DESIGNING AND BUILDING IMMERSIVE EDUCATION SPACES USING PROJECT WONDERLAND: FROM PEDAGOGY THROUGH TO PRACTICE[1]

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This paper presents work on the JISC funded SIMiLLE project to build a culturally sensitive virtual world to support language learning. This builds on the MiRTLE project (funded by Sun Microsystems), which created a mixed-reality space for teaching and learning. The aim of the SIMiLLE project is to investigate the technical feasibility and pedagogical value of using virtual environments to provide a realistic socio-cultural setting and content for language learning interaction. The paper starts by providing some background information on the Wonderland platform and the MiRTLE project, and then outlines the requirements for SIMiLLE, and how these requirements will be supported through the use of a virtual world based on Project Wonderland. We then present our plans for the evaluation of the system, with a particular focus on the importance of incorporating pedagogy into the design of these systems, and how we can support good practice with the ever-growing use of 3D virtual environments in formalised education.

1. Introduction

Judging by the growing interest in Virtual World environments as reflected in computer-assisted language learning international conferences such as WorldCALL and EuroCALL, these applications are part of a group of emerging technologies which are believed to have great potential for foreign/second language learning. The shift in the use of the web from static to more interactive uses (Web 2.0) is reshaping the way we learn (Alexander, 2006). However, there is virtually no research to-date, which provides evidence of the specific traits and characteristics of technological applications such as Virtual World environments that might contribute to the learning of second and foreign languages.

In this paper we present our current work on the SIMiLLE project. The problem we aim to address in this project relates to the need to enrich foreign language learning experiences for overseas students who wish to study in a UK Higher Education (HE) institution. By studying in the UK the students have the advantage of being immersed in the culture but traditional classroom methods rarely take advantage of the cultural context to control the learning content (classroom learning by definition remove students from the 'real' world), and outside of the classroom, the students often cluster together forming linguistic or cultural ghettos.

This paper provides some background information on the technology platform we are using (Wonderland) and our previous project MiRTLE (Gardner 2008). We then go onto describe the SIMiLLE project in more detail including the requirements for the project and how we intend to support best practice in L2 teaching and learning. This is followed by an overview of the design of the SIMiLLE systems and the evaluation frameworks being used. The ultimate objective of this work is to improve the design of immersive education spaces, and to assess and validate the effectiveness of different pedagogical approaches, and inform best practice in this emerging field. Background

1.1. *Project Wonderland*

Sun's Project Darkstar[2] is a computational infrastructure to support online gaming. Project Wonderland[3] is an open-source project that builds on Darkstar, offering a client-server architecture and set of technologies to support the development of virtual- and mixed-reality environments. Project Wonderland provides a rich set of objects for creating environments, including building components (e.g., walls) and furniture (e.g., desks), and it supports shared software applications, such as word processors, web browsers, and document-presentation tools. For example, one or several users can draw on a virtual whiteboard and view PDF documents and presentations. A user, represented by an avatar, can communicate through the avatar to others in the world by means of the voice-bridge and a microphone and speaker or by the use of a dedicated chat window for text messages.

The current release 0.5 is a major re-write of the previous 0.4 versions. There are three major changes in 0.5 (amongst many smaller changes). First, all the basic Wonderland APIs have been re-designed. The API changes

[1] * This work is supported by the Joint Information Systems Committee (JISC) in the UK.
[2] http://www.projectdarkstar.com
[3] https://wonderland.dev.java.net/index.html

should dramatically improve development going forward. Another major change in 0.5 is in replacing Java3D with the more modern jMonkeyEngine[4] (JME) scene graph. There are features in JME that substantially help to upgrade the look of Wonderland including render-to-texture, programmable shaders, and multi-pass rendering. Additionally, there is an existing and growing tool chain around JME, including a Collada[5] loader, which is a benefit to Wonderland content developers, as it allows users to easily import 3D objects such as can be found on Google Warehouse[6]. The third major architectural change is in replacing the existing inflexible avatar system with a modern state-of-the-art avatar system that includes new bone models, and advanced skinning features.

The Wonderland Server Architecture conforms to the Representational State Transfer (REST) style of architecture. A Wonderland client is run on a user's local PC. This is achieved using Java WebStart, which, (as long as the user has Java already installed) allows a user to access a web page to initiate the download and running of the Wonderland client. The system may also be administered via the same web page. This enables the initial world to be selected, snapshots of the current world state to be taken and modules to be added. Modules may be code that extends the core system's functionality e.g. an SVG Whiteboard or artwork such as being developed for the worlds used by the SIMiLLE project. The administrative facilities also allow the Darkstar Server, Voice Bridge and Shared Application Server to be stopped and started together with their properties being set. The Darkstar server is Sun's online games engine and the Voice Bridge provides the audio capabilities in world via Voice over IP (VoIP) with a selectable range of audio qualities. The Shared Application Server allows the in-world sharing of applications such as Firefox and OpenOffice.

