of recommended courses and activities using a variety of WhoLoDancE tools, depending on the available hardware and needs of the user e.g., dance genre, level, focus, movement principle, qualities, actions etc.

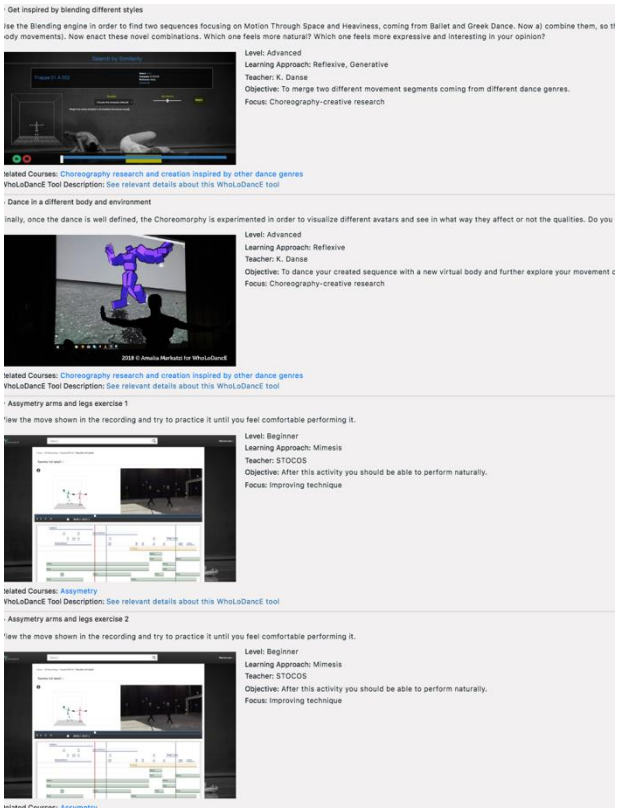


Figure 1. A list of activities suggested by WEP using different WhoLoDancE tools (Similarity Search, Choreomorphy, WhoLoDancE Movement Library & Annotator)

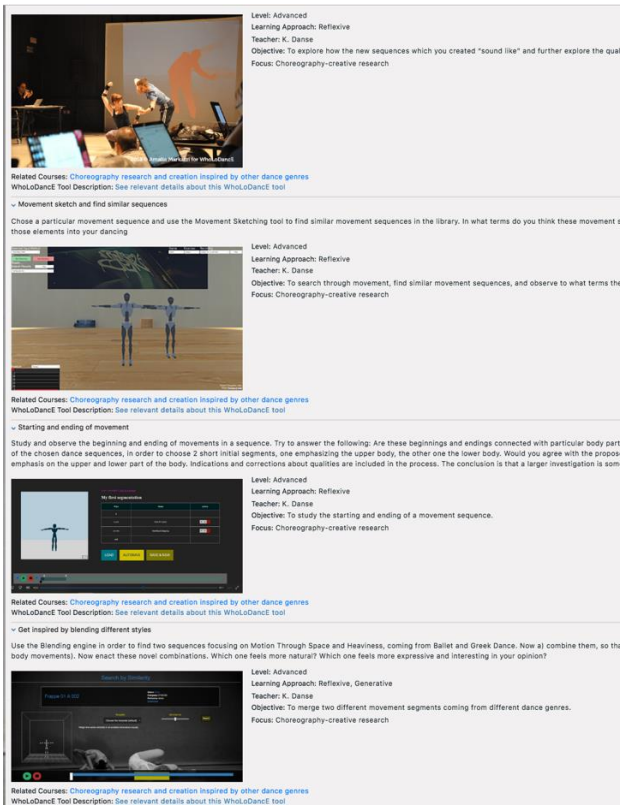


Figure 2. A list of activities suggested by WEP using different WhoLoDancE tools (Sonification & Movement Sketching, Blending Engine, Segmentation Tool, & Similarity Search)

2.2 Architecture

In this section, we describe the main components of the WhoLoDancE Educational Platform, as well as the technologies used to develop the interface and the back-end system. Figure 3 shows the basic workflow of the system. The approach goes towards an integrated but flexible architecture, which takes advantage of the wealth of knowledge that derives from the WhoLoDancE Movement Library and the WhoLoDancE Ontology. The main components of the architecture, consist of the following: 1) The WhoLoDancE ontology, which organizes and represents the domain knowledge consisting dance genres, movement vocabularies and descriptors and their relationships, 2) The repository of the WhoLoDancE Movement Library, which provides the recordings, and their metadata and annotations, 3) The Reasoner which serves to infer new knowledge from existing knowledge combining the ontology with the WhoLoDancE Movement Library's repository, 4) The Control Unit which is a custom API that integrates the content from the WhoLoDancE Movement Library with domain knowledge and finally 5) the WhoLoDancE Educational Platform's back and front end, web-based interface which stores and serves the Educational units (Courses and Activities) to the end-user. In the following section we present the detail the Data Storage which is implemented through the four first components (Ontology, Movement Library, Controller and Reasoner) while the WEP interface will be described in detail in Section 3.

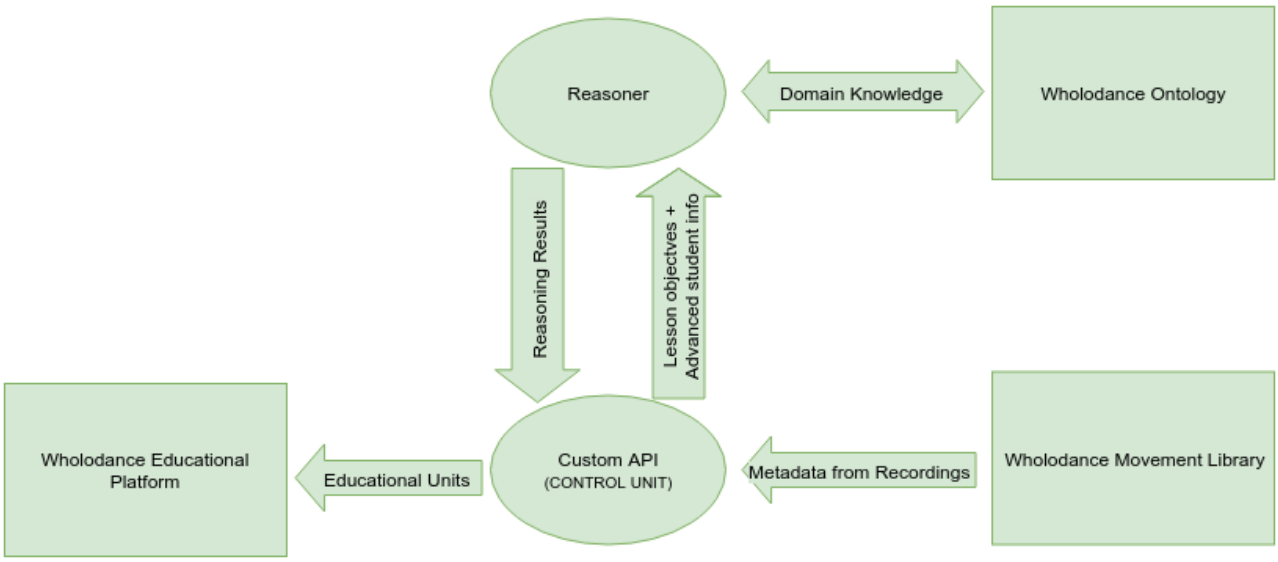


Figure 3. WhoLoDancE Educational Platform Architecture

2.3 WEP data storage

The WhoLoDancE Educational Platform consists of two main layers: 1) The Data Storage layer and the 2) User web-based Interface which will be described in detail in section 3. The Data Storage layer represents the infrastructure that implements the storage of the activities and courses that were generated through the WhoLoDancE Ontology. Moreover, it is connected to the WML data storage in order to have access to the multimodal recordings and their metadata. The Data storage consists of the following main components:

- The Recording Repository: as described in D5.2 Beta Prototype Testing and Validation of Data Management Platform [12]
- The Educational Units Database: this component is the archival system for the educational units that were created by using the WhoLoDancE Ontology. The database was implemented in PostgreSQL and it includes the following tables:
    1. Activity: contains the activities that were created to specify the user's tasks in an educational unit.
    2. Course: contains a complete package of activities.
    3. WhoLoDancE Tool: contains the tool names that have been created throughout the WhoLoDancE project.
    4. Hardware: contains the hardware that a user might need to complete an activity/course.
    5. Note: contains the notes that a user has written while taking an activity.
    6. Rate: contains the score that a user has given to an activity.

The detailed schema of the database of WEP is shown in Figure 4.

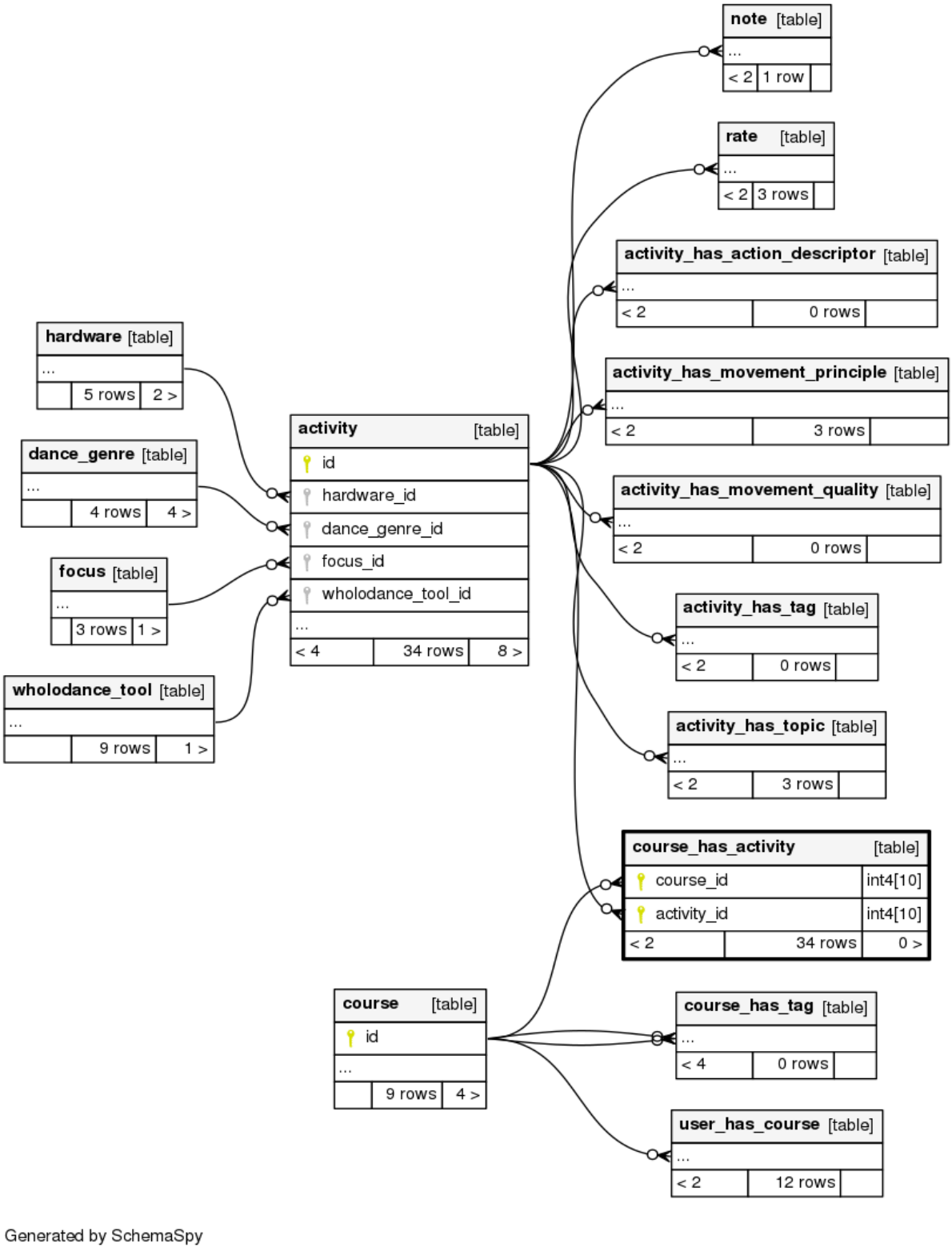


Figure 4. WhoLoDancE Educational Platform database schema

2.4 Ontology

The Ontology that has been integrated both in WEP and WhoLoDancE Movement Library, extends the "WhoLontology" that has been described in detail in deliverable *D3.1 Report on semantic representation models* [17], the top concepts of which are shown in Figure 5.

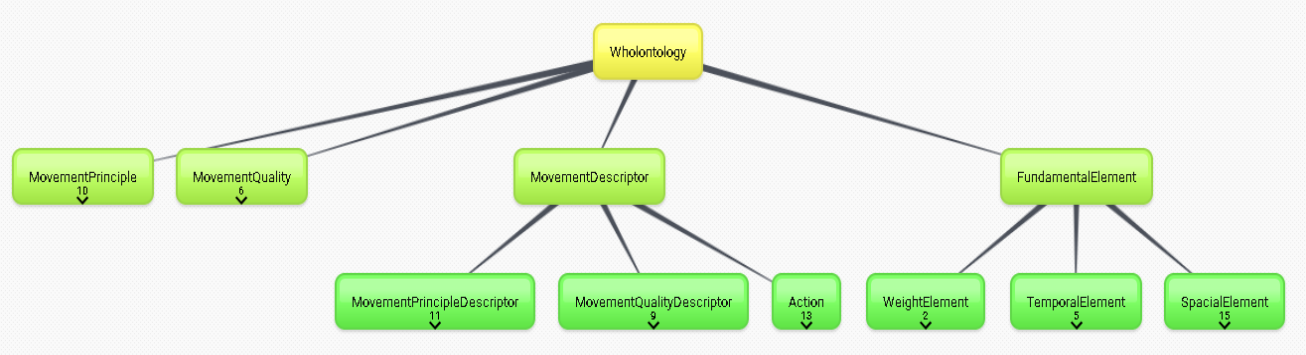


Figure 5.The basic conceptualization of WhoLontology

Whereas in D3.1 we have described the top concepts that were used for describing the movement in the recordings, the current version has been enriched with Classes, Instances and Object Properties that describe the following aspects:

- Educational information, such as the Learning Level, the Part_of_a Class, the Learning Entity such as Course and Activity
- Dance Genre specific concepts that allow to inference and enrich the potential educational use of each recording, based on domain knowledge and rules that are subject to the specific dance genres:
    - Such part of the ontology includes concepts and relationships associated with Greek Dances, their structure, locality, form and learning difficulty that derives from this knowledge,
    - Concepts that are related to the Ballet vocabulary and syllabus, and the domain knowledge that allows us to infer that a particular part of the syllabus contained in a recording is appropriate for a specific Learning Level, or Part_of_a_Class (and therefore a recommended activity in the WEP)
- Relationships between Movement Descriptors, Principles, Qualities, Actions and particular parts of dance vocabularies, as well as Learning Units (Courses and Activities).

In Figure 6, a view of the ontology in Protégé is showing a part of it representing the Ballet terminology, concerning the movement vocabulary. In what follows, we present a particular example of the movement "Echappe" and the domain knowledge which is asserted in the ontology and how the Reasoner in Protégé inheres new knowledge, i.e. new assertions from the existing.

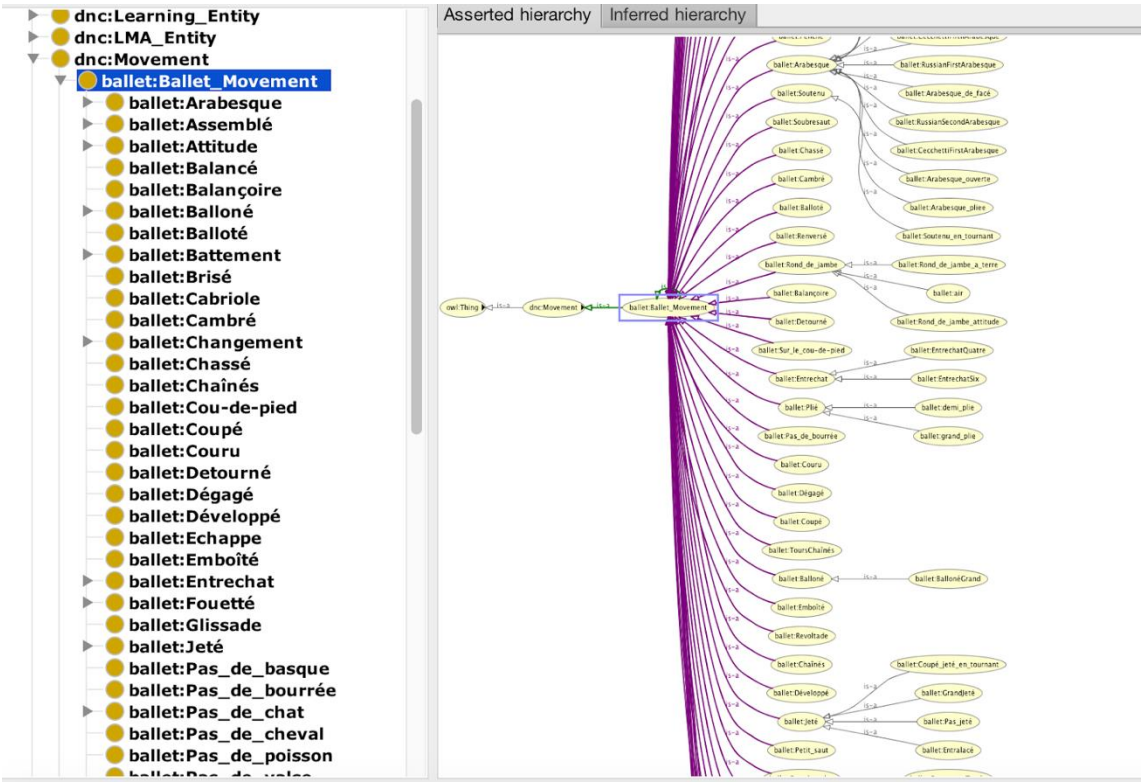


Figure 6. Ballet Movement part of the ontology

Example: A Recording might be tagged with the term "Échappé". The ontology infers that this could be tagged also with:

