

A Refined Workflow for Designing Virtual Worlds for Collaborative Learning

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Abstract—It has been shown that collaborative learning can be fostered by computer support, especially in distance learning situations, where students meet online with their peers to work collaboratively on exercises or projects and discuss in groups. We share the spreading belief that particularly virtual worlds (3D Collaborative Virtual Environments) are suitable for collaborative learning, and present a refined workflow for the design of virtual worlds and the collaboration experiences users acquire in them. Our experiences from applying it in a first use case show that this presented interdisciplinary approach is a way to exploit the distinct features the novel medium offers. We further show how our workflow facilitates the promotion of virtual worlds following a two-fold approach: it implements ‘design for research’ as well as ‘research for design’.

Virtual Worlds, 3D CVE, Collaborative Learning, Experience Design, Programming, Virtual Architecture

I. INTRODUCTION

It has been shown that collaborative learning can be fostered by computer support, in particular in distance learning situations, where students meet online with their peers to work collaboratively on exercises or projects and discuss in groups [6]. While asynchronous online tools are already widely being used in current education practice, interest on synchronous Internet-based tools has been emerging only recently. We specifically share the spreading belief that virtual worlds (i.e., 3D Collaborative Virtual Environments, CVE) are particularly suitable for collaborative learning, and present a refined workflow for the design of virtual worlds and the collaboration experiences learners acquire in them. We claim that this interdisciplinary approach is a promising way to exploit the distinct features the novel medium offers. This claim is invigorated by our experiences from applying the workflow in a first use case, the *ShanghAI Lectures* project.

The ShanghAI Lectures (<http://shanghailectures.org>) is a mixed-reality global teaching and intercultural collaborative learning project. Its core components are a lecture series on embodied – natural and artificial – intelligence (see [20]), presented by Prof. Rolf Pfeifer (director of the Artificial Intelligence Lab, AI Lab, at University of Zurich) and task assignments for multicultural student teams from all over the

globe. The lectures are broadcasted from Jiao Tong University in Shanghai in fall term 2009 via video-conference. More than 340 students collaborate in self-managed global virtual teams on projects and weekly group assignments, view video-recorded lectures and expert talks together, and meet online with experts in the field, all embodied as avatars in a virtual world. For the development of this virtual world – that we named UNIworld – we chose to utilize and extend the open-source toolkit *Project Wonderland* developed by Sun Microsystems, which enables the customized design of the virtual environment, the extension of communication tools such as immersive audio and cameras into the real world and collaboration features such as shared applications, and the implementation of tailored extensions, such as authentication schemes and social software features (e.g. virtual business cards).

The remainder of this paper starts with illuminating the background, namely collaborative learning and virtual worlds and their applicability to the former. In section III we describe the refined workflow, also by describing its core steps in detail: Experience Design and Programming. Section IV describes the use case, how we applied the presented workflow in practice, in order to create a virtual world for an international collaborative learning setting. Then we conclude with summarizing our experience from applying the workflow, and give an outlook and present future steps in our design and research.

II. BACKGROUND

In order to elucidate the decision of using a virtual world for an intercultural collaborative learning project, this section first provides some background on (computer-supported) collaborative learning and presents some of its key concepts, before leading over to the applicability of virtual worlds for the matter. After presenting reasons why this medium is particularly suitable, we discuss the lack of structured approaches of designing virtual worlds in nowadays practice.

A. Collaborative Learning

One main understanding is that collaborative learning occurs as a side-effect of collaborative problem-solving. A collaborative situation involves interactions between participants, synchronous communication, negotiation, and effects [6]. In [6], Dillenbourg also thoroughly discusses the various aspects and approaches of Computer-Supported Collaborative Learning (CSCL). One main factor that emerges is that collaboration greatly benefits from being structured and organized. To this end, one approach to structure and formalize, and also pre-construct collaboration processes is the concept of Collaboration Patterns, which have been defined as “techniques, behaviors, and activities for people who share a common goal of working together in a group” [10].

Roschelle & Teasley define collaboration as “a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem” [21]. For the latter they coin the term Joined Problem Space. Similarly, also taking up this notion of (non-physical) space as a crucial requisite for collaboration, Nonaka et al. define ‘*ba*’ as a shared context for knowledge creation [17]. Various scholars argue that this non-physical space can be realized by designing the physical space where collaboration takes place (see [11][18]). It is thus advantageous to exploit the features of the environment in which collaboration takes place, and to support (or control) awareness of information in it as well as of the presence of others and their ongoing activities [11].