The development of the Wonderland platform by Sun Microsystems was originally conceived as a tool to support collaborative working by Sun employees (Yankelovich 2004). As such it had a number of clear design goals, which we hope to exploit in this project:

- Focus on social interaction, formal and informal
- Strong sense of social presence, allowing for discussion of sensitive topics
- Spontaneous, unplanned interactions, particularly socializing before and after planned events to build trust
- Enhance communication during formal interactions
- Design for collaboration
- Seamless document sharing with no need to switch contexts
- Extreme extensibility
- Allow developers to add any sort of new behaviour

As such the key strengths of Wonderland can be characterised as having live application sharing, the ability for integration with business data, flexible deployment options, scalability and the fact that it is an open platform.

Wonderland is therefore a very different beast to the commonly used Second Life[7] platform. The Wonderland platform is primarily intended to be tailored and integrated by organisations within their own infrastructures. Whereas Second Life is a publicly accessible online service with very large numbers of users who can make use of a virtual economy to organise their lives. However, Second Life has already been used extensively by teaching institutions to carry out online teaching (for example see [Robbins, 2007]). There is no doubt that Second Life has been used very successfully to support online teaching and learning. However, it does have several issues around its use, particularly concerned with the privacy and security for participants taking part in online sessions, and whether there are sufficient controls in place for organisations to use it as part of their formal teaching infrastructure.

1.2. *MiRTLE*

The objective of the MiRTLE project (Mixed Reality Teaching & Learning Environment) was to provide a mixed reality environment for a combination of local and remote students in a traditional instructive higher education setting. Figure 1 illustrates the virtual classroom from an early version of MiRTLE. The environment

[4] http://www.jmonkeyengine.com/
[5] https://collada.org
[6] http://sketchup.google.com/3dwarehouse/
[7] http://www.secondlife.com

augmented existing teaching practice with the ability to foster a sense of community amongst remote students, and between remote and co-located locations. The mixed reality environment linked the physical world of the classroom with a virtual world for remote learners. As the MiRTLE project was one of the first to make use of the Wonderland platform, it was essentially coded against a moving target and was a testbed for all of the initial Wonderland developments up to and including the 0.4 version. MiRTLE was deployed across all the major server architectures, which include Windows, Apple OSX, Solaris and Linux (Ubuntu). The other key innovation was in the development of the MiRTLE concept itself, with the successful integration and demonstration of the concept, which combines real and virtual worlds into a single practical service. This was then tested in a number of different delivery scenarios and has gone on to be adopted by others around the world.

From the initial evaluations of MiRTLE at the University of Essex, a number of valuable issues, were highlighted, that have implications for future uses of this technology. It particularly highlighted potential social issues, such as the impact on student motivation and perceptions of crowding and jostling for position in the virtual classroom. The trial showed that there was potential for naturalistic and spontaneous social interaction between virtual and physically present students, which may increase a sense of presence for all involved. Teachers also recognized the potential value of this approach, and that, once students are logged on and settled, the MiRTLE environment had a minimal impact on normal learning patterns. A key finding was that spontaneous social interaction between virtual and physically present students was possible. It implies that MiRTLE facilitated a breaking down of the barriers between the virtual and the physical, allowing impromptu and naturalistic exchanges that are likely to increase a sense of presence for all involved.

Figure 1. MiRTLE. Lecturer view of remotely located students and student view of lecture

2. SIMiLLE

The MiRTLE project was very much about emulating current teaching practice by modeling and augmenting existing teaching or lecture rooms. The SIMiLLE project is taking a different approach in that it is looking to exploit some of the key features of virtual worlds in being able to simulate new environments, which can enable effective teaching and learning to take place. One of the aims of the SIMiLLE project is to investigate the technical feasibility and pedagogical value of using virtual environments to provide a realistic socio-cultural setting and content for language learning interaction. It is recognised that optimum language learning occurs when the learner is immersed in the host culture. However, if students are given language-learning tasks to complete in the real (host culture) world, it is difficult for teachers to observe and assess progress. On the other hand, the traditional approach is for students to act out their simulations or role-plays in a classroom setting that is removed from the every day cultural milieu. The problem for ESL (English as a Second Language) learners based in their home country on distance programmes is even greater with no access to the cultural milieu at all. In both sets of circumstances a virtual world that reflects features of the host cultural environment and supports a range of potential everyday language learning interactions could provide a valuable medium for achieving ESL teaching and learning outcomes.

The SIMiLLE project proposes to explore the technical viability and pedagogical value of such an approach by building a virtual world for language learning using Sun's Darkstar Platform and Project Wonderland tools.