- ***Symmetry*** (rdfs:subClassOf dnc:Movement Principle)
- ***Jump*** (rdfs:subClassOf dnc:Action)

- ***Light*** (rdfs:subClassOf dnc:Movement Quality Descriptor)
- ***Direct*** (rdfs:subClassOf dnc:Movement Quality Descriptor)
- ***Sudden*** (rdfs:subClassOf dnc:Movement Quality Descriptor)

- ***Lightness*** (rdfs:subClassOf dnc:Movement Quality)
- ***Directness*** (rdfs:subClassOf dnc:Movement Quality)
- ***Suddenness*** (rdfs:subClassOf dnc:Movement Quality)

- ***Allegro*** (rdfs:subClassOf dnc:Part Of Class)
- ***Center*** (rdfs:subClassOf dnc:Part Of Class)

- ***Beginner*** (rdf:type dnc:LearningLevel)
- ***Intermediate*** (rdf:type dnc:LearningLevel)
- ***Professional*** (subC rdf:type dnc:LearningLevel)

In Figure 7 and 8, on the right part of the print-screen the asserted knowledge is shown in bold while with the lighter font, we can see the inferred knowledge for this recording. Based on the knowledge described above and the fact that the Recording with the id REC0002 has Annotation TagEchappe the reasoner infers also that this recording refers to movement which can be described with Lightness, Directness, Suddenness, and Symmetry (Figure 7). In addition (Figure 8), the reasoned infers that this particular tag,

applies to the REC0002, fits Level Beginners, refers to particular Movement qualities such as *Directness*, *Lightness* and *Suddenness* and to particular Movement Principles such as *Symmetry.*

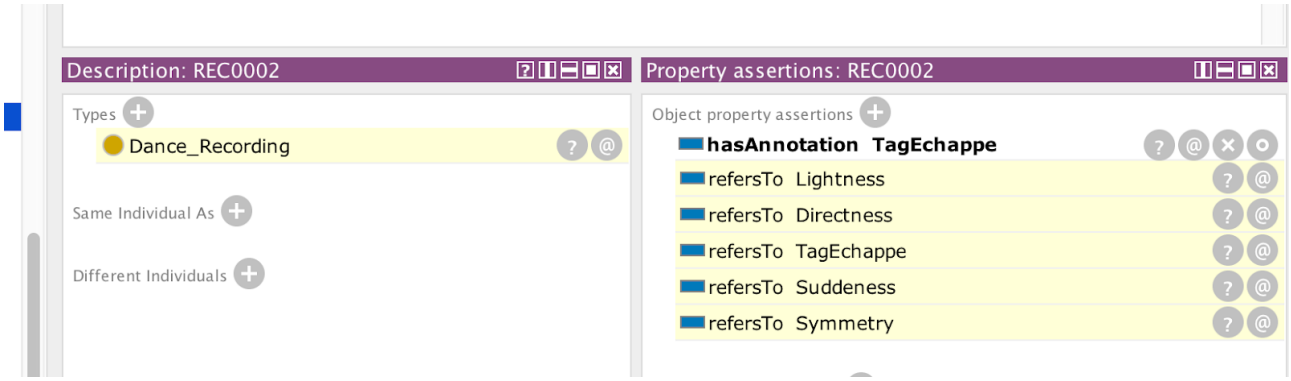


Figure 7. Protégé view, the inferred knowledge about the Recording REC0002, based on the fact that there is a tag asserting that this recording contains the movement "Échappé"

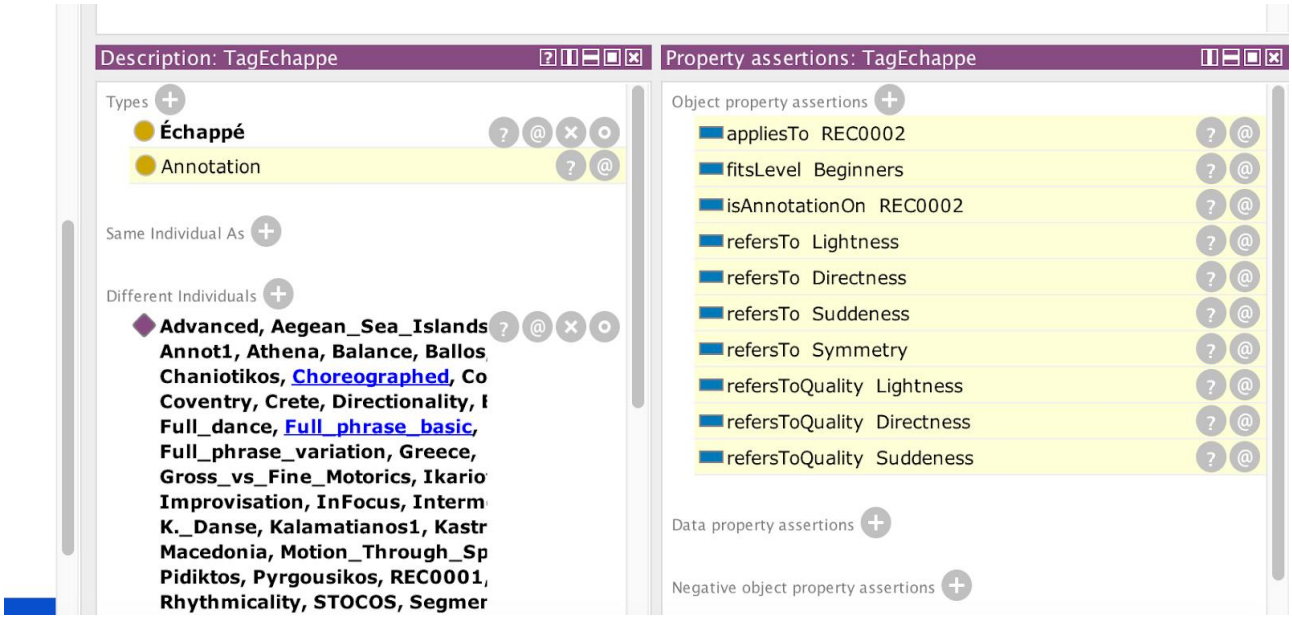


Figure 8. Inferred knowledge about the Tag, based on the fact that the particular movement implies particular qualities in its performance

2.5 User Interface

The interface of the platform has followed an iterative design approach involving the dance experts of the consortium in a formative evaluation using prototype mock-ups.

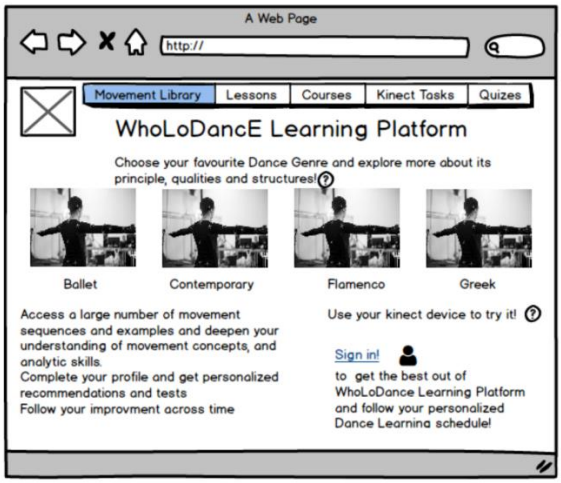


Figure 9. Mock-up for Home page

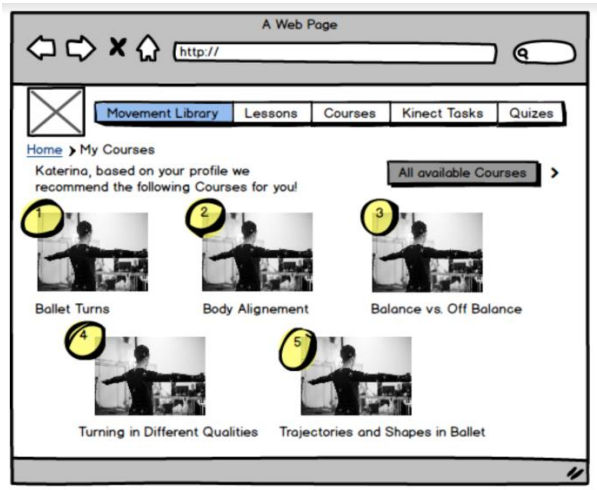


Figure 10. Mock-up for browsing courses

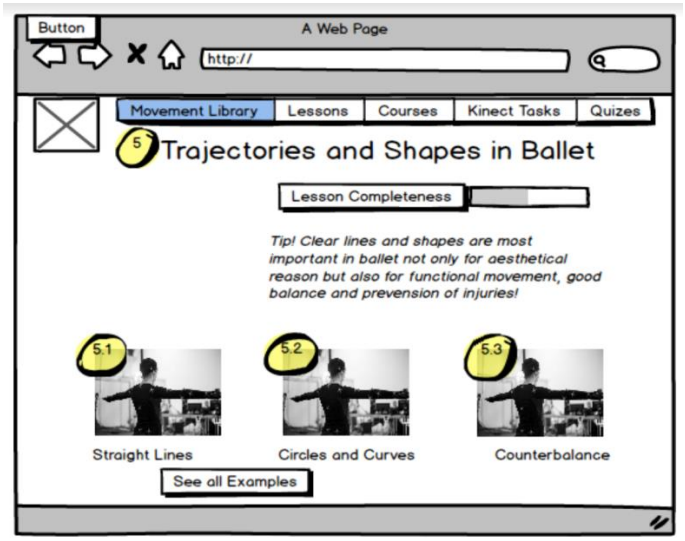


Figure 11. Mock-up for a set of activities

2.5.1 Home Page

2.5.1.1 Description

Figures 12, 13 and 14 present the Educational Platform's Home Page. Generally, the Home Page displays two basic structures.

On the left side of the page, the "Browsing Categories" menu is located. This menu has been included in order to offer the opportunity of browsing courses and lessons with specific traits. Several terms have been used such as browsing by dance genre, teacher, level and class.

The second basic structure is located at the centre of the page. As the figures 12, 13 and 14 demonstrate, it contains three or four discrete panel, depending on the user's status. The user's status is based on three aspects. Setting personal preferences, visiting and receiving recommended courses, as well as enrolling in a course, affect the home page interface.

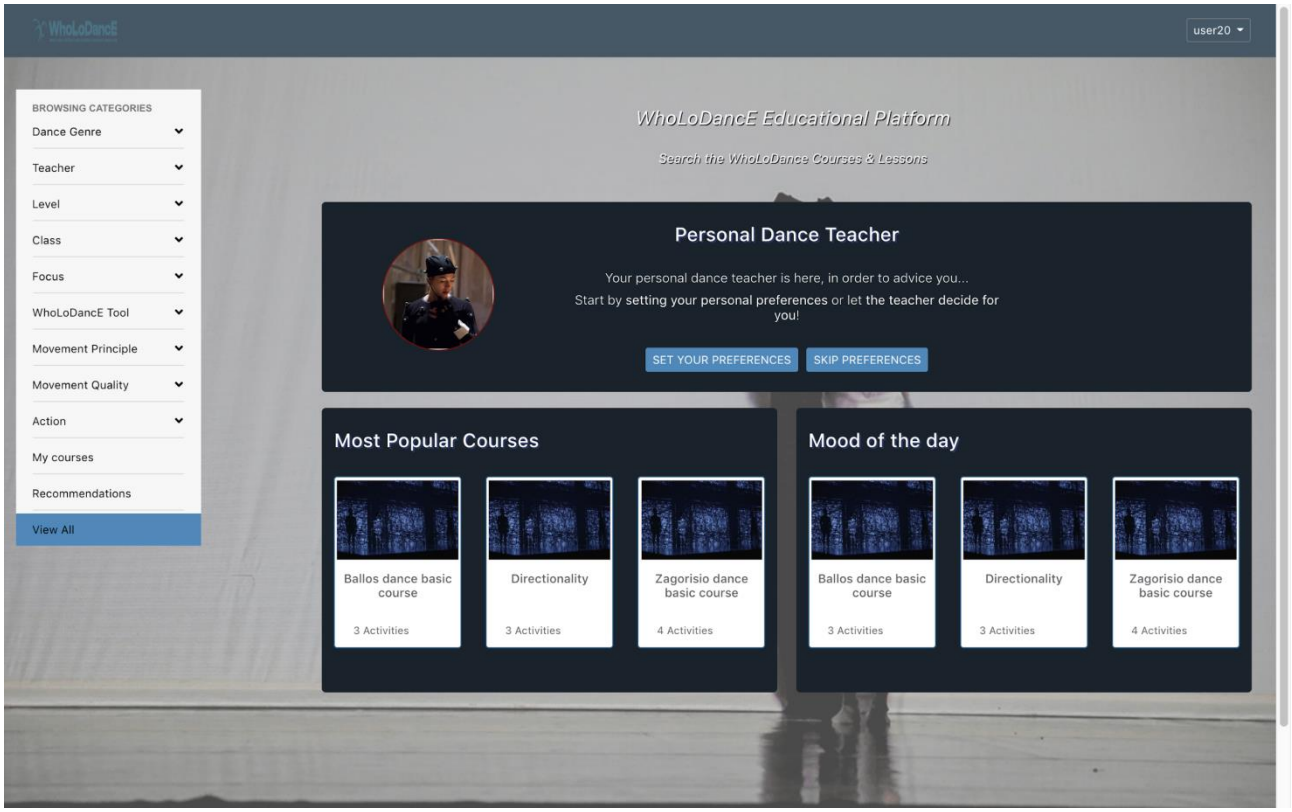


Figure 12. Home page (user logs in for the first time-no preferences defined)

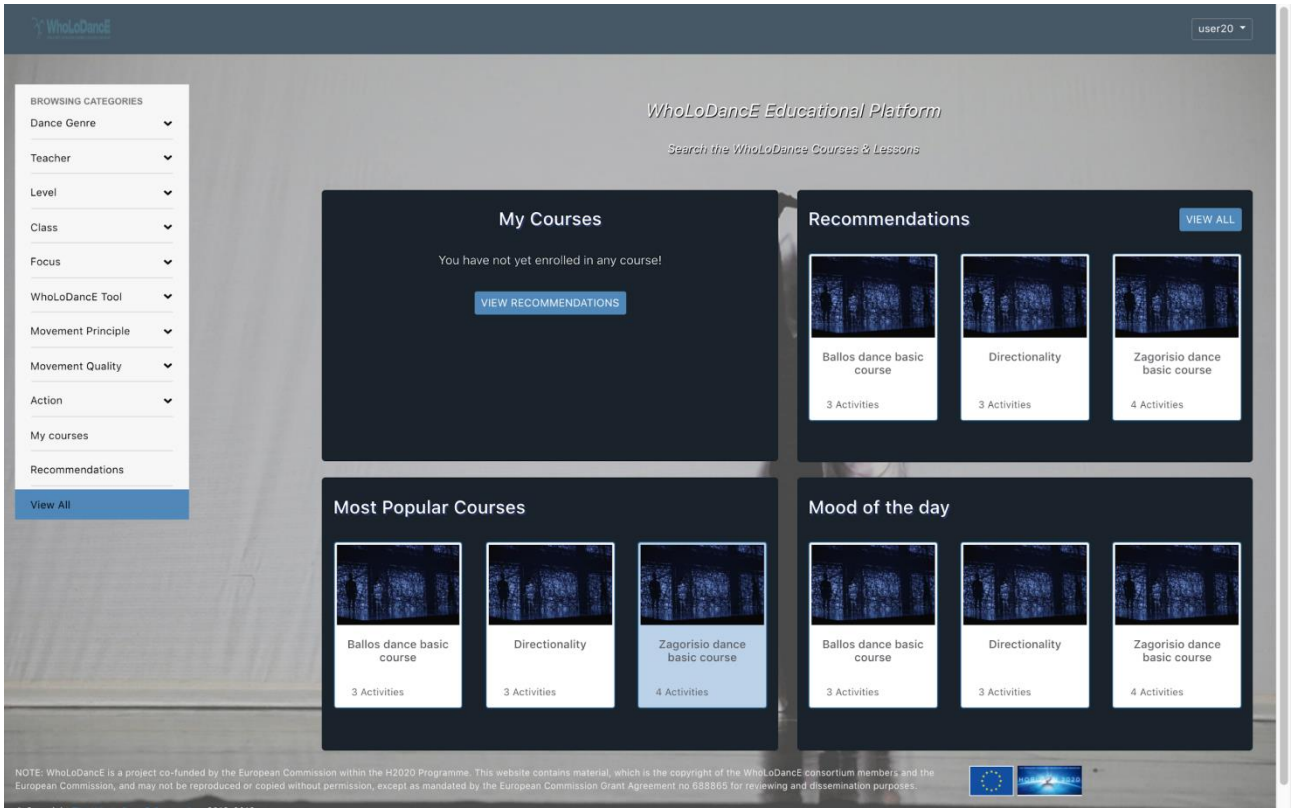


Figure 13. Home page (user that has not enrolled in any courses)

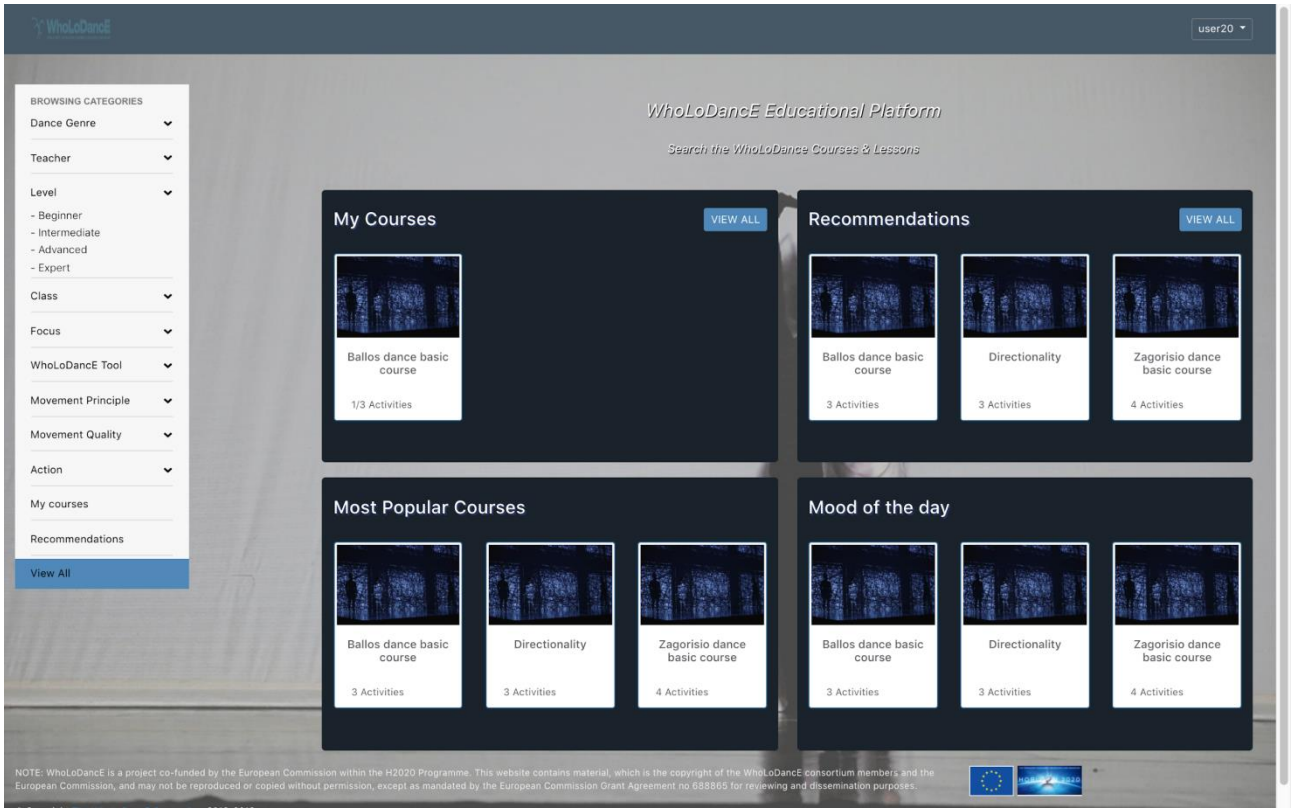


Figure 14. Home page (user has set preferences and enrolled to courses)

2.5.1.2 Related requirement

The Home page constitutes an introductory interface, which aims to provide users with an overview of the Educational Platform tool, as well as its content.