B. Virtual Worlds

Dourish [7] believes that “probably the most significant transition, in terms of [...] user interface models that are familiar to us today, was the transition from text to graphical interaction”. This can be understood as a transition from communicating using mere one-dimensional streams of characters to interacting in a 2D space (a Collaborative Virtual Environment, CVE). Tomek [26] defines a CVE as a software environment that creates a “configurable universe which emulates a number of serviceable aspects of physical reality”, such as the mentioned concept of space, movable objects, navigation, and communication between (representations of) humans. Schmeil & Eppler [22] summarize relevant motivations for using CVE for information sharing and knowledge management, and outline how three-dimensional CVE in particular can enhance functionality and usability in a number of respects. Using the introductory mental model of transitions from above, utilizing 3D spaces can be understood as entering the very space in which information and data is organized spatially, as opposed to having separate spaces for users and information, as it is realized in scenarios merely utilizing 2D collaborative environments.

Formal definitions of virtual worlds are still generally rare. A virtual world is a special type of 3D CVE (Collaborative Virtual Environment), also labeled Multi-User Virtual Environment (MUVE), in which a multitude of users from anywhere can be present at the same time and meet, communicate and navigate with avatars in a shared space, together with information and knowledge. Furthermore, virtual worlds allow for a form of virtual social interaction resembling face-to-face interaction in many ways: avatars can approach

each other, assume socially significant positions, face each other, gesture to each other, and, in some systems, even exchange facial expressions.

The education community has identified virtual worlds as a novel medium for collaborative learning. Especially modern education approaches such as constructivist learning, situated learning, and problem-based learning are applicable in these environments [15]. In addition, a number of conferences have emerged that are held exclusively in-world, particularly in the popular virtual world Second Life, such as the SLEDcc and SLCC conferences, and the SL Education Workshop.

It is only in recent years, however, that studies about mechanisms of social interaction in virtual worlds (and Massively-Multiplayer Online Games, MMOGs) are conducted: Moore et al. for example study awareness and accountability across several online worlds [16]; Ducheneaut et al. [9] investigate player-to-player interactions in a virtual world; Wadley & Ducheneaut [27] experimentally examine collaboration in Second Life. These studies highlight shortcomings of both the designs of the virtual worlds themselves, and the interaction and communication models applied in the environments, and also make design recommendations based on findings from ethnographic studies and results of experiments. Just as it is the case with game design, the design of collaboration experiences is a domain where social sciences can have much influence both by recommending best practices and evaluating the effects of virtual social environments [9][24].

The ShanghAI Lectures with its virtual world exercises is a pioneer project that employs such a highly interdisciplinary approach [12]. For highly international and multicultural teams of students, its virtual world (UNIworld) had to provide a comprehensive setting as a place for them to work on exercises that accompany the lectures. To tackle this complex task we needed to form an interdisciplinary team and develop and apply the workflow we present in this paper.

C. Design Workflows

As three-dimensional virtual worlds are a rather novel medium to be used for other purposes than entertainment, the structured design of serious virtual worlds has not yet been discussed in the scientific discourse. In fact, work on structuring and organizing the design of virtual worlds, virtual worlds themselves, and the interaction in virtual worlds is still very sparse (for an exception, see [23]). A well-cited book on game design, specifically on the design of so-called Multiple Multiplayer Online Role-Playing Games (MMORPGs), which in fact are virtual worlds, is [4]. However, it addresses exclusively game design.

Hence, in construing our workflow on collaborative learning (and related collaborative tasks) as the application domain, we present pioneer work in trying to support and improve the design process for these virtual environments.

III. A REFINED WORKFLOW FOR DESIGNING VIRTUAL WORLDS FOR COLLABORATIVE LEARNING

Our presented approach employs a highly interdisciplinary team of communication scientists, architects, psychologists, and computer scientists to design the virtual world and scaffold collaboration experiences within it. Utilizing Sun’s Project Wonderland toolkit as a virtual world platform we have built UNIworld as the collaborative virtual environment to be a place for the exercises of the ShanghAI Lectures. In the following we present the two core methods in our virtual world design approach, namely Experience Design and Programming, and show how they fit in the overall process, by presenting the workflow we developed and applied for the development of UNIworld for the ShanghAI Lectures project.

A. Experience Design

The term Experience Design was coined in brand marketing; the basic idea was to deliver experiences that differentiate the products of one’s particular brand from similar products of competitors. Only since recently it has been recognized as an emerging full-fledged design discipline [5], and has become prominent mostly for the design of games, and also for the design of leisure activities for future home environments. Experience Design is understood to comprise more than its related discipline of User Experience Design, which is prominent in designing for the World Wide Web but mostly regards the aspects of functionality, efficiency, and desirability [14]. For the design of effective collaboration experiences, however, social, communicational, and interactional factors, just to mention a few, have to be taken into account. Streitz et al. [25] first applied the term of Experience Design in the field of Computer-Supported Cooperative Work (CSCW), which is closely related to CSCL. For this field, the Experience Design approach could mean a transition from system-oriented, importunate smartness to people-oriented, empowering smartness [24]. In regard to virtual worlds or CVE in general, Experience Design has not yet been mentioned in the scientific discourse.