A side menu that works as a browsing option was developed. Users that are unfamiliar with the tool's content have the opportunity to select between eleven discrete categories, as well as a View All option, in order to capture the essence of the courses.

Moreover, the system provides users with a personalized experience, by guiding them and forming the interface according to the users' needs.

2.5.1.3 Specifications

The Educational Platform tool attempts to offer the choice of a personalized learning experience with recommendations that are produced by the user's preferences. At the same time, there is also an option to discover the tool's content and freely browse courses or specific lessons.

The browsing option takes place with the use of a side menu that appears in the majority of interfaces. The "Browsing Categories" menu has been enhanced with twelve distinct categories and more specifically the dance genre, teacher, level, class, focus, WhoLoDancE tool, movement principle, movement quality, action, My Courses (courses that the user has enrolled to), recommendations and View All. Most of those options have been designed as dropdown lists with subcategories. For example, the level option includes selections for beginner, intermediate, advanced and expert users (Figure 14). Furthermore, two panels titled "Most Popular Courses" and "Mood of the day" have been included for those users who are interested to randomly discover new courses and lessons.

Figure 13 presents the case in which users either visit the Educational Platform tool for the first time and they have not set their preferences yet, or they have not received any recommended courses from the

system. In order to provide a personalized experience, the system suggests users to determine their dance preferences, level and available equipment. If users prefer to avoid this step, they can also visit the "Recommendations" page, so as to explore the automatically produced recommended courses.

If users have already set personal preferences or they have visited the "Recommendations page" but they are not enrolled in any course, a different panel appears. As it is shown in Figure 13, the first panel prompts users to click the "View Recommendations" button, so as to select courses according to their interests.

Finally, Figure 14 demonstrates the common view of the Home Page interface when there are recommendation choices and users have already enrolled in any courses.

2.5.2 Browse

2.5.2.1 Description

Browse Page (Figure 15) is where users will be redirected, if a browsing category or the "view all" option is selected. In the current interface, users can find a list with related courses and activities. Each one of them is shown with a description and further details.

The "View Activity" button will redirect to the viewer page, where the lesson is displayed. On the other hand, the "View Course" button will present them with a list with the included activities. Filtering the results is also provided as a means to find a course or an activity of their interest. Figure 16 shows the results of the filters.

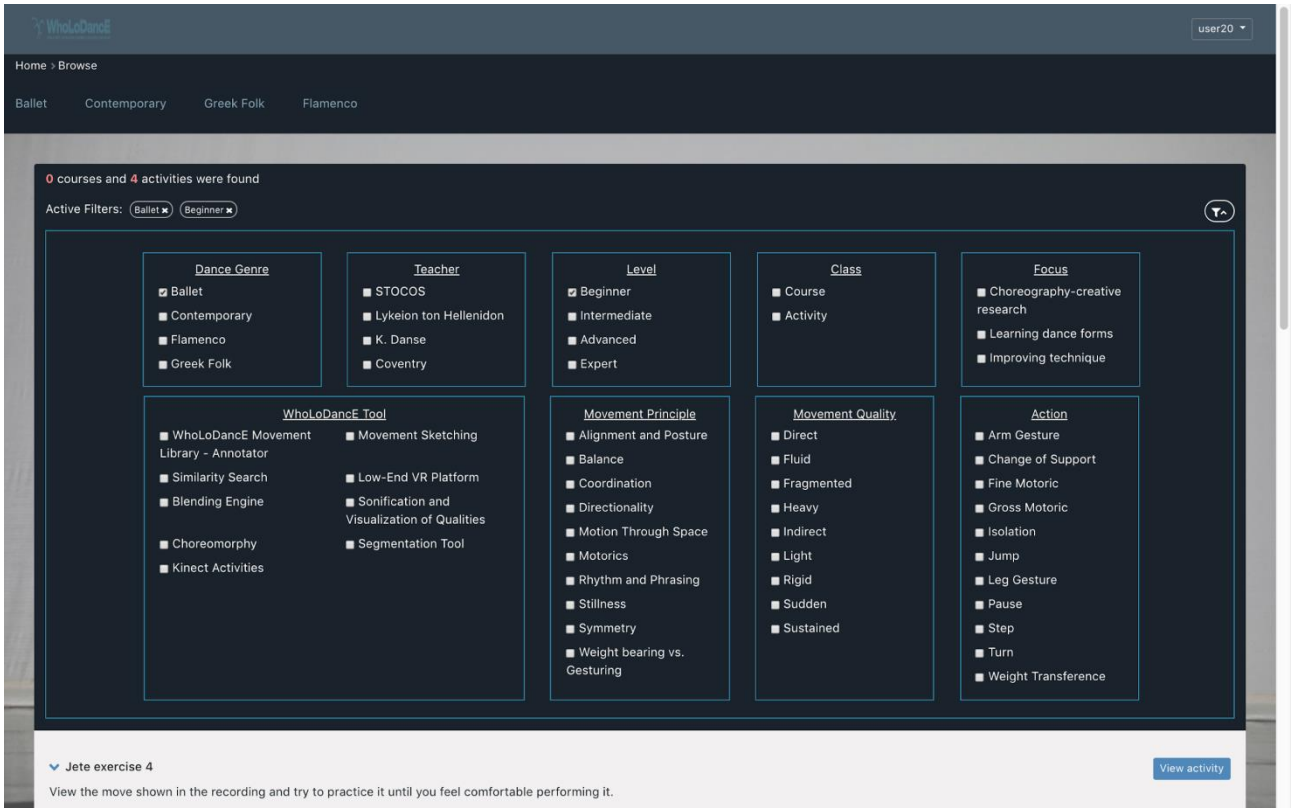


Figure 15. Browse page filters

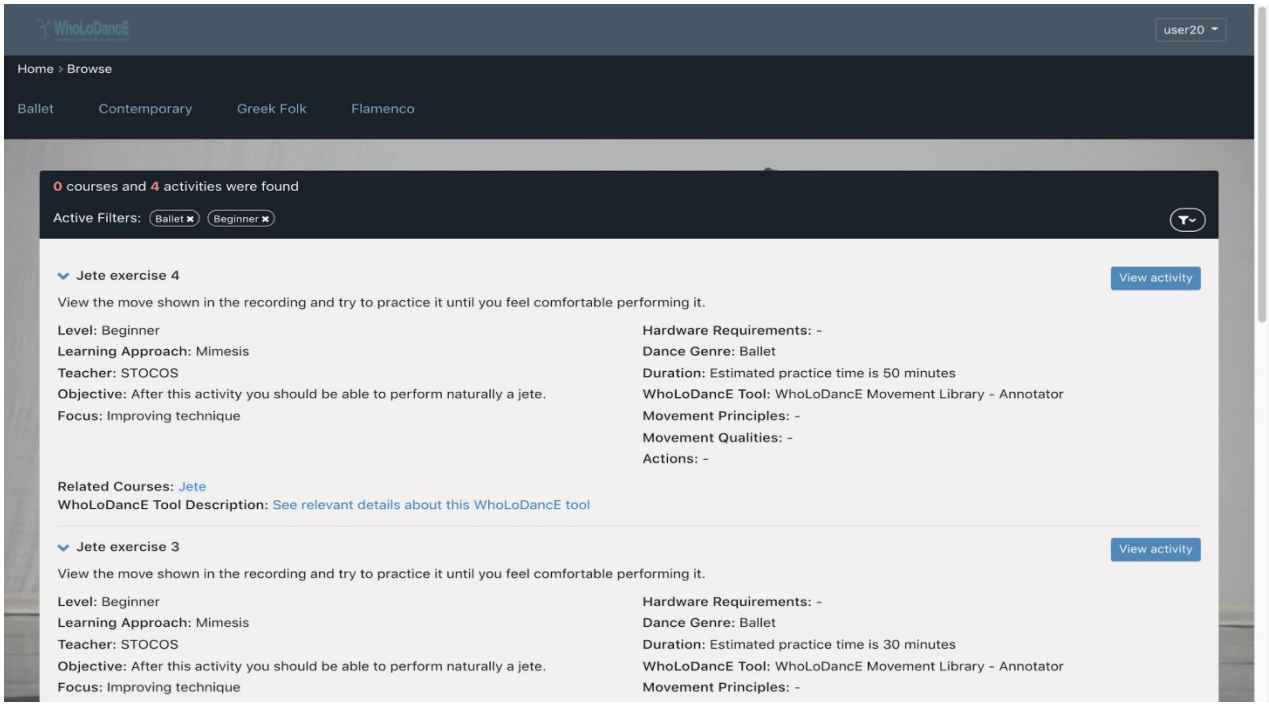


Figure 16. The Browse page

2.5.2.2 Related requirement

The Browse Page serves as a means to discover the Educational Platform's content. By comprising an advanced filtering system, a list of activities and courses is shown. Each selection in the list includes a description and details, offering an insight into the content.

2.5.2.3 Specifications

A filtering panel is located at the top of the Browse Page (Figure 15). The panel has been developed as a slider with hide and show options. It contains eleven filtering choices (the same choices are also included in the "Browsing Categories" menu of the Home Page). Each active filter is presented by a checkbox and a tag label.

Figure 15 shows the same page when the filter panel is hidden. A list of activities and courses is located below the filter grid. Each course displays further details such as Level, Teachers, Focus, Dance Genre, Hardware Requirements, WhoLoDancE Tools, Movement Principles, Movement Qualities and Actions. A "View Course" button displays the "Course Page".

Following the same strategy, each activity item displays information such as Level, Learning Approach, Teacher, Objective, Focus, Hardware Requirements, Dance Genre, WhoLoDancE Tools, Movement Principles, Movement Qualities, Actions, Related Courses and WhoLoDancE Tool Description. A "View Activity" button leads to the display of the corresponding activity.

2.5.3 Activities Page

2.5.3.1 Description

The Activities page allows users to enrol to a course, which is added to the "My Courses" list.

Each course contains a title, a description, as well as a list of activities (Figures 17, 18, 19). Moreover, when an activity has been displayed, a "Click to Complete" button appears (Figure 18). Finally, a status label accompanies an activity row, when it is completed (Figure 19).

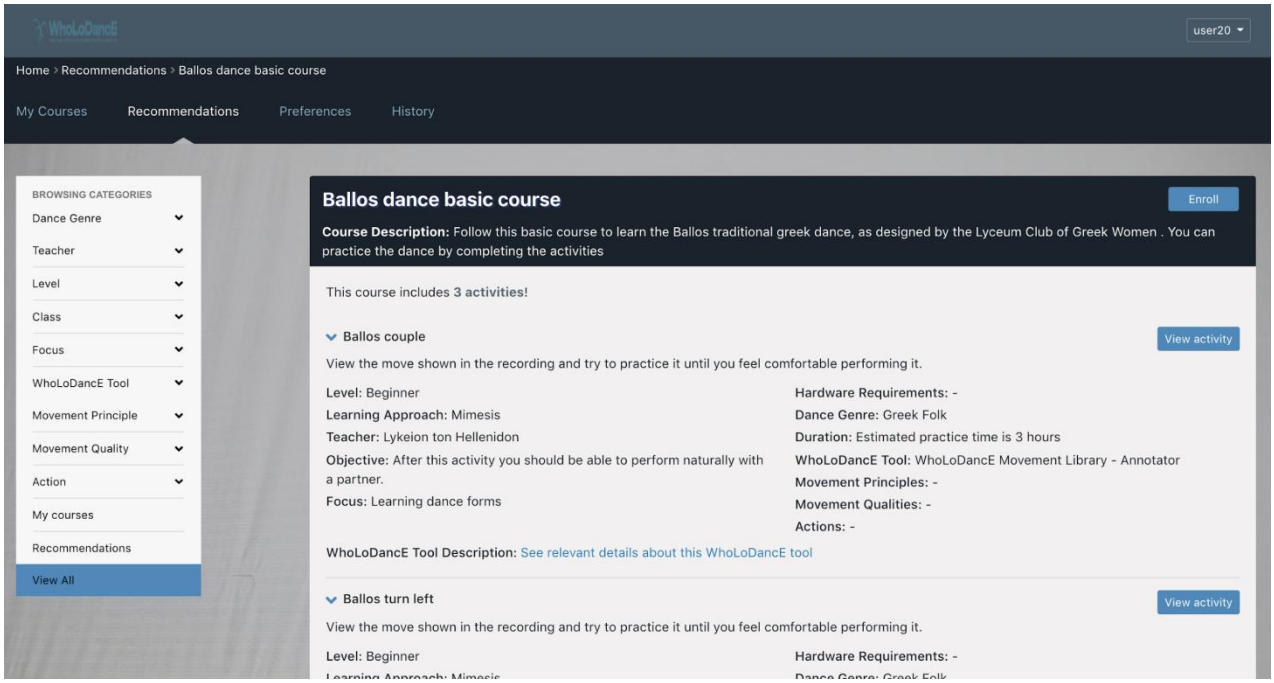


Figure 17. Activities page

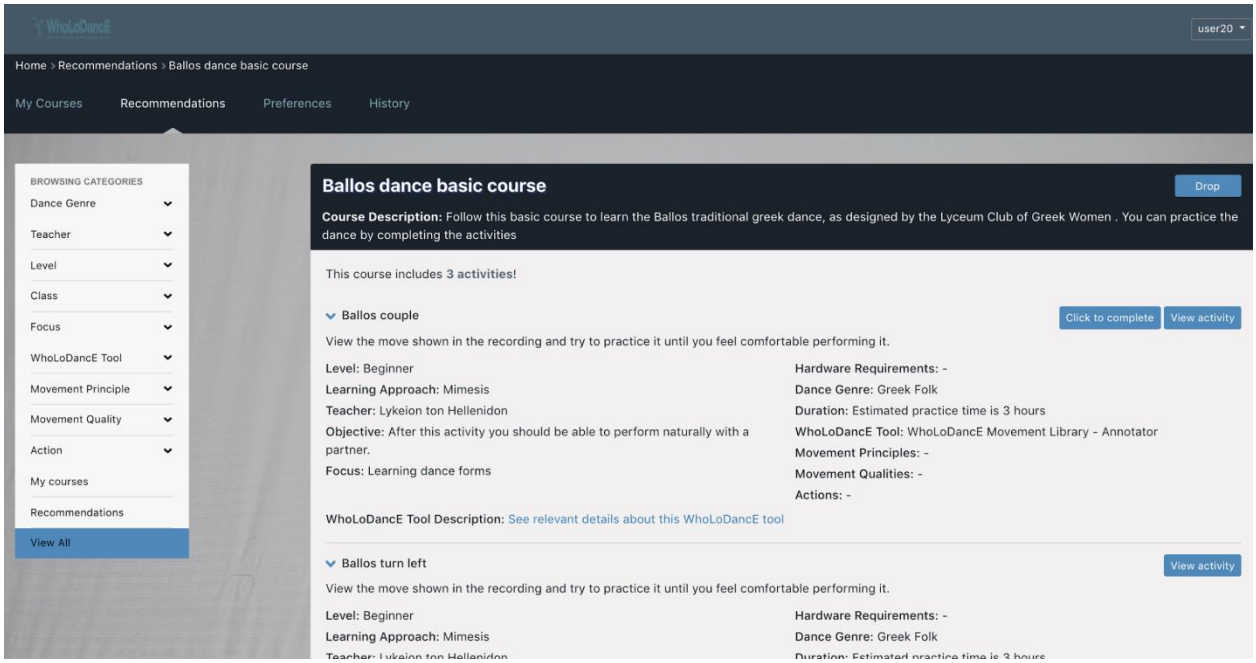


Figure 18. Activities page

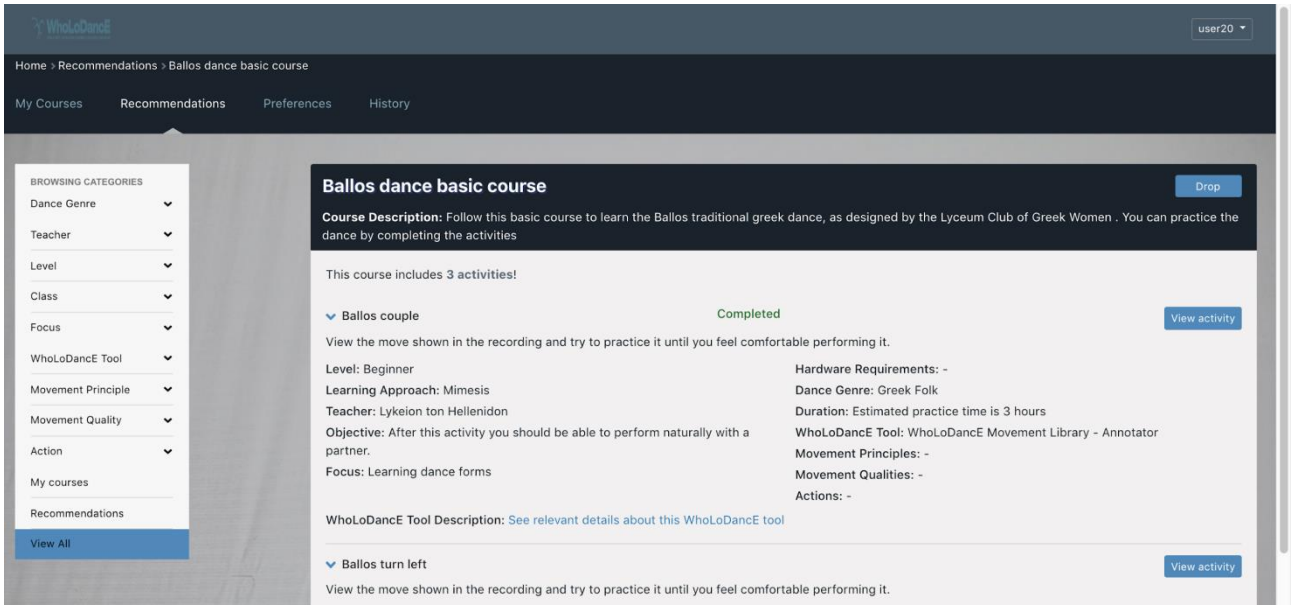


Figure 19. Activities page - Completed Activity

2.5.3.2 Related requirement

The Activities page has been developed as an effective medium that allows users to discover the content of a course. More specifically, it shows the list of activities that are included in a specific course. Each activity is combined with specific relevant information to it, as well as labels for its status.

2.5.3.3 Specifications

The WhoLoDancE Educational Platform's contains courses and activities. Each course may include several activities (Figures 17, 18, 19). The activities of a course are shown in the "Activities Page".

The page displays the title of the course and a button to enrol. By enrolling, the course is automatically added to the "My Courses Page". Just below the title, the description of the course follows.

The main task of the interface is to present the activities of a course. Through that direction, a list of the included activities follows. Each activity is displayed with a title and several details, such as Level, Learning Approach, Teacher, Objective, Focus, Hardware Requirements, Dance Genre, Duration, WhoLoDancE Tool, Movement Principles, Movement Qualities, Actions and link to an external description of the WhoLoDancE Tool. The "View Activity" button redirects the user to the Viewer page allowing to display the activity.

When an activity is displayed, the activity's row also contains a button with the title "Complete Activity" (Figure 18). When an activity is completed, a green label appears as a reminder for the users (Figure 19 Completed label).

2.5.4 My Courses Page

2.5.4.1 Description

This is where users can see all those courses in which they are enrolled (Figure 9). The "My Courses" page, has been designed gather all the enrolled courses. Furthermore, each course is displayed with further details, a status bar (number of completed courses), as well as a "View Course" button, which redirects users to the "Course Page".

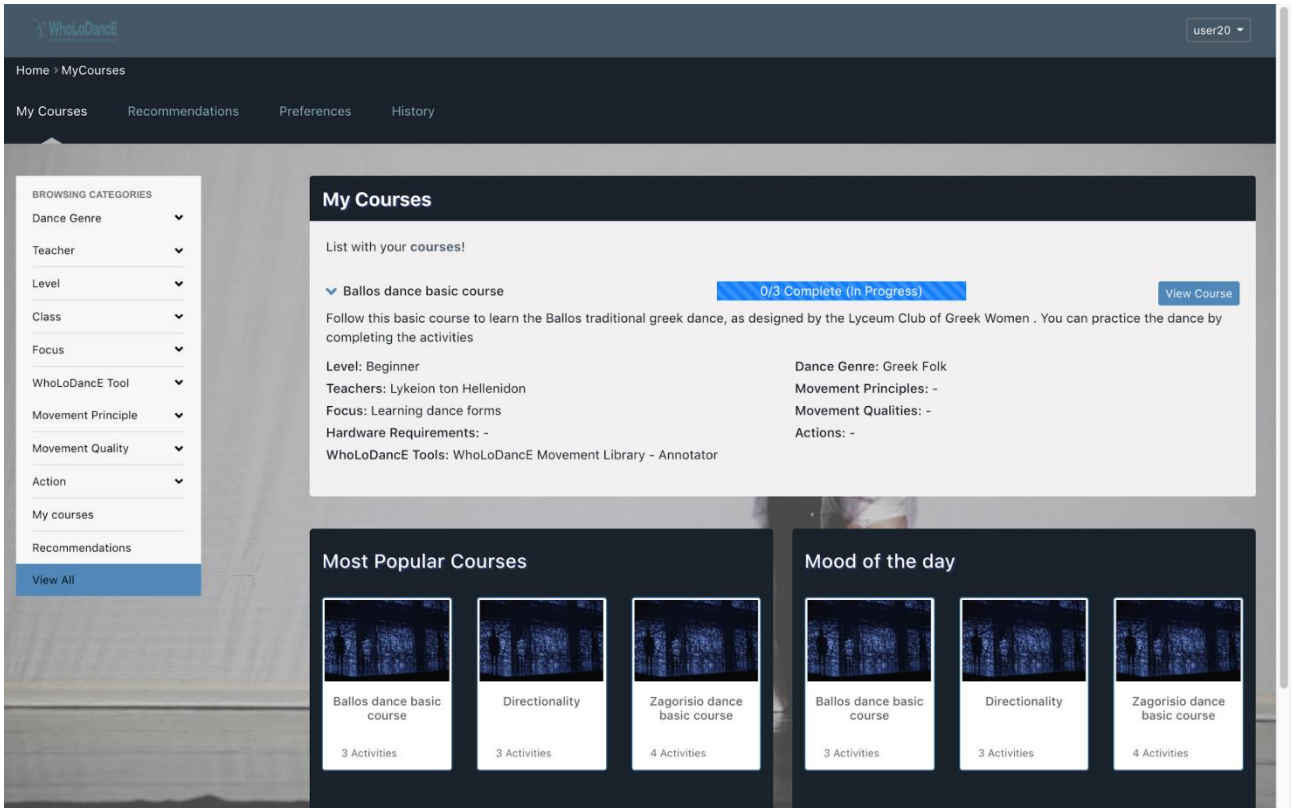


Figure 20. My Courses page

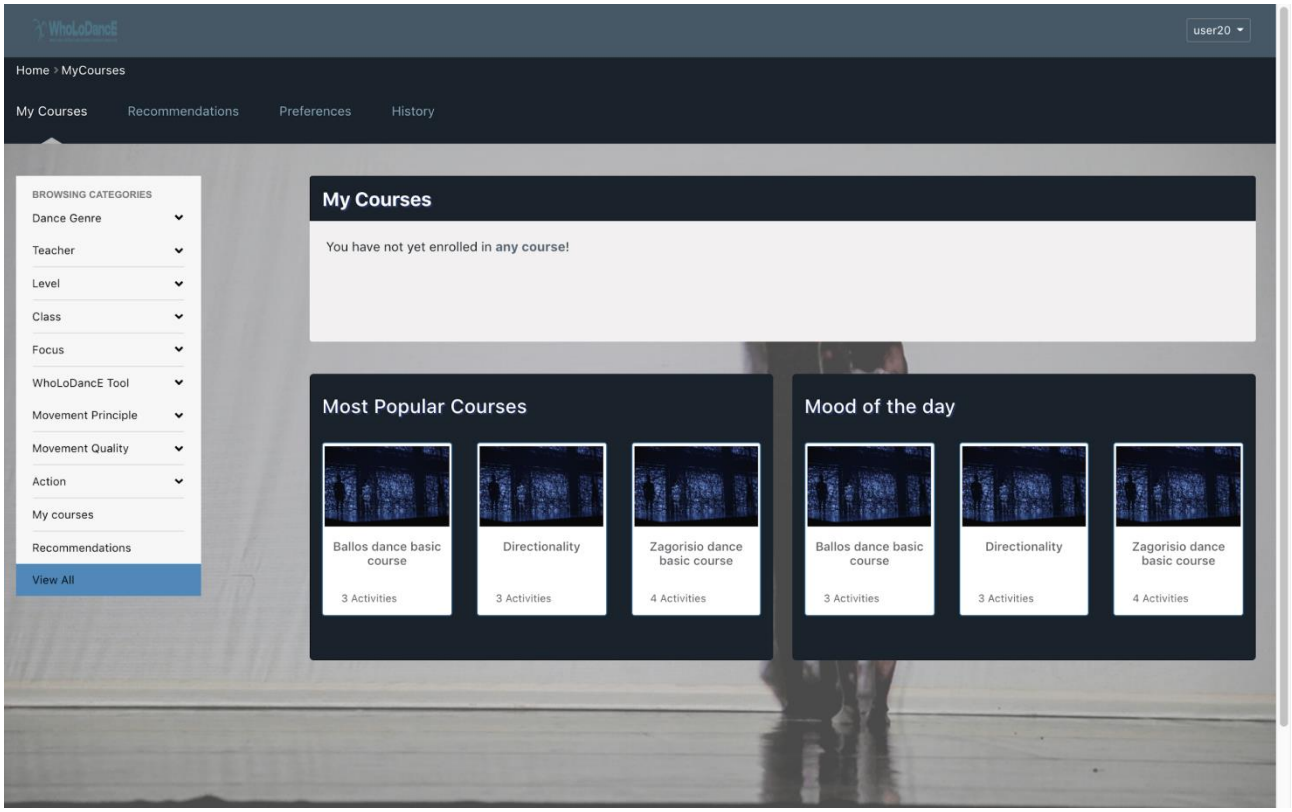


Figure 21. My Courses Page-empty list

2.5.4.2 Related Requirement

In order to offer a personalized experience, in which users can quickly and effectively select and gather their favourite courses, it was necessary to create a page with specific characteristics. The “My Courses”

page has been created to meet the users' needs, by bringing together in a list all the courses, in which a user is enrolled.

2.5.4.3 Specifications

The "My Courses" page displays a list with all the enrolled courses. The design of the page follows the same appearance, as all the other lists do.

On the left, the "Browsing Categories" menu is displayed. The center panel titled "My Courses" shows a list of the enrolled courses. Each course item shows all relevant details, as well as a "View Course" button. A blue bar shows the user's progress in each course (Figure 20), which is replaced by a green "Completed" label, when all the activities of a course have been completed. When the list is empty, the comment "You have not yet enrolled in any course" notifies users.

2.5.5 Recommendations

2.5.5.1 Description

Discovering the content of the WhoLoDancE Educational Platform could be achieved both through browsing and with the recommendation system. The recommendation system is an effort to provide users with a set of courses that target on their personal skills and preferences. The recommendation list is more effective when users define their preferences of the "Set Preferences" page.

The Recommendations page (Figure 22) interface follows the same design approach, as every other page that contains lists of courses. A panel with the title "Recommendations" includes several courses. Each course is displayed with the course name, description, relevant details and a "View Course" button.

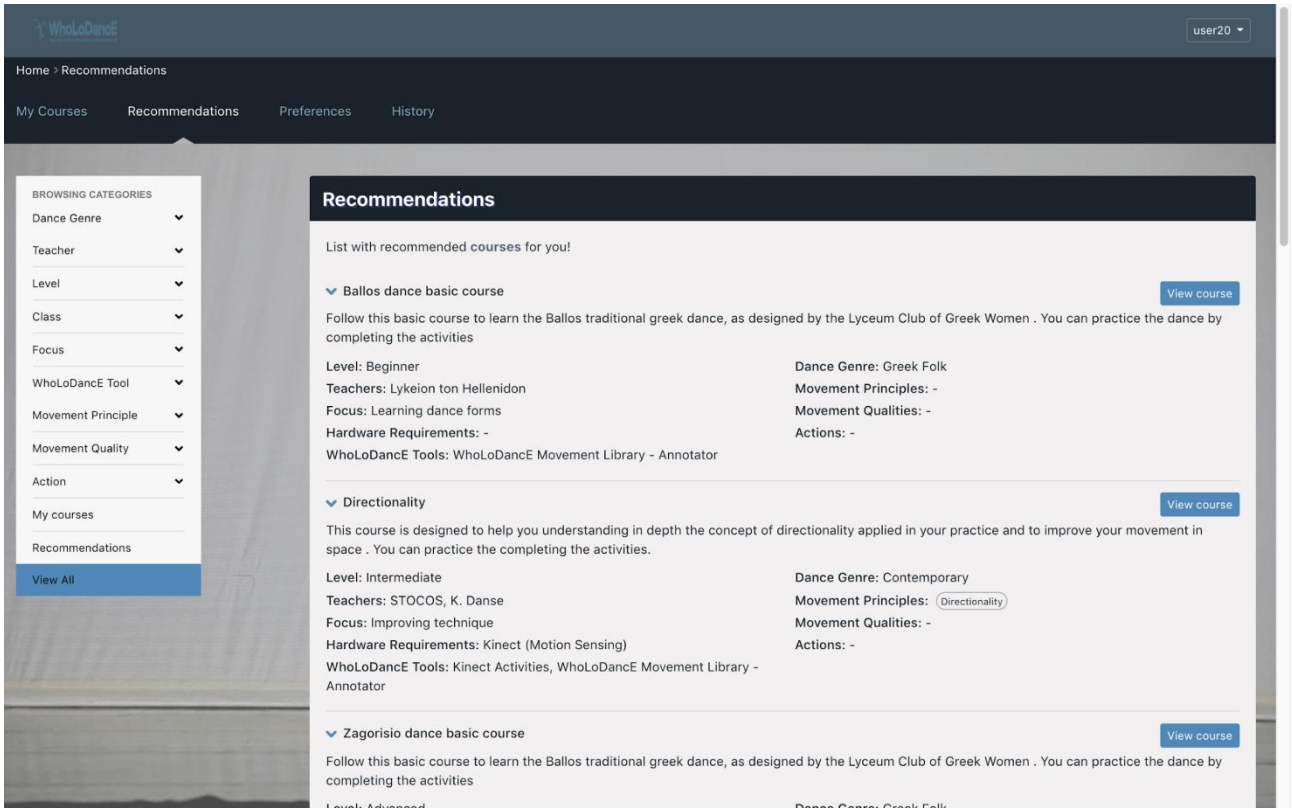


Figure 22. Recommendation Page

2.5.5.2 Related requirement

Searching in a Platform for courses and activities of interest, without previous experience of using it, can be a difficult task. A recommendation system was considered mandatory.

The “Recommendations Page” directs users to specific content and offers the opportunity to enrol, view or reject any of them.

2.5.5.3 Specifications

The view of the “Recommendations Page” follows specific design prototypes, in order to provide content with consistency. On the left side of the page the “Browsing Categories” menu is located. The horizontal menu with the four choices for reaching the “My Courses”, “Recommendations”, “Preferences” and “History” pages has also been included.

In the center of the screen the Recommendations list of courses is displayed. Each course contains a title, which also serves as a toggle button (show and hide the details of a row), relevant information such as Teachers, Dance Genre and Level, and finally a “View Course” button.

2.5.6 History

2.5.6.1 Description

The History Page includes a list of actions taken during the use of the Educational Platform tool (Figure 23).

2.5.6.2 Related requirement

Recording actions would be a helpful feature for every tool. Not only can users detect and remember some of their past actions but also provided an insight into the users’ needs and preferences.

2.5.6.3 Specifications

Following the common design approach that has been used in all other pages, the “History Page” has been developed as a history reference for the users’ actions. A list of actions, sorted by date, offers users the opportunity to see their completed effects. Enrolling in a course and completing an activity (Figure 12) is a sample of that list.

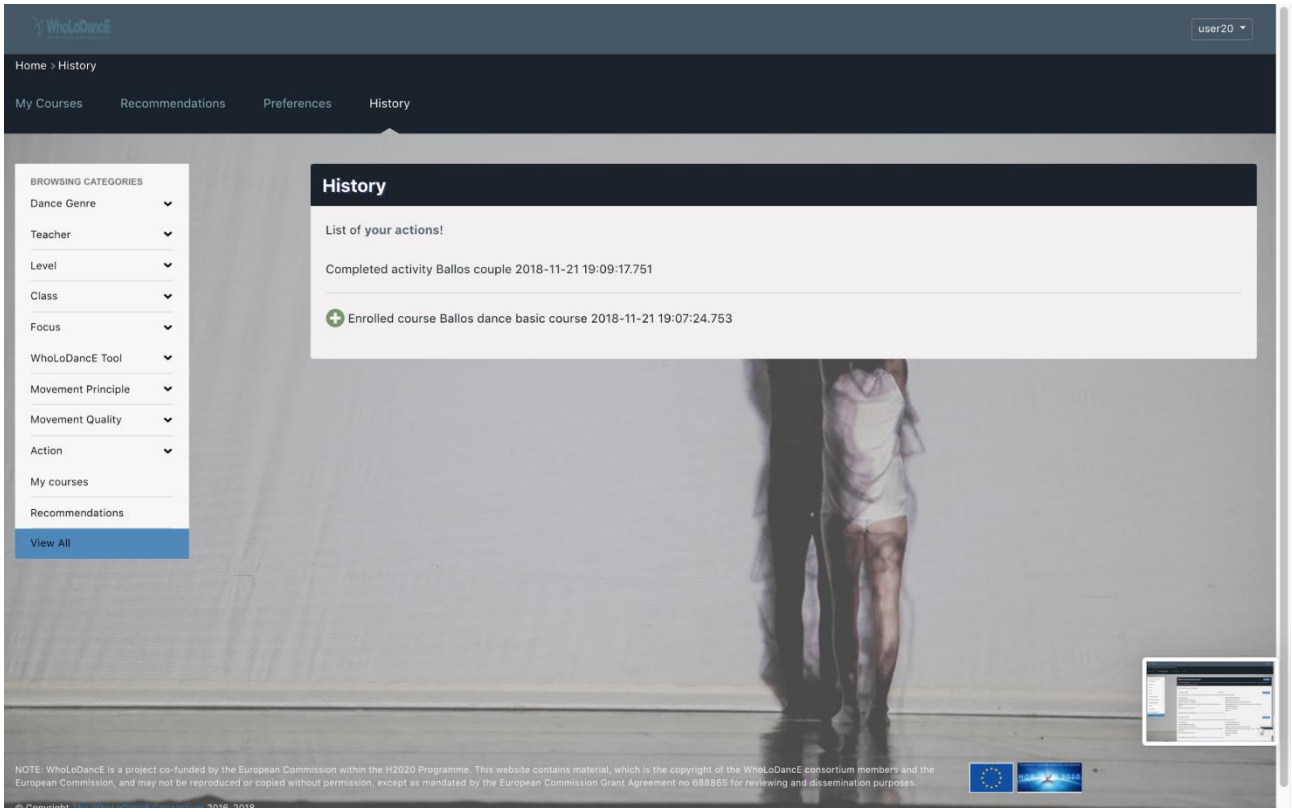


Figure 23. History Page

2.5.7 Annotator Viewer

2.5.7.1 Description

As it is demonstrated in the Figures 6, 7 and 8 each activity bears a 'WhoLoDancE Tool" field. The latter refers to the tool that is used as a view option and might defer. Through the current version of the tool, the only option that could be used as a viewer for an activity is the "WhoLoDancE Movement Library - Annotator". The "Annotator" viewer has been initially developed as a view option for the "WhoLoDancE Movement Library" application and it is analytically described in the D5.4 Final Release, Testing & Validation Data Management Platform Report. An adjusted version of that page has been incorporated, so as to meet the requirement of displaying an activity.