Schmeil & Eppler present a framework for the description and creation of collaboration patterns in virtual worlds, based on semiotics theory (fig. 1) [23]; it connects the infrastructure of available actions and objects in a virtual world (the syntactic level) through a dramaturgy (the semantic level), giving meaning to the former, with goals in given contexts (the pragmatic level), and thus constitutes a usable blueprint for the design of collaboration experiences for virtual worlds. In other words, the approach is to develop collaboration patterns, which are to scaffold real collaboration experiences in the virtual environment. Here, a collaboration pattern is an instance of the framework, and comprises “objects, actions, rules and steps, for participants with roles who meet at a location at a certain time, to collaborate on a common goal, in a context” [23].

Our approach utilizes this framework in order to create collaborative learning and collaborative project work experiences (the pragmatic context) by designing appropriate activities (the semantic level) that make particular use of Wonderland’s features and properties (the syntactic infrastructure). The resulting design and virtual architecture are

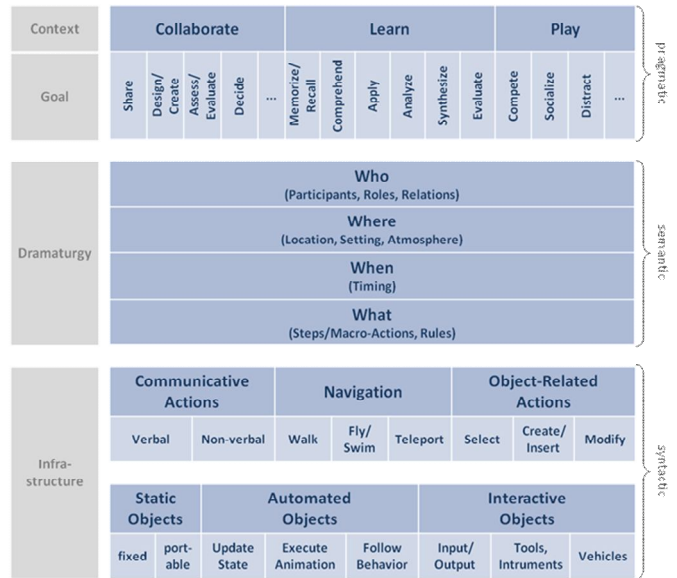


Figure 1. Framework for Virtual Embodied Collaboration (from [23])

manifested in our implementation, UNIworld. The activities (particularly their settings, roles, and steps) draw from experience of former, traditional student exercises on the same content. The virtual objects that were formalized within the Experience Design are forwarded as requirements for the software developers who implement virtual tools and other objects. The created collaboration processes, rules, settings, actions, and roles of participants serve as input for the next step leading to the world design, the so-called Programming. Fig. 2 shows a collaboration pattern as an example of the output of experience design for collaboration in a virtual world.

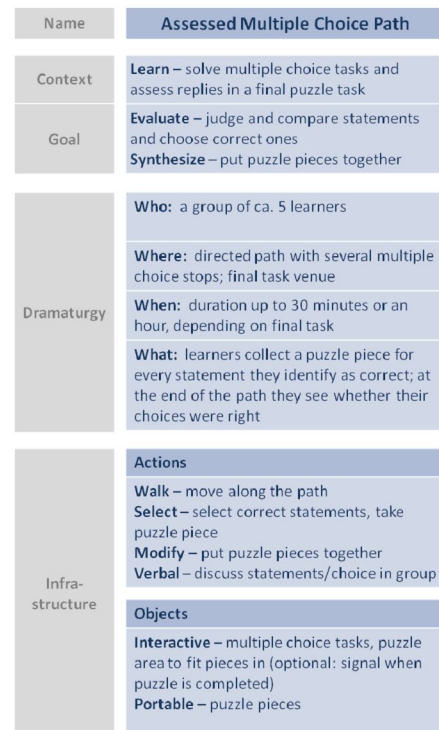


Figure 2. A collaboration pattern created with the framework

B. Programming for Virtual Architecture

Recent paradigm changes in collaborative work practice and the increased importance of interdisciplinary teams and of team-building across a company's departments demand for innovative configurations of space [2]. The systematic aspects of architectural spaces have a middle-term influence on the formation of social networks [11][7]. Architecture is not only perceived by the individual but it allots and structures the possibilities of mutual awareness and thus of encounter and communication in time and space. Indeed architecture induces place-making and "placeness" [11], but even more it provides a framework for the creation of space. "Space is a social product just as much as place", Dourish states; both are "products of different sorts of social practice" [8]. Whereas place is "the understood reality", situated in a field of opportunities that have been taken or not, "space" as an outcome of social practice "is composed of intersections of mobile elements" [8]. Space, again, is a field of opportunities, and of limitations. Architecture is a framework for both kinds of social practices and for the communication and coordination processes they go along with.