The page includes four distinct structures (Figure 24, Figure 25). From top to bottom respectively, the interface includes a title and detailed information related to the activity, a custom player that displays the motion capture and video files synchronously, a timeline structure with annotations related to the current recording and finally a panel, which allows rating the usefulness of the activity and keeping personal notes/comments.

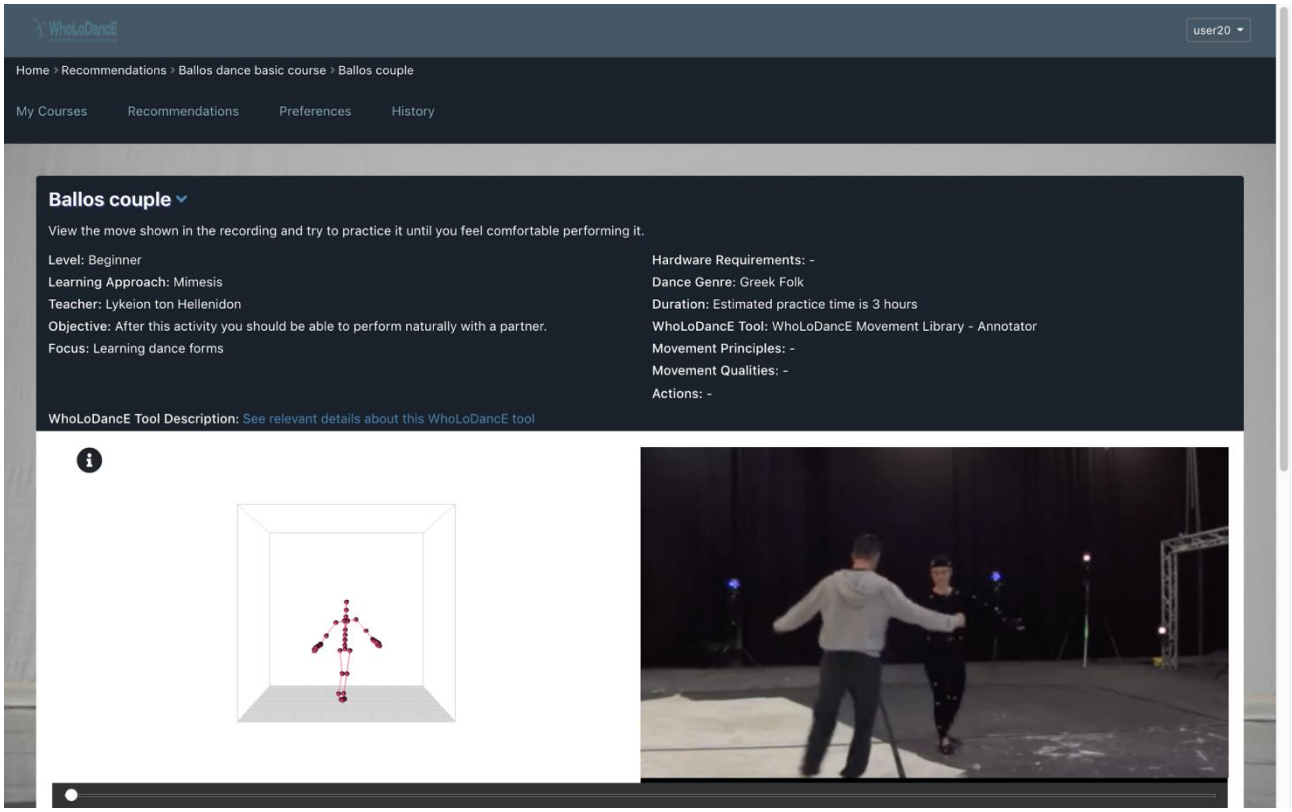


Figure 24 Annotator viewer page

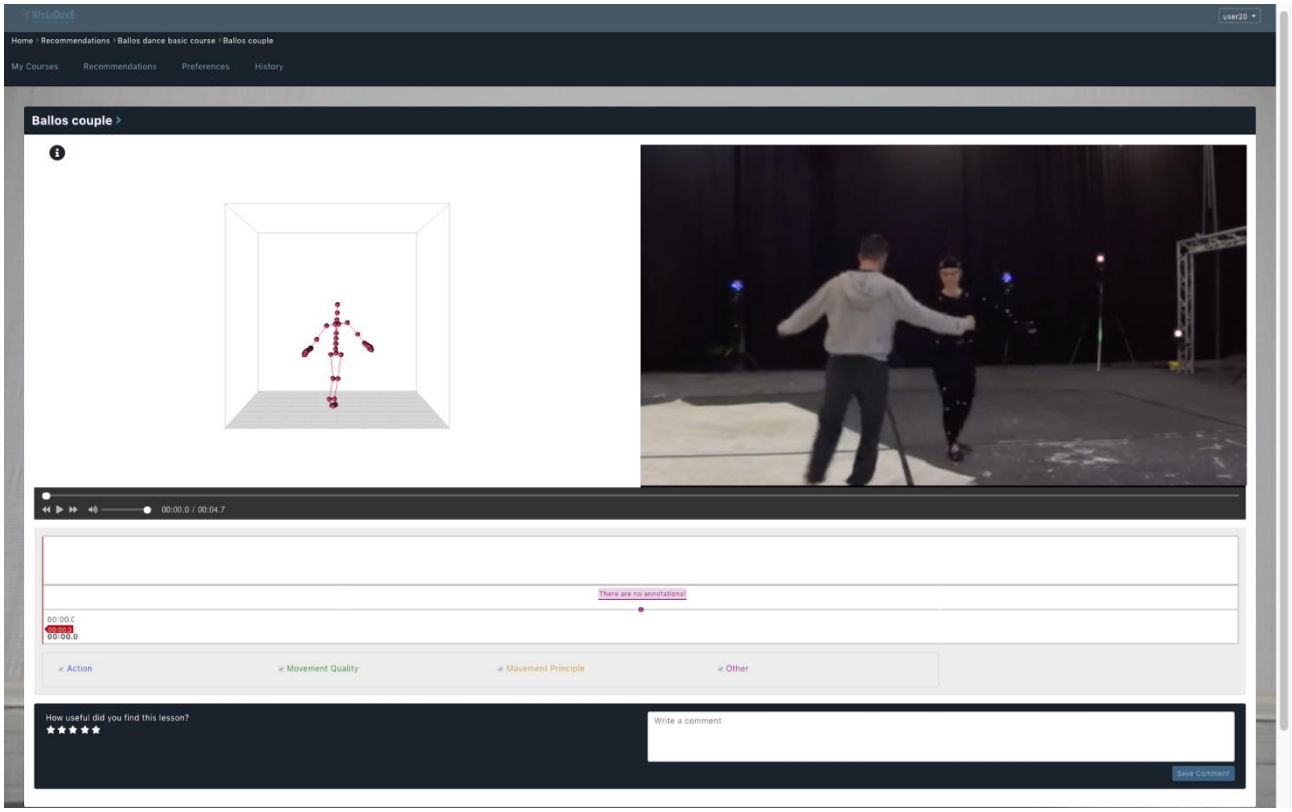


Figure 25 Annotator Viewer Page

2.5.7.2 Related Requirement

The future purpose and plan of the Educational Platform tool is to offer several different views and types of activity, by integrating all the WhoLoDancE tools.

The creation of the "Annotator Viewer" page constitutes the result of the effort to combine, the WhoLoDancE Movement Library tool and its annotations, with the Educational Platform tool. Their coupling offers two essential functionalities, viewing the motion capture recording, as well as annotations referred on them.

2.5.7.3 Specifications

As it was already mentioned above, the "Annotator Viewer" page could be described by four distinguished components, each one of them with a decisive role (Figure 24, Figure 25).

On top of the page the activity's title is located. The title also serves as a slider, so as to allow revealing or hiding a panel with details related to the activity.

Just below title, the structure of a custom player follows. The player undertakes the synchronized reproduction of the relevant video and motion capture file. Regarding the latter, WebGL library combined with JavaScript have been used, in order to create a cube, in which a 3D skeleton avatar demonstrates the dancer's motion.

The player is combined and synchronized with a timeline structure, which is responsible to demonstrate annotations related to the dancer's motion. As it is clearly described in the D5.4 Final Release, Testing & Validation Data Management Platform Report, the "WhoLoDancE Movement Library - Annotator" is a tool that offers the opportunity to discover the WhoLoDancE repository and add/edit/delete annotations. In the Educational Platform tool, the view structures have been adjusted and build in. The timeline shares the annotations of the Movement Library tool. However, it does not allow adding or editing annotations.

Finally, on the bottom of the page, users would find a panel that includes a rating mechanism and a textarea. The rating structure refers to the usefulness of the current activity and the textarea has been created, in order to allow personal comments. Both structures are visible only by the user that rated or commented.

2.6 User management and preferences

The User Management system allows for the easy management of the users. The system provides a set of functionalities for the user such as registration. Both WEP and WML are connected with the same back-end user management system, which ensures access to both platforms with the same credentials. Following the same concept as with WML, the users first have to register (Figure 26).

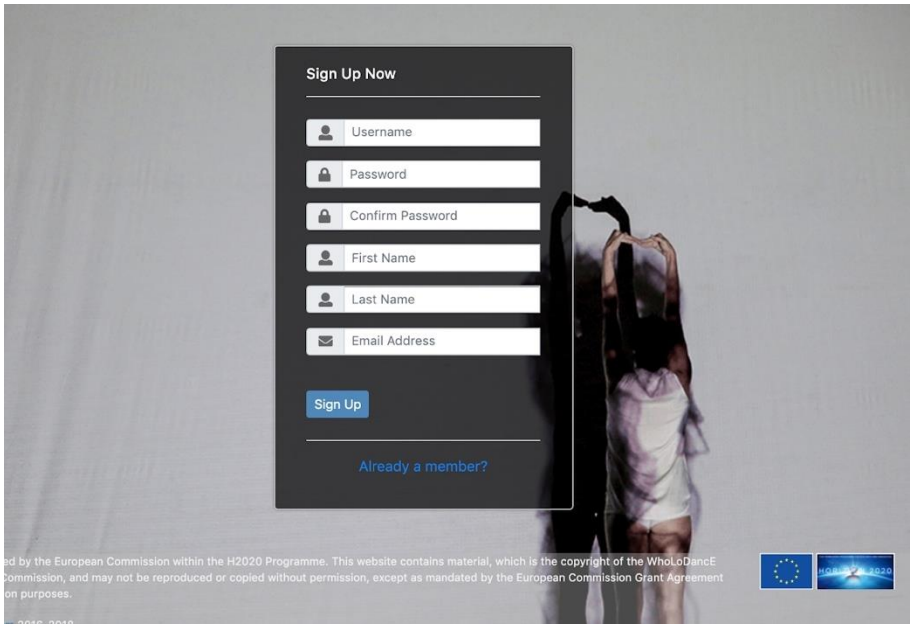


Figure 26. Registration Form

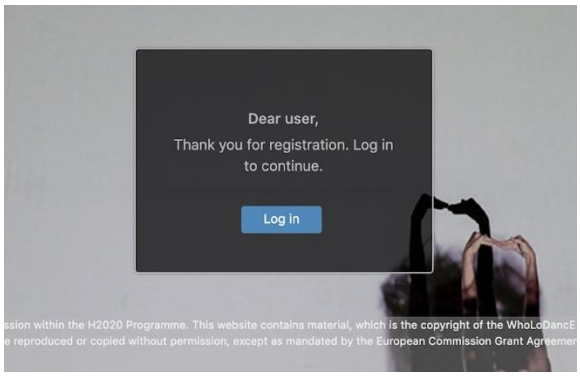


Figure 27. Successful Registration message

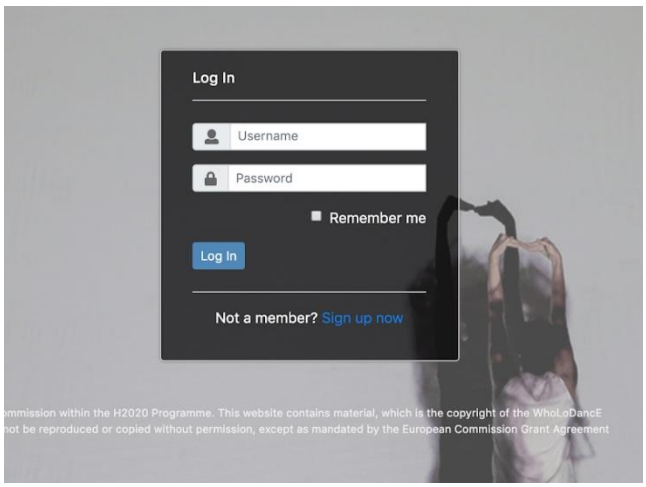


Figure 28. Log in form

2.6.1 Set Preferences

2.6.1.1 Description

The “Set Preferences” page has been designed and developed as a means for collecting each user’s personal preferences and interests, in order to provide recommended courses.

The current interface is constituted by three steps/questions and each one of them can be answered by clicking on the preferred checkbox card (Figure 29). Each step includes four images and the process is considered complete when the finish button is clicked.

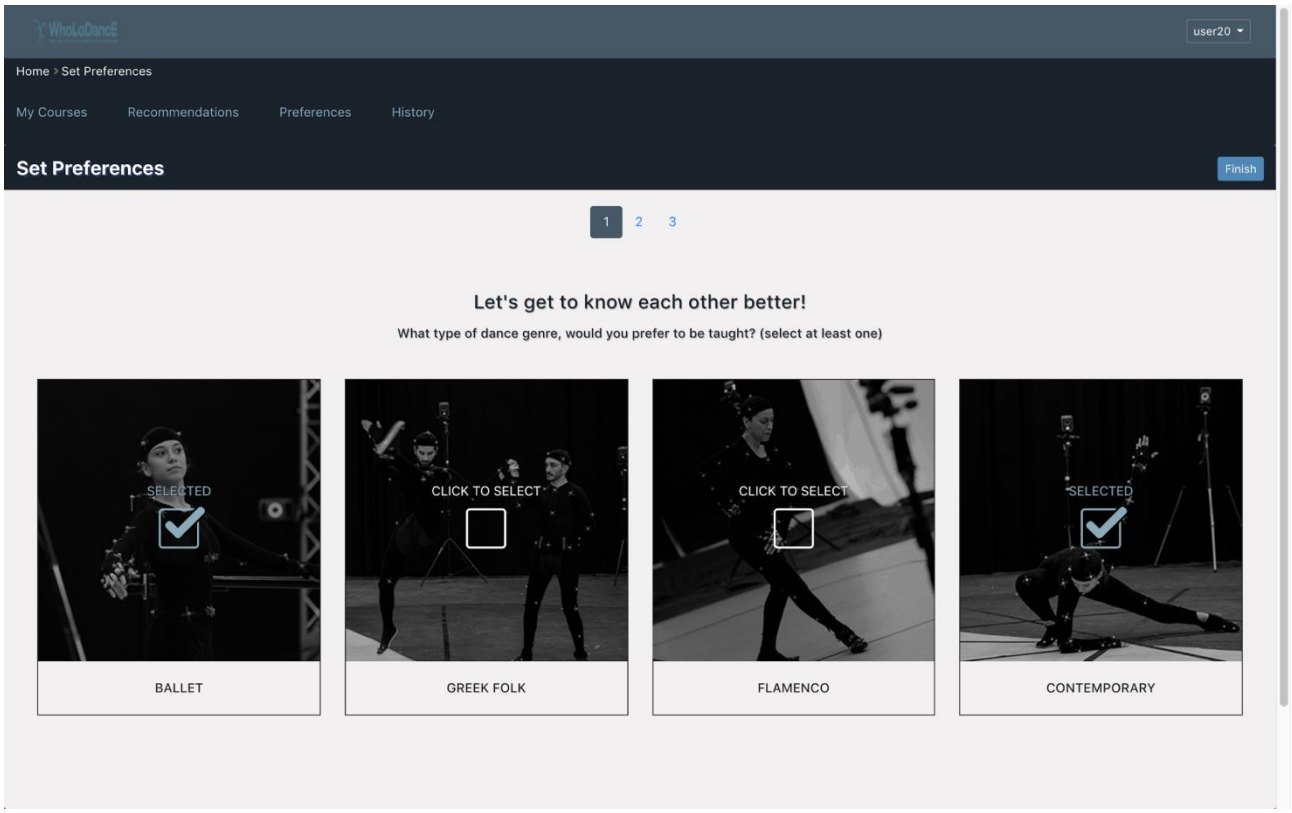


Figure 29. Set Preferences page

2.6.1.2 Related requirement

The list of preferences shown in Figure 29 has been created by the selected choices of the “Set Preferences” page. The editing option also redirects users to the “Set Preferences” page. In other words, the current page is responsible for the collection of information that would provide effective and targeted recommendations, for each user separately.

As the process of adding personal preferences and receiving recommendations is the rudimentary goal of the platform, it was essential to develop a clear and attractive interface. Checkboxes in the form of cards were designed, to trigger the users’ interest and clarify the selections’ meaning.

2.6.1.3 Specifications

The page includes three discrete steps. Questions concerning for the user’s preferred type of dance genre, dance level knowledge and hardware availability have been used.

Each step follows the exact same construction (Figure 29). Four cards with relevant images and titles, simulating the functionality of a checkbox have been developed as an input. The question is located above

the previous mentioned cards/checkboxes. When the three questions, or a subset of them, have been answered, users can click the “Finish” button, which redirects them to the “Recommendations” page.

2.6.2 Preferences Page

2.6.2.1 Description

In order to create a personalized experience and provide users with focused suggestions, according to their distinct characteristics and needs, it was essential to develop a “Set Preferences” system. This page (Figure 30) shows this information.

2.6.2.2 Related requirement

As the Educational Platform tool aims to provide users with recommended courses, it is essential to offer a more specialized experience, tailored to each user’s profile. In order to achieve that goal, the system prompts users to select their preferences, so as to receive targeted suggestions.
The current page shows users their specified preferences and allows editing.

2.6.2.3 Specifications

The Preferences Page (Figure 30) can be reached by the horizontal menu on top of the page. Through that interface users might both review and alter any of their preferences. Functionalities are provided by the use of a panel, which contains the selected preferences and the “Edit Preferences” button.

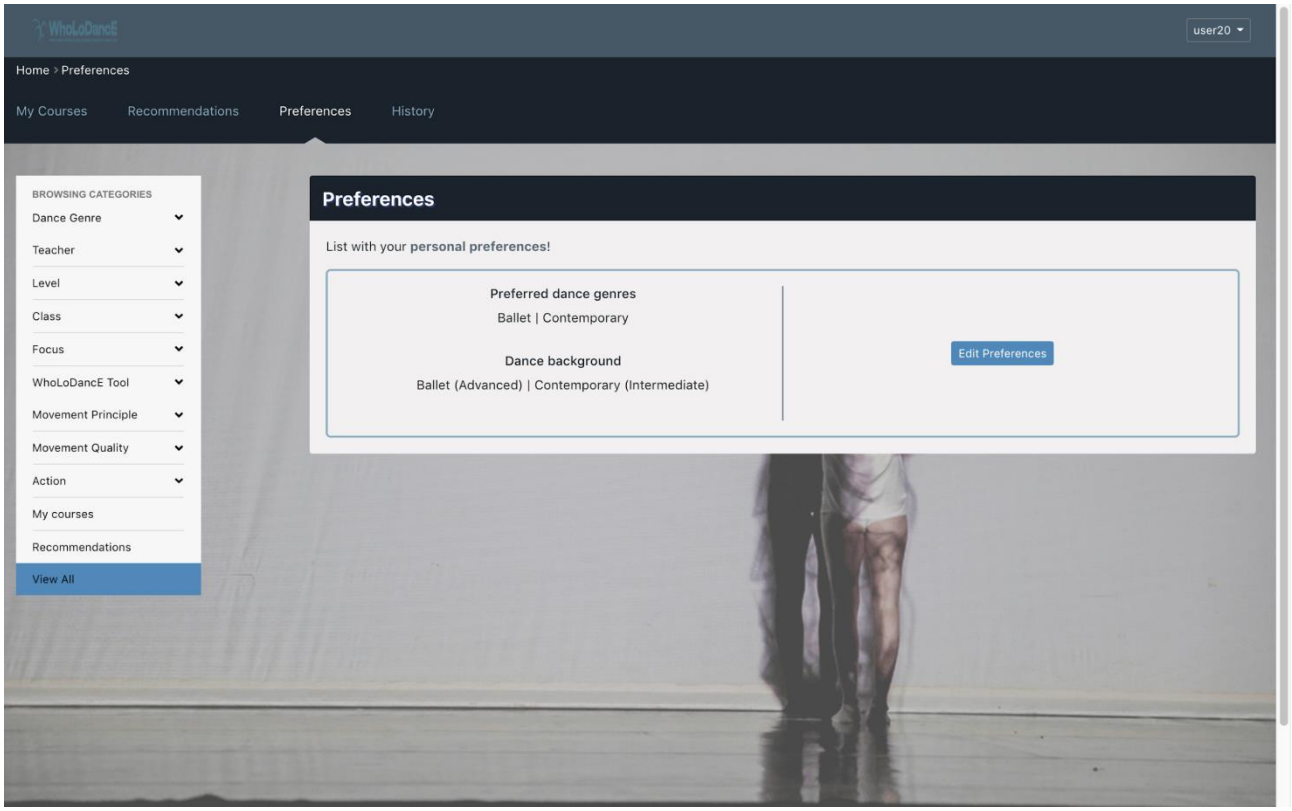


Figure 30. Preferences Page

2.7 Evaluation and conclusions

For both the definition of the conceptual model and the user interface design of the WEP, an iterative design approach was used, involving dance experts from the different genres in the approach from day one, in the form of focus groups, interviews, face-to-face sessions, and formative evaluation of mock-ups. In particular, a formative evaluation included the involvement of 3 UI/UX and 3 potential users outside the

consortium (students of Greek Dance, Ballet and Contemporary dance). In addition, extensive long-term evaluation has been conducted in the framework of WP7 and is reported in the corresponding deliverables. Overall, the results were positive, and the majority have described the tool as promising, attractive and usable and suggested many improvements for making the platform smarter in terms of recommendation and or integrating an authoring tool for the teacher.

One of the limitations that we acknowledge, is the fact that some of the WhoLoDancE tools require devices that are not easy to be reached by dance practitioners easily and in low cost, e.g., motion capture hardware and mixed reality devices. Nevertheless, all these tools have been tested and evaluated in lab conditions and have shown a great potential for future dance practice, when hopefully of these technologies will become less complex and more affordable by larger audiences.

3 Choreomorphy: personalized 3D experiences

3.1 General description

Choreomorphy is a whole-body interaction interface that allows a user to visualize their movement in real time using motion capture technologies. The interface allows the user to change between different avatars and visualizations real-time, in order to focus on specific aspects of their movement such as traces, trails, and volumetric space, and improvise while seeing themselves as different avatars and shapes. The main design and implementation idea behind this tool is the fact that each avatar and visualisation of movement highlights different aspects of the user's movement and eventually provokes different qualities and patterns of moving. A fact that is very important from both the pedagogic but also the creative and aesthetic perspective. In other words, Choreomorphy enables the user to intuitively change and personalize their view of the movement.

3.2 Architecture

As shown in Figure 31, Choreomorphy's flexible architecture allows the software to work with different inputs and outputs, offering a variety of interactions depending on available hardware and setting.

Choreomorphy consists of the following versions:

1. Choreomorphy LIVE. The application allows the users to see themselves in different avatars, visualizations and environments while they are wearing an inertial Motion Capture suit. This application can be used as a tool for self-reflection and dance improvisation. The design of the tool has been done in close collaboration with dance practitioners and is subject to iterative evaluation.
2. Choreomorphy WebGL. This web application loads pre-recorded motion capture animations from the WhoLoDancE repository. It is integrated into the WhoLoDancE Movement Library for optimized viewing purposes.
3. Choreomorphy standalone. This standalone application loads pre-recorded motion capture animations from the WhoLoDancE repository by specifying the url of an animation.
4. Choreomorphy HoloLens. This application extends the same functionalities to Mixed Reality. The user can see the pre-recorded movement with avatars that move in the physical space. Also, they can interact (change avatar, trails etc) with pre-defined gestures and follow the movement in physical space while wearing the HoloLens.

For Choreomorphy LIVE we have used the Synertial motion capture IGS-420 system. It is a whole-body inertial suit with 42 sensors. Tests have been conducted in the lab with the Noitom Perception Neuron 32 sensor inertial suit.

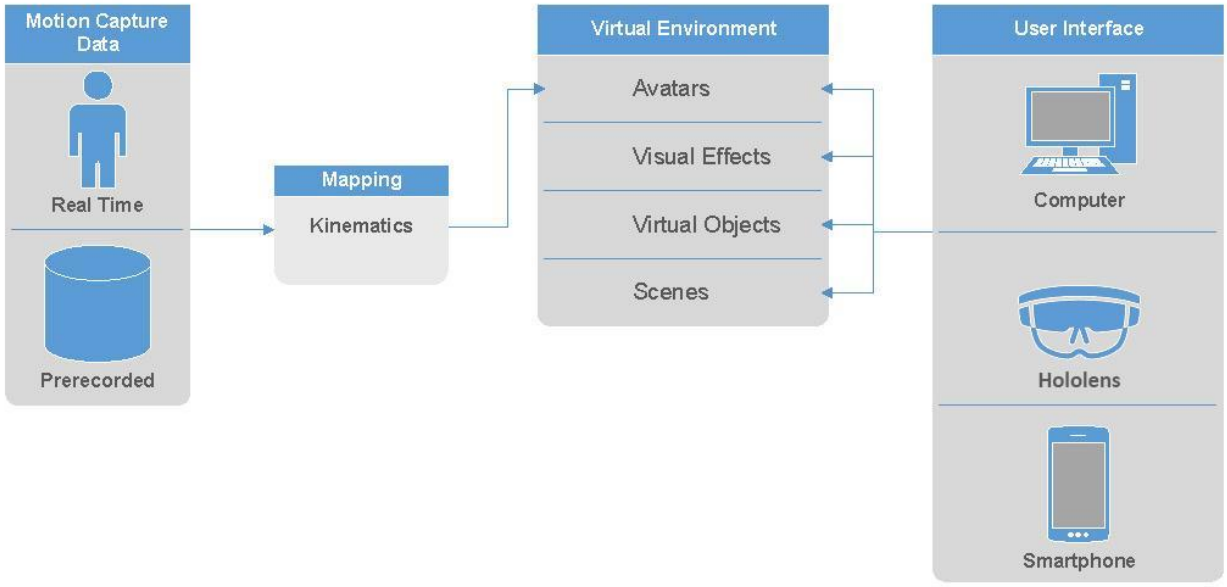


Figure 31. Choreomorphy Architecture

3.3 User Interface

Choreomorphy provides a set of options that enable the user to optimize their experience according to their needs. Every setting can be changed in real-time in all of the three versions described above. This set of options contains buttons, sliders and switches. The use of each option is described down below:

Table 1-shows a sample of the User Interface

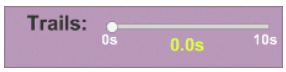
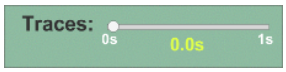
Symbol	Type	Description	Shortcut
	Button	Transform from an avatar to another. Right = previous avatar Left = next avatar	right arrow / left arrow backspace / enter
	Button	Change Field of View (Switch between basic and cinematic camera)	C
	Button	Take snapshot of the scene	S
	Button	Change Environment	E
	Button	Change the texture of the floor	F
	Button	Restart scene	R
	Slider	Fadeout duration of Trails	-
	Slider	Fadeout duration of traces	-
	Switch	Hide/Show User Interface	I
	Switch	Hide/Show Template Menu	K

Figure 32. Choreomorphy User Interface Layout

The template switch () changes according to which avatar is enabled. For the time being we have implemented two modes. The first concerns the visual feedback that the user feels from the alteration of the textures of the avatar (Figure 33) and it's called Texture Template Menu.

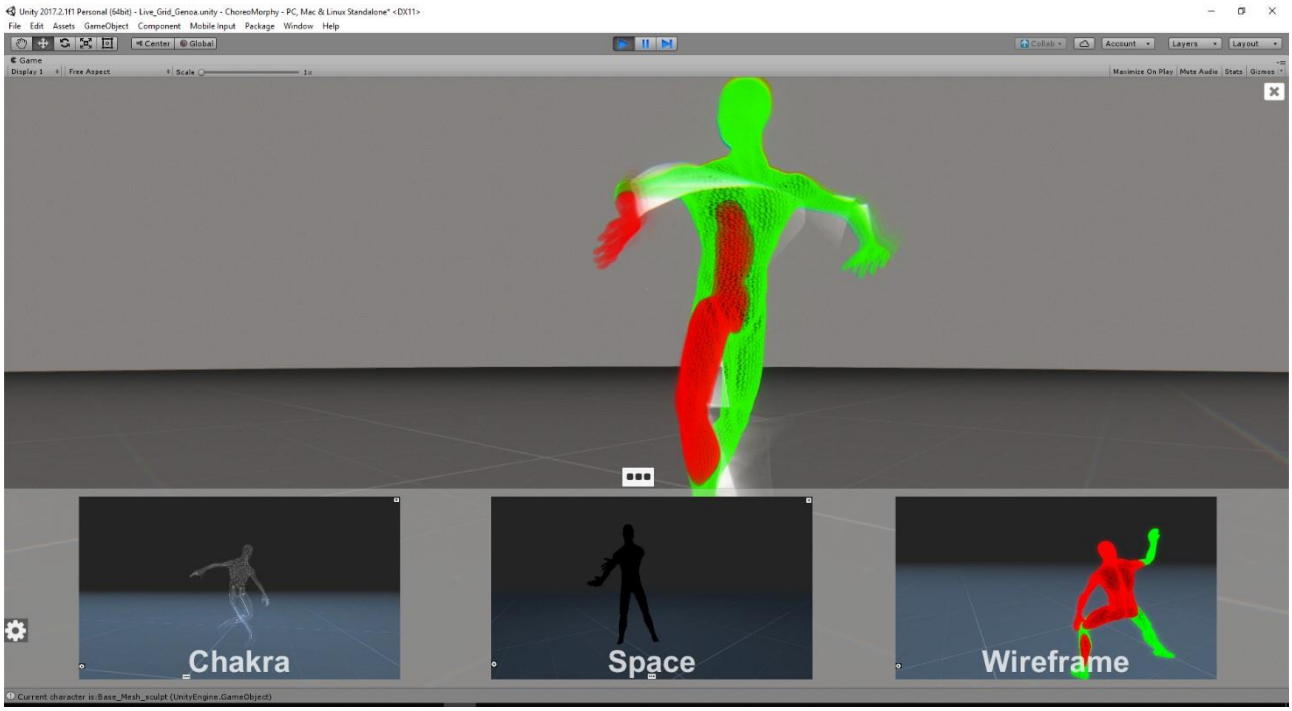


Figure 33. Texture template menu

The second one concerns the training of the user to a choreography with the assistance of a blob that contains their avatar. More specifically, the blob executes a dance choreography and the goal of the user is to mimic the choreography in order to keep their avatar inside the blob. The more difficult the training is, smaller the blob is, which means that the user must do more accurate movements in order to stay within the blob. This mode is called "training template menu" and is shown in Figure 34.

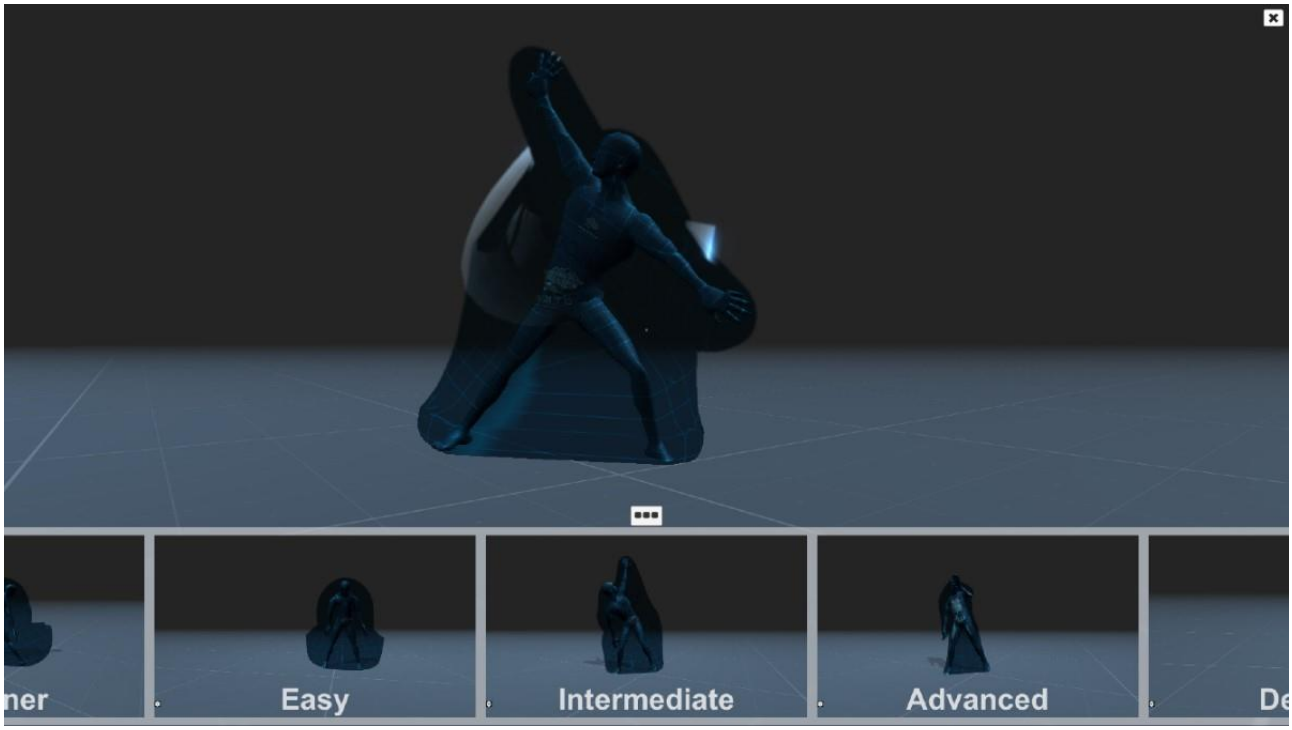


Figure 34. Training template menu

3.4 Avatars

For the visualisation the user's movement Choreomorphy included the avatars shown in Figures 35-42. Their different body proportions and appearances in scale, shape and texture serve in embodying the users into alternative vessels.