For our demands we state: Whereas "place" stands for expertise and intra-group communication – a kind of professional "nest-building" – following Dourish' "space" conceptualizes inter-group relations and communication. We have to understand space-building processes not only in office buildings and research institutes but as well in virtual spaces, if we want to further innovate communication. Per definition, this aspect of communication cannot be institutionalized or organized but has to be spatially configured and designed [2].

In the context of spatial design, Programming does not relate to software development but is a systematic and exhaustive practice to collect and structure information about organizational experiences and aims with the purpose of guiding a design process. First Programming approaches have been introduced to the architectural design practice in the USA by the architecture company CRS about 50 years ago [19]. Since the 1980s Programming has been enhanced and extensively applied by Henn Architekten (see <http://www.henn.com/#en/methoden>), resulting in a sophisticated process that in the meanwhile is established also in international practice.

Design problems are complex in the case of collaborative spaces as several issues interact with each other: spaces are perceived – visually, atmospherically, acoustically; spaces are interpreted, walked across, spontaneously used for gatherings, etc. Finally, spaces are – and shall be – produced and re-produced in communicative processes (as discussed above). Spaces – perceived, produced and re-produced – form a unifying background for the issues that are crucial for the integrity of any Experience Design: Infrastructure, Dramaturgy, Goal (see above). In the forefront of designing a similarly complex field of demands, restrictions, resources etc. has to be recorded and to be clearly laid out. Programming is particularly applicable whenever a challenge concerning spatial organization – be it finally discharged into a building or not – is of innovative nature so that a precedent has to be set. The Shanghai Lectures and the accompanying exercises represent

such a precedent, as the functional design of virtual worlds is yet to be thoroughly investigated.

The Programming method gathers dynamic from the relation between problem-seeking and problem-solving. A main principle of the Programming approach is to clearly separate the task (or: problem) from the target solution. Instead of directly heading for a building concept or another final solution, the challenge is to scrutinize the "architecture" of the problem at first. Once an organization has assertively acclaimed the need for a new spatial strategy, all the knowledge, experience, ideas and imaginations of the involved parties are gathered. An extensive workshop and additional interviews are a good practice to perform this step.

The most characteristic manifestation of Programming – often equated with the procedure as such – is the recording of all information and knowledge on handy cards by trained drawers during the workshop. Each card plots one idea both in keywords and a diagram or visual metaphor. Fig. 3 shows a sample of the cards that were created in the main Programming workshop for the design of UNIworld (the cards are labeled in the German language; the figure is just to illustrate the method of visualizing information). The information collected on these

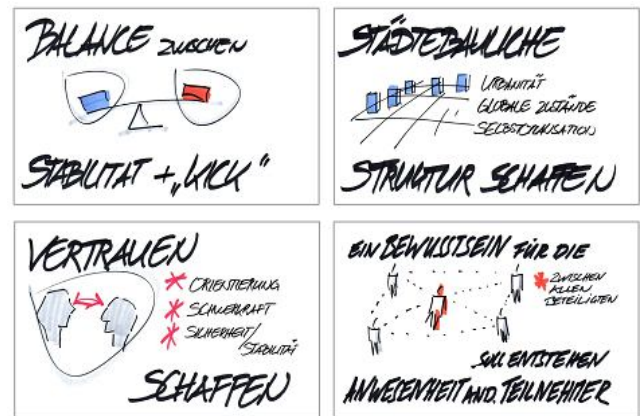


Figure 3. A small sample of the cards that were created and used within the Programming workshop, conveying and structuring information and ideas

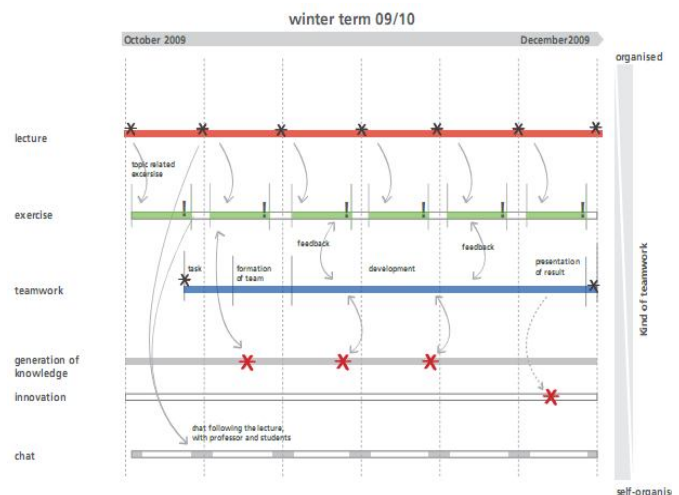


Figure 4. Interconnected processes expected in UNIworld

cards is then structured into the five categories of aims, facts, concepts, tasks, and requirements. Further steps employ complex diagram charts to concentrate and organize information for particular fields of investigation. Fig. 4 shows a chart visualizing the processes that were foreseen and expected in UNIworld. 3D models can be applied to organize even more complex relations, and also to display information on further workshops. Step by step the constructed information space is transformed into embodied spatial concepts, appropriate either for buildings, cities, businesses, or virtual environments. In summary, Programming creates a contextual information space (i.e., a multidimensional and flexible order), composed of both textual and visual elements, prior to the final design.

The construction of spaces is bound to resources and technical limits. Spaces and their configurations mirror imposed organizational ideas; they limit or foster self-organization processes and interconnect them, corresponding to diverse goals. Architectural spaces enable and limit the production of spaces [8]. Programming is a method to identify, to describe and to display these issues and to show their conflicts and agreements. As these entirely different issues interact and together form a design problem, an interdisciplinary approach is inevitable.

C. Workflow

Figure 5 illustrates the workflow of our interdisciplinary approach to virtual world design for collaborative learning experiences. It is shown how the several steps interface, i.e. which output of a preceding step serves as input for a subsequent step. It further shows how the sequence of the steps forms a cyclic process; experiences, evaluation results, and (design) practices are utilized in a subsequent design cycle (macro view). Within this macro process, some particular steps (i.e., micro processes; especially the Programming and World Design processes) can be evaluated on the spot; feedback from the successive step can be directly incorporated (micro view).

In this workflow, the design of a virtual world for collaborative learning experiences starts with information about the instructional design of courses and other learning activities planned to be conducted in the virtual world, knowledge about established collaboration practices relevant in this scope, and general information on the context, in which the learning activities are supposed to take place. This assembled information feeds the first step of the cyclic process in the workflow, that of Experience Design. This step, which we described in detail earlier in this section, outputs processes, roles, actions, (virtual) objects, characters, settings, and further requirements to the environment (e.g. different atmospheres for different settings). This information serves as direct input to the Programming step (also described in detail earlier in this section), in which it is interpreted, structured and organized in a way that it supplies the World Design with spatial and social requirements, a strategic and philosophical brief, a visual protocol of all the gathered information (see fig. 3 and 4 for examples), and general as well as specific guidelines for the design. The task of the World Design step then is to transform this vast amount of thoroughly structured information into a 3D model, into (virtually) tangible architecture and landscape design. This step has the highest resemblance to architectural practice, although here it is generously supported by the two previous steps (Experience Design and Programming, the two core steps/methods in the workflow). For this reason, it is likely that the World Design requests the Programming for changes to be made to, e.g., spatial requirements, design guidelines, and content (see micro-workflow in fig. 5). Similarly, the 3D models, that is the output of the World Design, can be given back to revision from the next step, the World Implementation, in case performance problems occur with the import of the 3D models in the virtual world, or shortcomings are detected, in terms of visibility, scale, or usability of objects, architecture or landscape. The output of the World Implementation step is a working virtual world, furnished with virtual (static and interactive) objects, set up