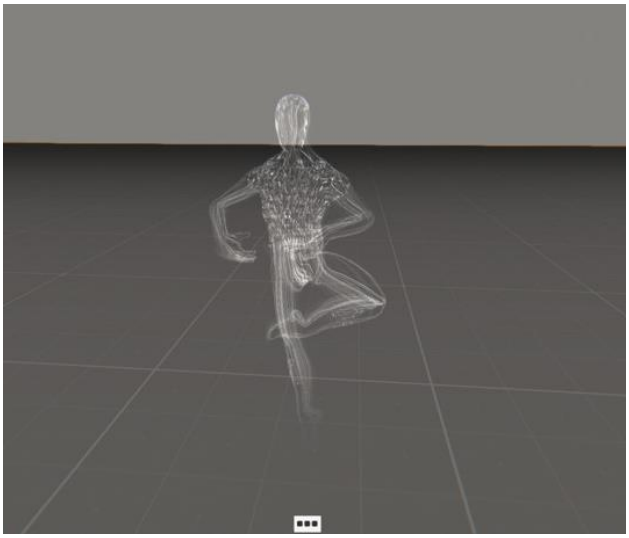


Figure 35. Chakra avatar

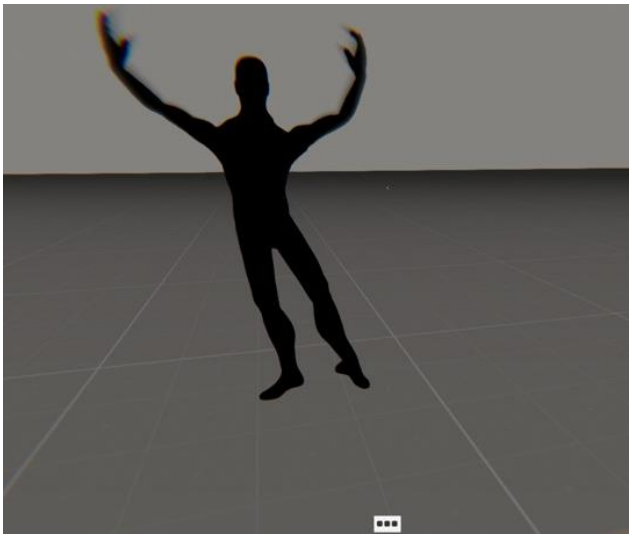


Figure 36. Space avatar

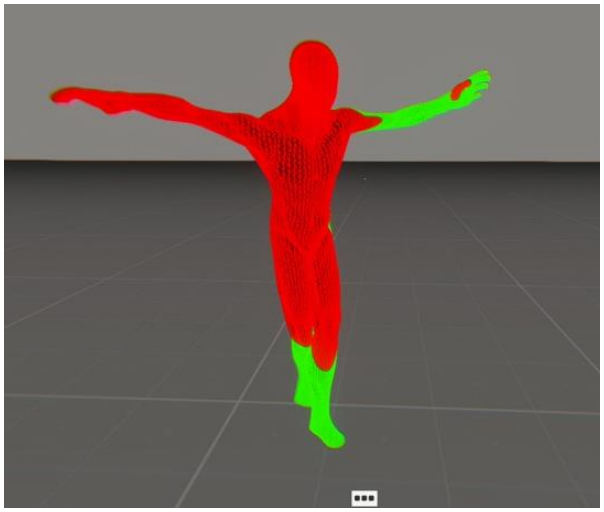


Figure 37.Wireframe avatar

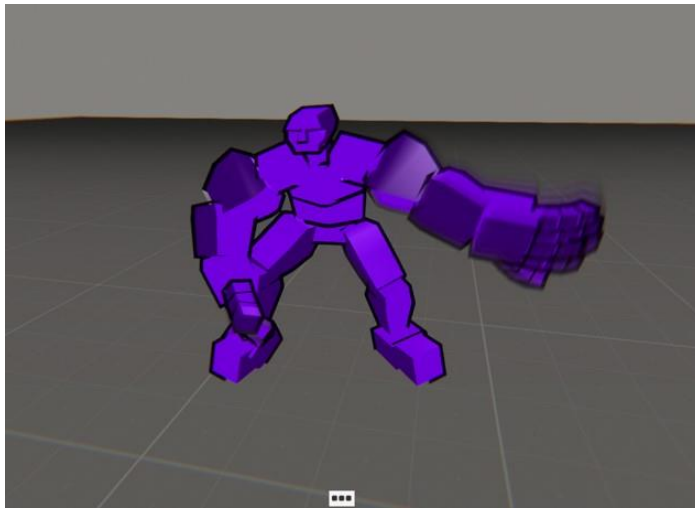


Figure 38. Brute avatar

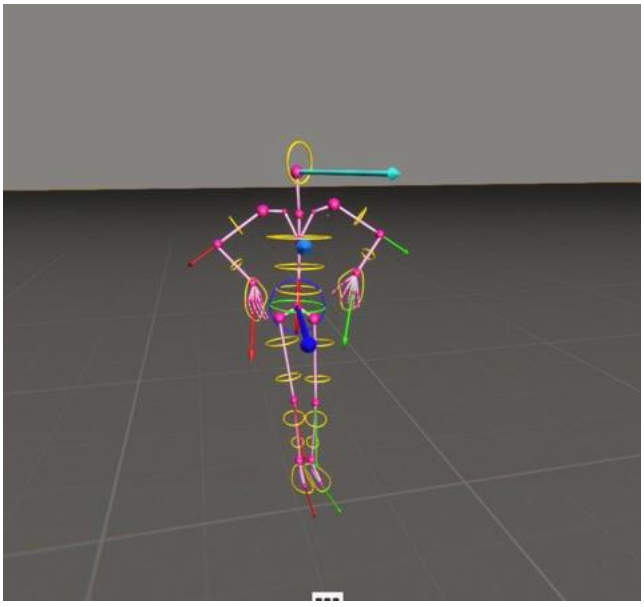


Figure 39. Arrow-man avatar (made by Motek)

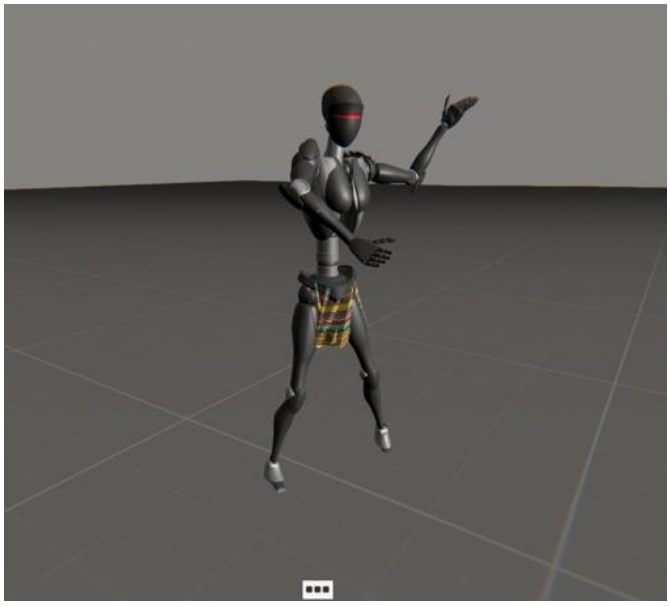


Figure 40. Figure 40. Robot avatar (made by Motek)

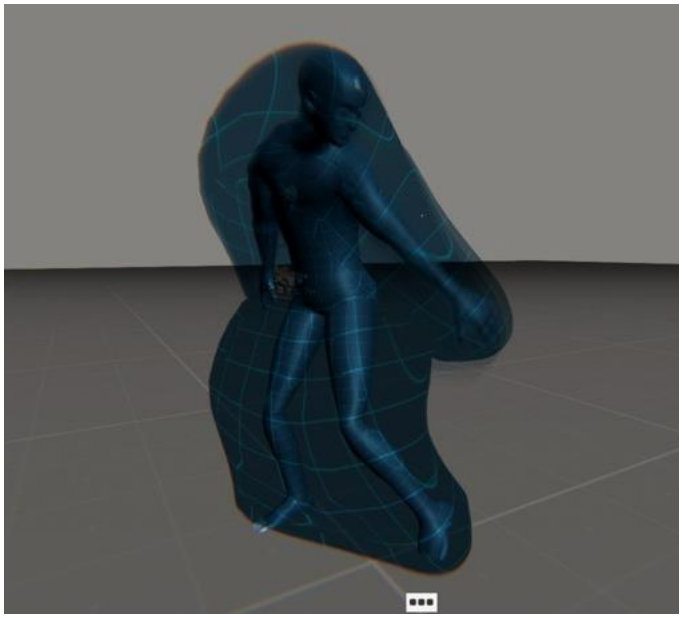


Figure 41. Blob avatar (made by Motek)

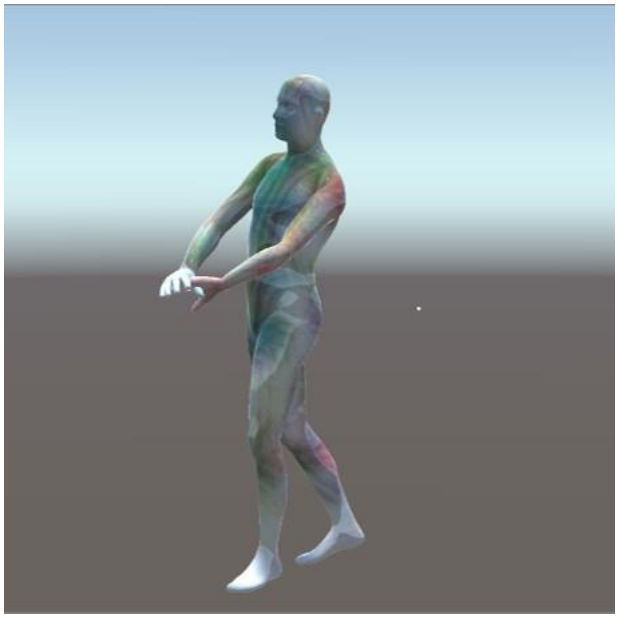


Figure 42. Choreomorphy avatar (made by Motek)

3.5 Environments

Users can choose a virtual environment for their improvisation session. Scenes vary from a very simple **Grid Scene,** which has a very neutral appearance without any busy background, so that the dancer can focus completely on their choreography, to more complex scenes like the **Disco Scene**, which immerses the dancer into a landscape with more elaborate graphics and colours and enhance their experience into a step further from reality while maintaining the basic rule of depicting the movement. The **Dance Hall Scene** on the other hand simultaneously transfers the user to a virtual training dance room, with which they are more familiar, but also maintains the neutrality of the environment without having any extra decoration (Figures 43-48).