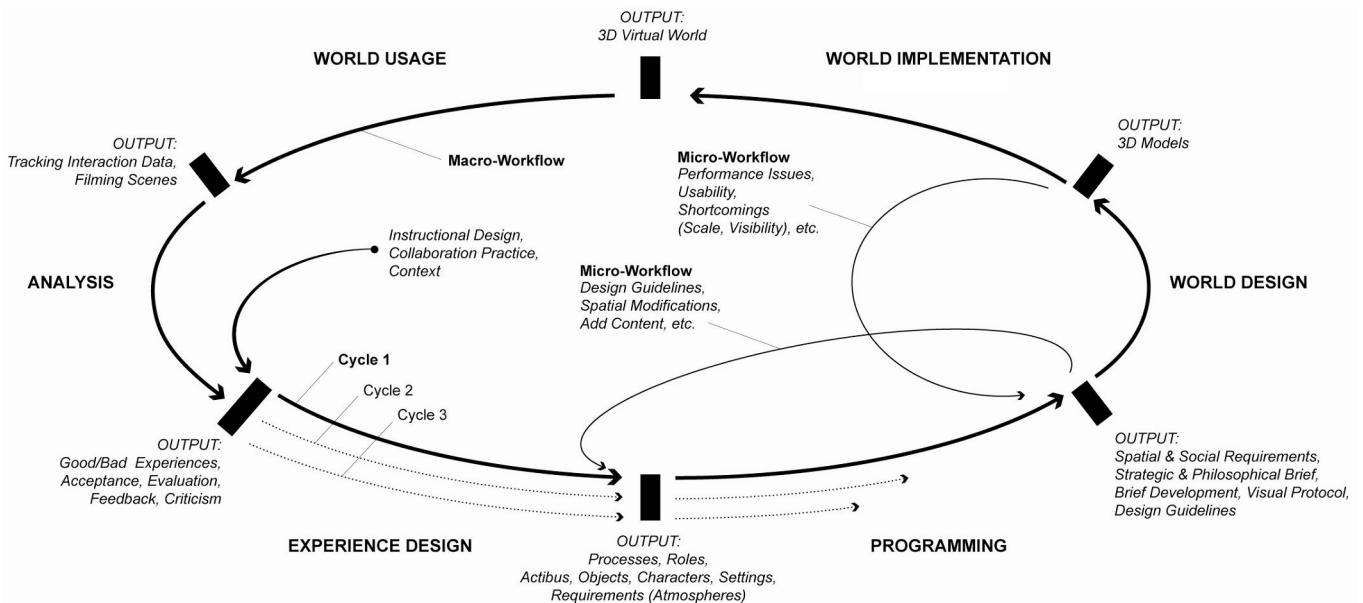


Figure 5. The refined workflow for designing virtual worlds for collaborative learning

with avatars that correspond to the character and role definitions, tested, and ready to use. Besides the stability of the virtual world, the cohesion of the experience of entering and roaming the environment are of great importance.

The utilization of this first finalized version of the virtual world forms the next step, labeled World Usage. In this step, it is crucial to track users' interaction, record activity and navigation data, and possibly even audio and video of important happenings and meetings (note: usually consents of users have to be requested before collecting data on their behavior in the world). After this World Usage (e.g., after the end of the term comprising virtual world exercises) and the associated data collection, the next step in the cyclic workflow is the Analysis of this collected data, resulting in an output summing up general findings like good and bad experiences, and qualitative and quantitative measurements like acceptance, feedback and evaluation of the virtual world, the collaboration and learning experiences in it, etc. Since everything related to a virtual world is by definition processed digitally, there are only few limits in terms of data collection possibilities; it is a great environment for a multitude of research fields, and furthermore offers potential and means to empirically evaluate variations of design parameters [3].

These findings about the virtual world and the collaborative learning experiences finally constitute the input for the next cycle (i.e., the next iteration of the virtual world design) and feed directly the Experience Design step.

IV. DESIGNING A VIRTUAL WORLD FOR THE SHANGHAI LECTURES PROJECT

The ShanghAI Lectures aim to foster collaboration in a multicultural and interdisciplinary global teaching context. In terms of educational goals, the project aims to (a) create a platform for the development of reflective thinking, (b) support the development of intercultural communication competencies, and (c) create the conditions for practicing an effective use of novel collaboration technologies, in order to prepare students for a modern work environment. However, the novel technology of virtual worlds for global collaborative learning should not impose a hindrance by no means; a principle to follow was thus Gibson's theory of affordances, to design the virtual environment and objects in it in a way that users intuitively know what they represent or in what way to use them (see [18][22]).

We pursue a "Learning through Discussion" approach to foster intercultural learning – which has been found to be essential to foster active learning and to construct conceptual understanding [13]. Small group discussions focus on thinking and reasoning instead of rote memorization; they enable students to reflect on their own thinking, discuss issues, exchange ideas, question statements, and formulate questions for clarification. In this view, lectures are supposed to foster students' motivation to learn a specific topic and to awaken their interest and curiosity while the actual learning takes place individually outside of the classroom and – in this case – in cooperation with peers, in a virtual world.

A. Constraints and Limitations

Sun's Wonderland platform was still under development as we designed and developed UNIworld. The system administrators, or better, the World Implementation team thus had to update the software on our servers constantly, in order to benefit from bugfixes or new functionality. With more than 340 students we further had to design the server infrastructure in a way that the bandwidth of each of them was sufficient. Test results showed that not more than about 40 avatars should enter the virtual world through one server, in order to ensure a high enough performance and prevent from system hang-ups and server crashes. As a consequence, we decided to set up 18 servers (i.e. sub-worlds) with a basic capacity of 25 students each (5 teams of 5 students). This way, there is enough free space left for students joining later, and more importantly, it is still possible for students to roam around UNIworld, navigating between different servers. This was an important issue for the world design, most of all for the Programming team.

B. Designing Collaborative Learning Experiences

The Experience Design for this project drew from the content and the accompanying exercises of a former 'traditional' lecture on the same content, and from practice in the robotics field, and tried to situate the collaboration that was to design within the context of natural and artificial intelligence and robotics. Since the virtual world within the ShanghAI Lectures project is used mainly as a medium for the student teams to work on exercises, these were the main focus of design. With considerable influence from instructional design, 15 exercises on the given content were developed, plus one tutorial exercise, with the purpose of getting the students comfortable with the Wonderland software.

Many of the exercises were designed in a way that they exploit the distinct features of the 3D virtual environment (including object manipulation, navigation, embodiment exercises, role play), others were designed around video annotation on 2D video walls inside UNIworld (e.g. annotation of slides and videos, sketching drafts on whiteboards), and one was planned as an 'ice-breaker' exercise: for team-building, a team t-shirt has to be designed in-world, using a whiteboard. However, due to the development state Wonderland was still at while we were implementing the exercises for fall term 2009, some exercises could technically not be implemented yet. We are planning to realize them in a next iteration of UNIworld (see Future Work section below).

C. Programming and World Design

The required step of splitting the whole world on different physical servers was a core issue for the Programming; several ideas on how to best manage this were thought out, some of them were further developed; in the end the approach we called internally the "paw tower" was decided upon. It realizes UNIworld as a big virtual tower, consisting of 18 stories, each of which provides team rooms for five teams of five students each, as well as a considerably huge public area. Fig. 6 shows the design of such a "paw" (its resemblance to a paw in design sketches gave it this working name): 5 team rooms and one public screen surround a common space where students meet. The student teams can place screens and interactive walls (i.e.

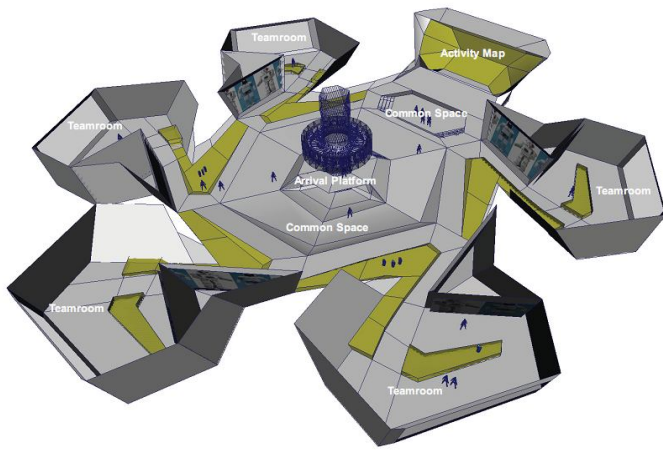


Figure 6. Design of a “paw”, i.e. a story of the tower, i.e. a sub-world for 5 teams of 5 students each; 5 team rooms and one public screen surround a common space and the arrival platform in the center.

whiteboards, web browsers, text editing software) in their team rooms and the common space (see fig. 7). For team project presentations, there is a designated area in front of each team room. To access another server, that is, to navigate to one of the other stories in the tower, a portal object can be activated, which serves as a direct link; once activated, the student merely has to walk through the portal with their avatar to teleport to another sub-world (although, re-logging in is still required at this stage of development of the Wonderland platform).

For research purposes, sub-worlds were realized in one of three variations: one of them implements closed team room, the second one team rooms with a big window, and the third implements team rooms that are completely open to the side facing the public space. This way we hope to gather insights on the influence of architecture on privacy in the scope of collaborative work in a virtual world.

V. CONCLUSION

Although the aesthetics of any environment turns out to be practically relevant in the end, any design has to start from a concept of experience: experiences already gained by an organization as well as experiences that shall be made in the future. Not the mere images that we can perceive in an environment are primarily relevant, but the influences it shows onto our feelings, actions and reactions, on memory and spatial orientation. Not the image is relevant in the end, but our interpretation, the story, the narrative. Experience Design aims at connecting the main attributes of experience within a blueprint matrix of tools, narratives and goals. Programming denotes and interprets these requirements into spatial ideas, thus leading to condensed diagrams and finally to alternative designs. The more avant-garde a project is, the more the emerging design alternatives tend to be employed as variables in an experimental situation. In terms of experiment setups, virtual worlds offer vast possibilities. With this project and the presented workflow, we combined ‘design for research’ and ‘research for design’. On the one hand, the world is designed to gather data on the behavior of the collaborating students, on the other hand, the analysis of the behavior in the realized