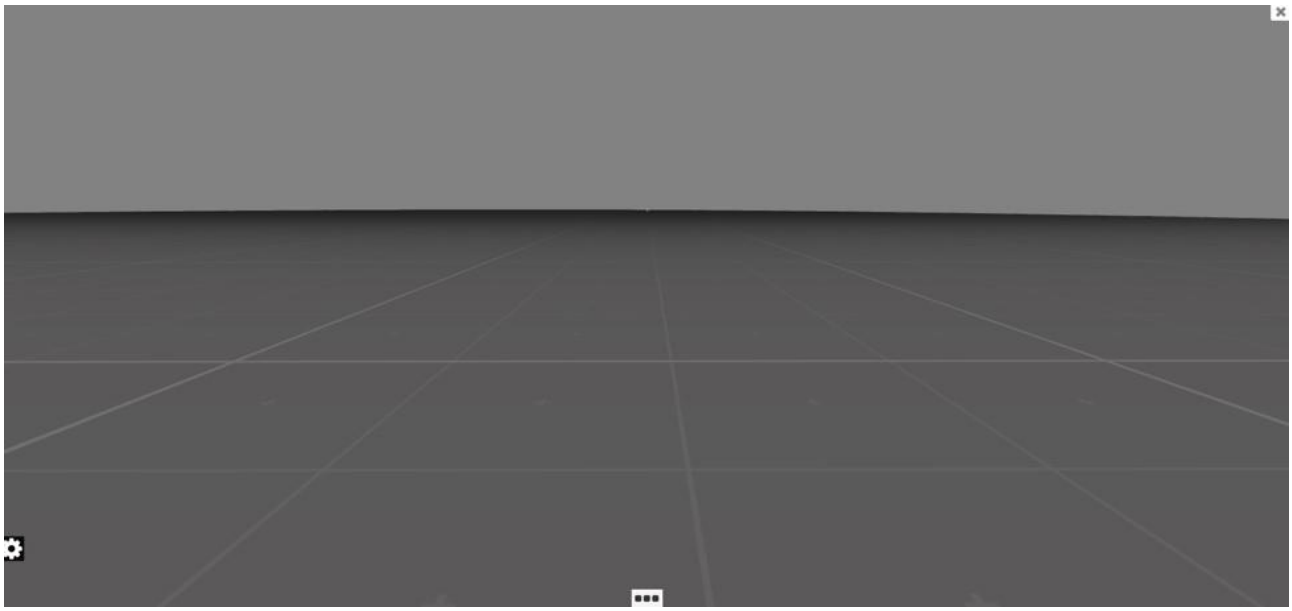


Figure 43. Grid scene

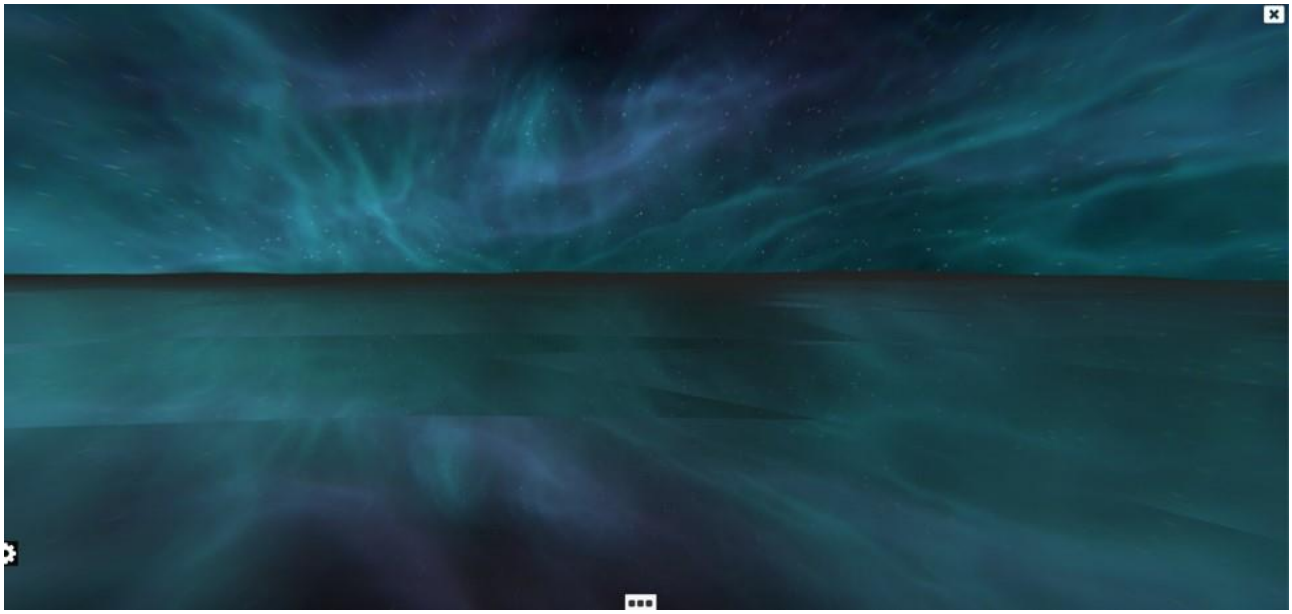


Figure 44. Aurora Borealis scene

Figure 45. Auditorium scene

Figure 46. Dance studio scene

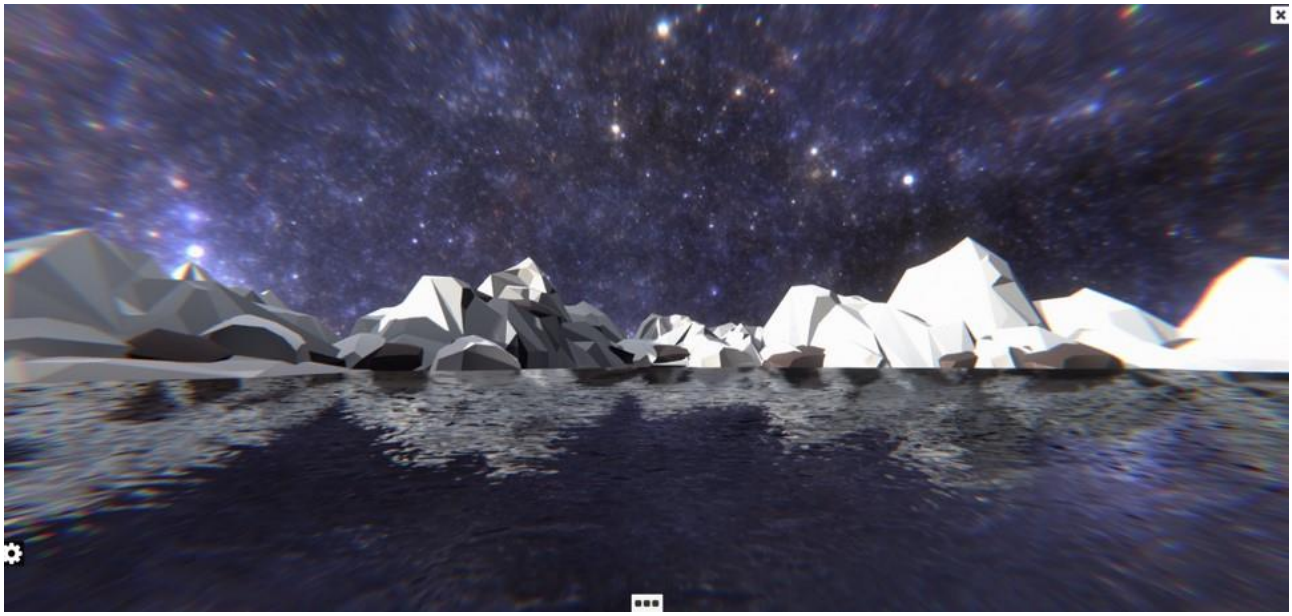


Figure 47. Frozen lake scene

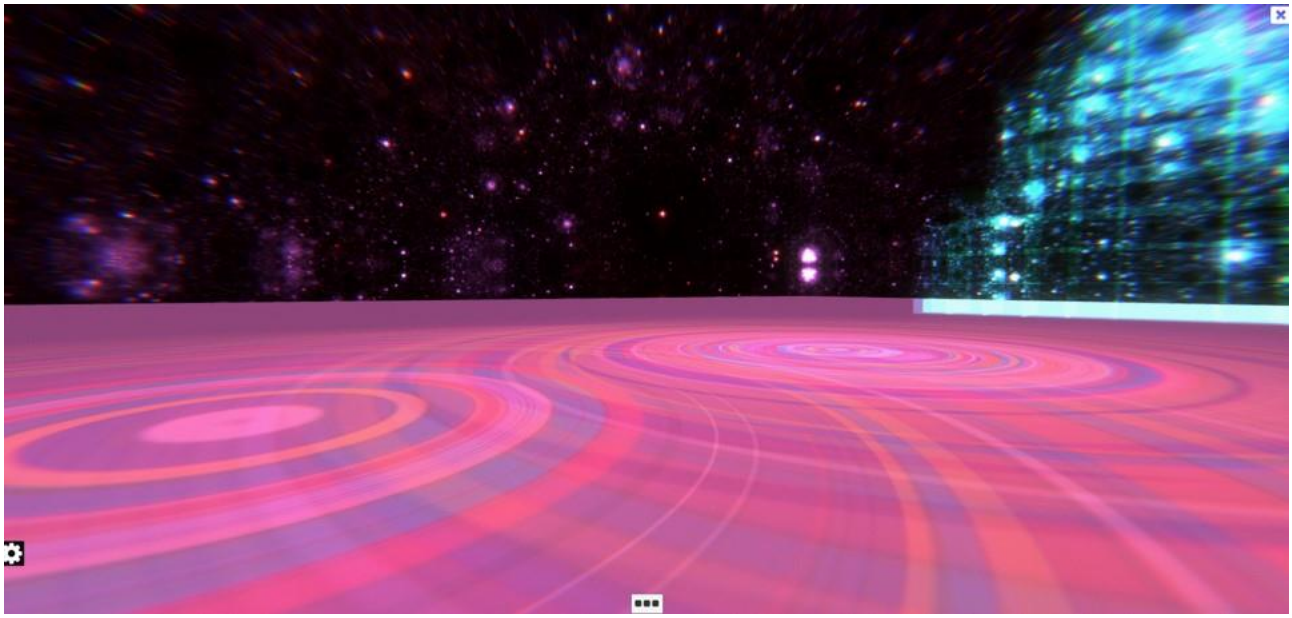


Figure 48. Disco scene

3.6 Floors

In the Grid scene, that represents the neutral environment in Choreomorphy, the user can customize the floor and choose between three different ones. The light and dark solid floors define the grid characteristic that can assist the user calculate the distance that they moved or extended their limbs while they are moving (1 block is equal to 1 meter). The water floor depicts the reflection of the avatar (Figure 51).

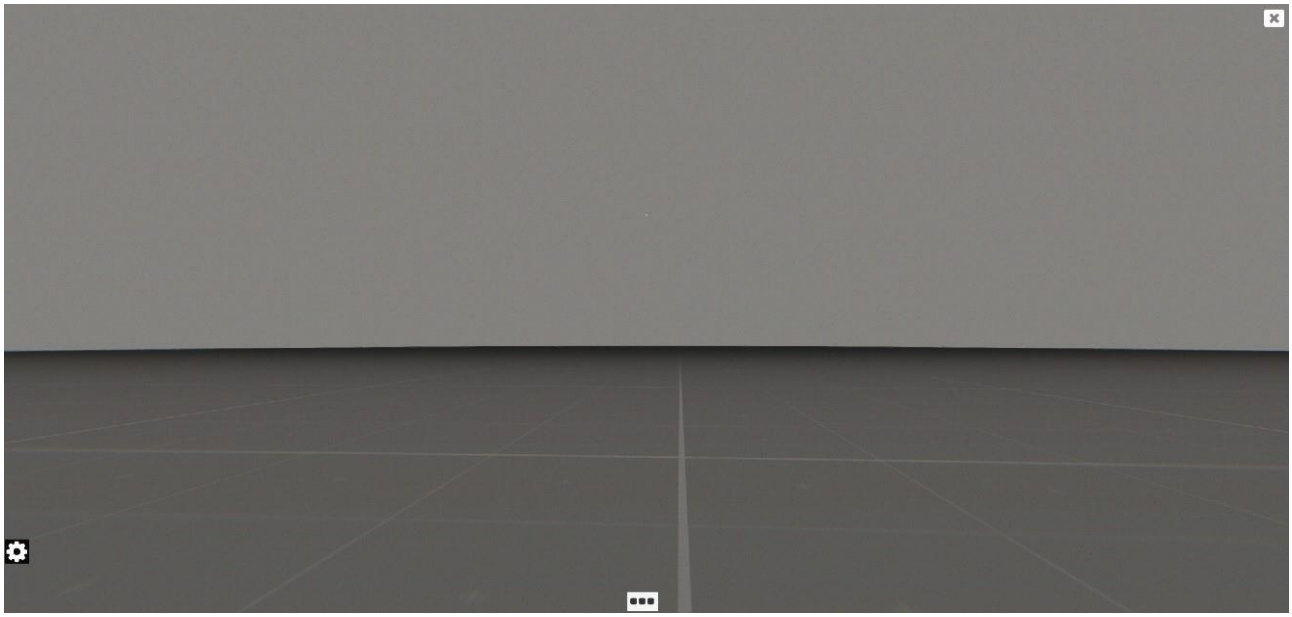


Figure 49. Light solid floor

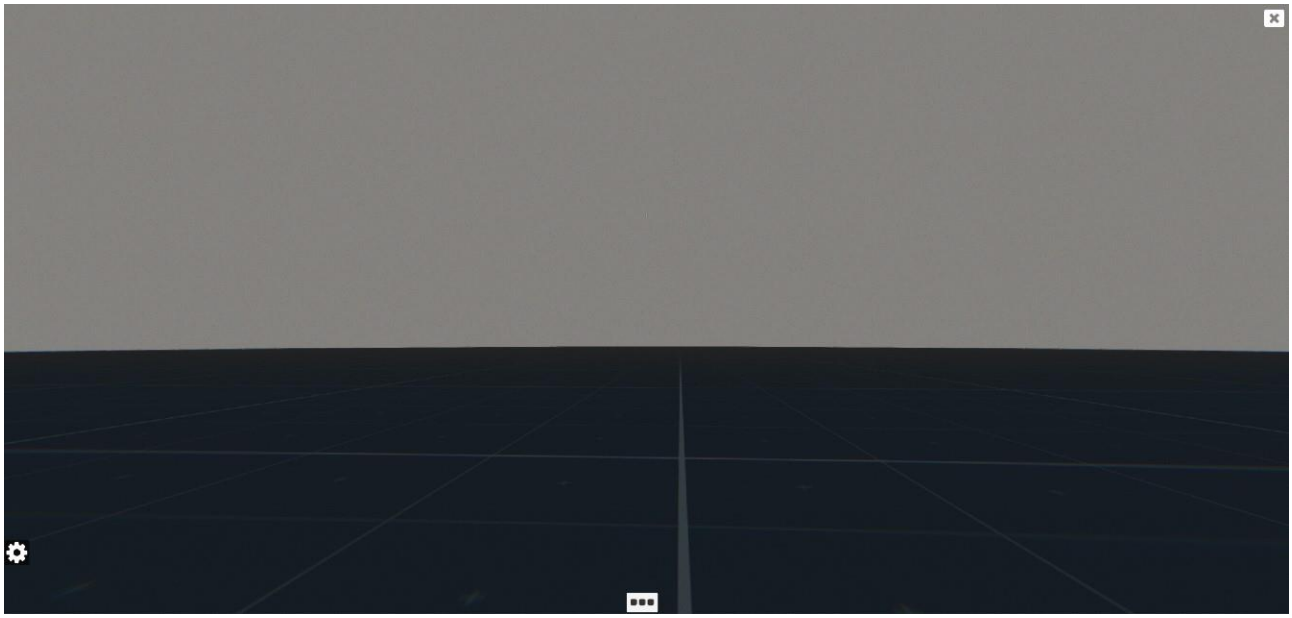


Figure 50. Dark solid floor

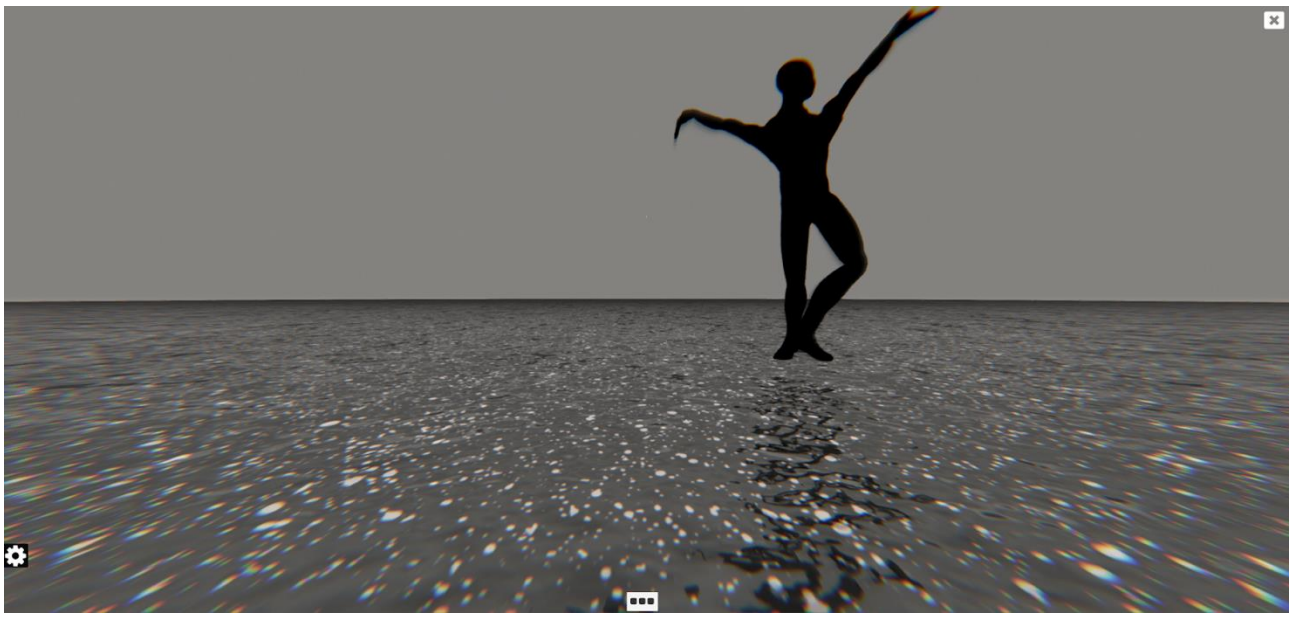


Figure 51. Water surface

3.7 Trails & Traces

3.7.1 Trails

They are dynamically generated 3D meshes that are attached along the limbs of each avatar and their texture map is a sprite with gradient from opaque color to transparent. This curtain-like 3D mesh connects pairs of joints of the avatar's rig. They depict the path that the avatar's limbs go through and create a whole trace of movement. Their fadeout time duration can be adjusted through the user interface. For each avatar there are specific color-themed motion traces.

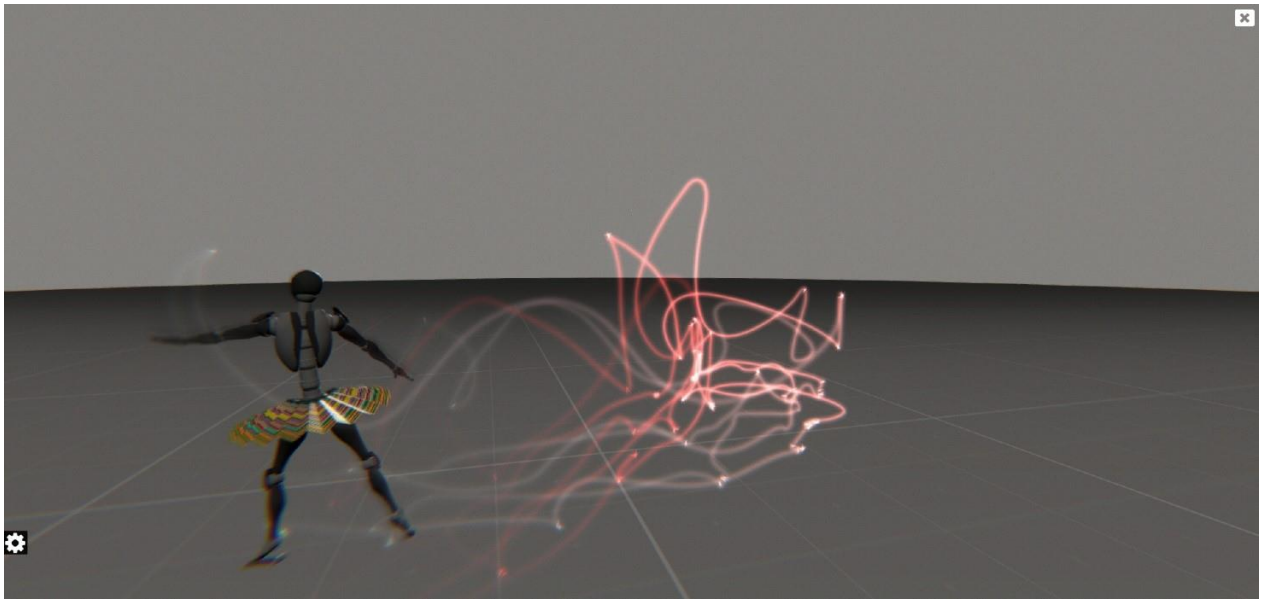


Figure 52. Trails

3.7.2 Traces

Traces (Figure 53) are entities that consist of large number of sprites that are too close to each other and replicate the effect of a light trail. They rendered behind the moving limbs of the avatar and emphasize the feeling of motion to the moving character. The user can adjust the time that the motion trails remain rendered in the scene before they fade out. For each avatar there are specific color-themed motion trails.

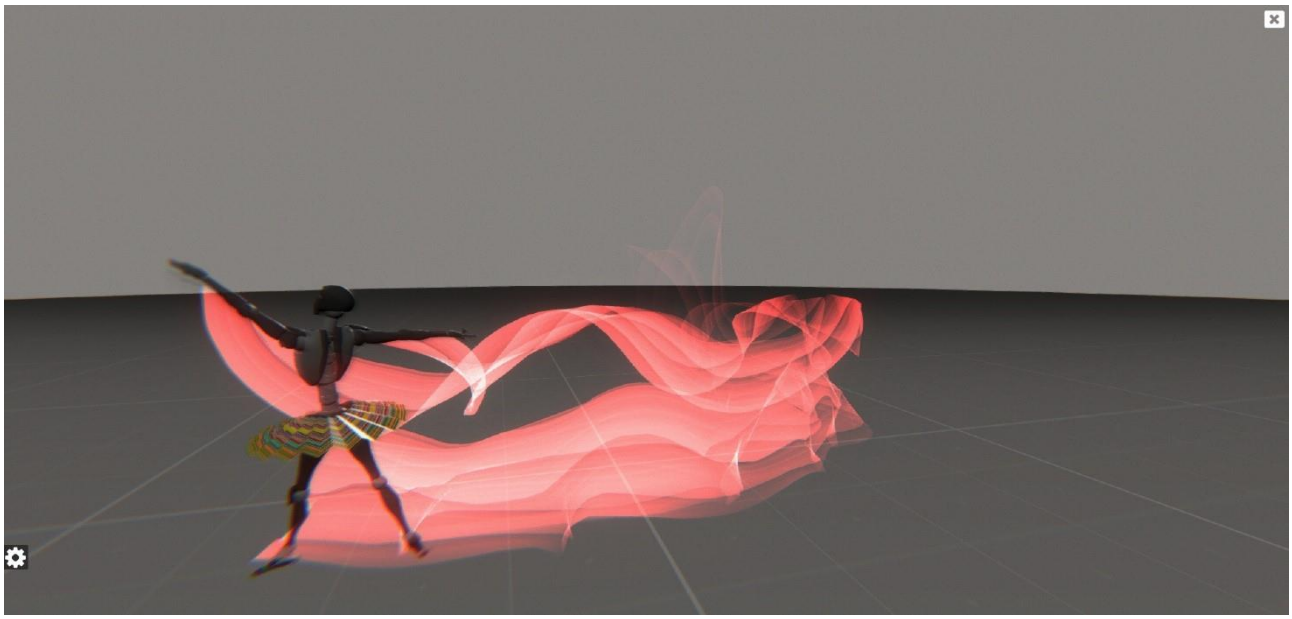


Figure 53-Traces

3.8 Camera

3.8.1 Main camera

The User can roam freely in the virtual scene by translating, tilting, panning and zooming the camera to configure the Point of View according to their preference.

3.8.2 Cinematic camera

This is a fixed rotation movement around the avatar, to create a cinematic perspective effect. The translation is keyframed and the target of the camera follows dynamically the subject, which is in our case the avatar.

3.8.3 Dynamic camera

This camera mode follows dynamically the avatar in the XYZ axis system maintaining always a distance between itself and the avatar. This distance can be changed anytime by the user.

3.8.4 Afterimage camera

In this mode the avatar's previous movement stays rendered on the screen creating an after-image effect. This technique is based on disabling the refresh of the render canvas for the ava

3.9 Evaluation and conclusions

The tool has been extensively evaluated with dance practitioners, from within and outside the consortium. The evaluation has shown a great potential for both educational and creative purposes. The results can be found in *"D7.2 First evaluation of personalised experience"* [16] as well as in the corresponding published papers [7][9]. In addition, the demonstration of the Choreomorphy LIVE has been presented in several dissemination and public events, including both adults and children.
The flexible architecture of Choreomorphy enables the easy integration of further scenes, avatars and movement effects, which makes it easily transferable to other use case scenarios and extensible in terms of visualizations and interactions. However, as discussed earlier, limitations include the complexity and high cost of current motion capture devices.

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