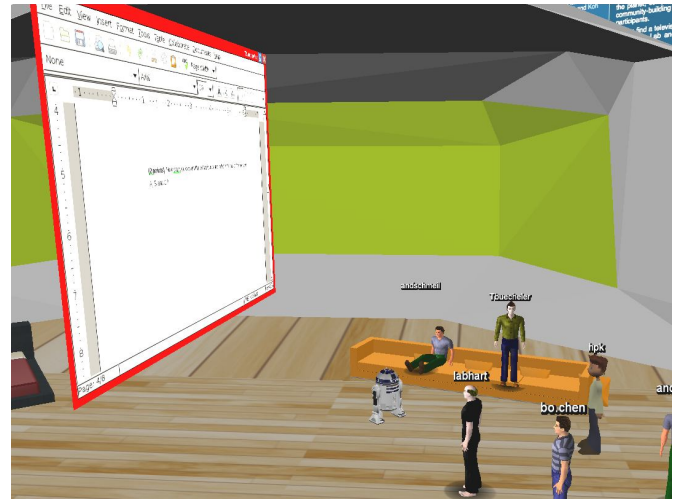


Figure 7. Screenshot of avatars collaborating in UNIworld, using a text editing software on an interactive wall

alternative team rooms (e.g.) give insights directly back to design; in a next iteration of the same lecture with exercises, another variable can be tested, following the presented workflow.

In this first use case applying the workflow, we found that it structures the whole process of creating a virtual world in a way that everybody involved in the project...

- knew their responsibilities and the boundaries of their competencies,
- was aware of what input they could expect,
- from whom they could expect it,
- when they had to expect it,
- and when they had to deliver output to whom at what time.

Thus, the workflow structures cooperative design in several ways, and keeps project members aware of the progress of the design. By strictly defining the type of output after each step of the macro process, inherent documentation takes place – keeping track becomes an automatic part of the process, with little to no overhead. Moreover, incorporating Experience Design and Programming, the workflow puts the human (experience) in the center of the focus. The inclusion of best practices and experiences into the workflow further adds to this. Finally, the nested micro- and macro-workflows allow for iterative or evolutionary design

VI. OUTLOOK AND FUTURE WORK

It is crucial that we advance our understanding of group interaction processes and the influence both collaboration design and virtual architecture have when working in virtual worlds, and why virtual teams succeed or fail in using these novel collaboration technologies effectively. The ShanghAI Lectures aim to improve the understanding in this issue by systematically investigating cross-cultural collaboration in virtual worlds.

The ShanghAI Lectures serve as a research platform to carry out studies that are embedded in a general research agenda for the systematic investigation of collaborative learning and working in 3D CVE [12]. The research project aims to explore various aspects of virtual team behavior in 3D CVE and to collect lessons learned to guide further research and future virtual world design. The educational context makes it possible to carry out a controlled field study with experimental manipulation of context factors (i.e., “input variables”). For this purpose, we have implemented a behavioral tracking system in UniWorld that offers the opportunity to collect longitudinal data of in-world behavior in an unobtrusive way [9]. Also audio, chat logs and work artifacts (e.g., shared work documents) are stored and can be used for quantitative and qualitative analysis of content. Once a design problem has been worked out it can be responded to by a series of solutions which in turn can prove their fitness. If the solution to a problem is a material building it will naturally not be realized in variations. In virtual worlds, alternative solutions can be realized, implemented, and evaluated. These appear as independent variables in the research context; the design of spaces contributes to the experimental design as a whole.

As more and more virtual world platforms allow for alteration, creation or import of virtual objects, architecture, whole world designs, functional features and even basic functionality, we can observe an emerging trend, from merely copying real world features and experiences, including technologies and interfaces, to an adaptive experience/world design. Based on an adaptive world design the appearance and behavior of a virtual world as such can change in real-time due to usage, success and failure, and self-organizing processes. This development can be conceived of as an increasing virtuality. To optimize a player’s (or: user’s) experience, designers should exploit the flexibility of digital environments [9]. In the first design cycle of UniWorld (for fall term 2009-2010) the virtual world and collaboration experience design is limited to a rather simple level, comprising a world design operating in more or less familiar modes of orientation, relating to floors and walls, performing actions like walking and talking, creating proximity and distance, experiencing gravity, collision, etc. A second design cycle –planned for next fall semester – will go beyond this level and introduce more sophisticated virtual objects, interactive and behavior-driven, and a responsive virtual architecture, with the aim of exploiting the distinct features of virtual worlds.

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