2.1. *Requirements*

The user needs for SIMiLLE were gathered through a number of workshops and discussions with the key stakeholders. As one aim of the project is to evaluate the pedagogical value of virtual worlds for language learning, it was important that the system and processes envisioned in the scenarios were based on specified teaching and learning outcomes drawn from the Common European Framework of Reference for Languages:

Learning, Teaching, and Assessment[8] (CEFR). It was also important that the system supported real-world classroom practice. This implied the need to elicit both the dynamics of classroom practice; for example, how simulation and role play activities are embedded in the class format, how many students in a typical class, how many students each activity involves, how long the activity lasts for, the teachers role in the activity etc.; and, the pedagogical perspective: the types of teaching and learning objectives the activity is designed to achieve, how the activities are developed, documented and assessed, what standards is it based upon, what type of virtual world activities are useful and help develop the desired language competence.

The resulting SIMiLLE scenarios reflect three different user perspectives. Scenario 1: the teacher perspective, considers the practicalities of creating and managing virtual world activities that meet specified teaching and learning objectives. It includes proposals for documents and processes, such as the Activity Plan and the Role Outline, that support in-world simulation activities for a class of around 16 students. Scenario 2: the classroom learner perspective, considers the experience of the student taking part in the in-world activities designed by the teacher. This includes being briefed about the roles s/he will play within the activity. Finally, scenario 3: the distance learner perspective, considered the experience of learners enrolled on on-line courses from remote locations.

2.2. *Supporting practice*

To support the use of SIMiLLE in everyday classroom practice, it was necessary to provide a framework to help teachers define the learning outcomes for the VW activities they design. The framework produced was based on discussions with teaching staff and details drawn from both the Common European Framework of Reference for Languages: Learning, Teaching, and Assessment (CEFR) and related local syllabus documents.

At the conceptual level SIMiLLE is envisaged as an open and flexible platform containing multiple resources for teachers to develop and refine their own learning scenarios; enhance virtual worlds with supporting objects; and observe student interactions. It is language independent allowing the creation of multiple worlds to reflect various cultural contexts. Students would be able to access the virtual world to carry out tasks, assume roles, make recordings and/or produce written evidence according to teacher instruction. As simulation or role-play activity is embedded within classroom practice, SIMiLLE is seen as working in conjunction with Course Management Systems (CMS) such as Moodle[9], which support document handling and student-teacher communication. Figure 2 provides an illustration of the overall concept:

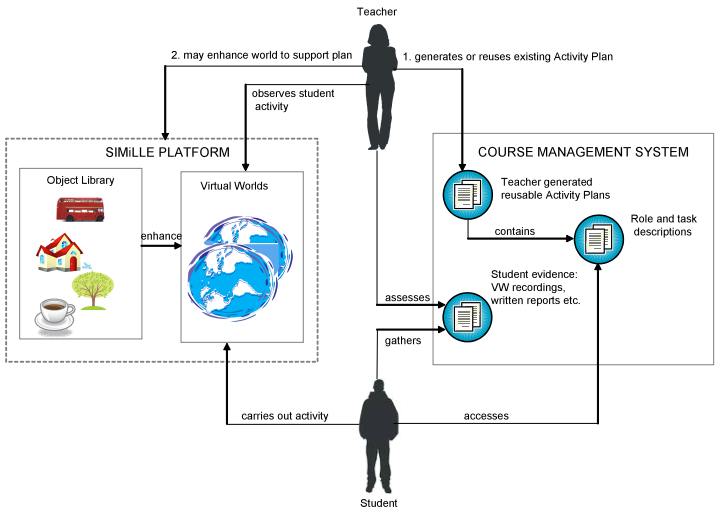

Figure 2. SIMiLLE concept

The process of developing learning activities within the virtual world starts with the teacher generating an

[8] http://www.coe.int/t/dg4/linguistic/CADRE_EN.asp
[9] http://moodle.org/

Activity Plan (similar to a lesson plan) based on their desired teaching and learning outcomes. A new learning activity/scenario may imply the need for new objects in a particular virtual world. For example, if the scenario required students to post a letter and no post box object existed in the specified world, the teacher would be able to access the object library and update the world with a suitable virtual artifact. Activity plans are stored on the CMS making them available for reuse or modification.

The Activity Plan contains task and role descriptions for groups of students (possible for the whole class). As part of the project we have produced templates for these documents to enable teachers to easily plan for new teaching activities using the SIMiLLE platform. When the activity is due to take place, the students access their task and role descriptions on the CMS and then enter the world to carry out the activity. The teacher may be in the world at the same time observing student interactions and making in-world recordings. Similarly the students may be required to record some or all of their activities as evidence or for personal reflection. Alternatively they may be required to produce written reports as evidence. Any such files would be stored on the CMS allowing the teacher to assess their progress.

The SIMiLLE concept has the potential to address three different contexts of use:

1. As part of a classroom activity involving all class members with a teacher present in both the real and virtual worlds
2. Outside the classroom but with the teacher present in–world
3. As an independent activity with no teacher presence

2.3. *Design*

The Virtual World requirements for SIMiLLE are being realised using Sun Microsystems Project Wonderland toolkit version 0.5. The toolkit provides the capability to build a world that has immersive audio and provides the ability to share desktop applications. It is an extensible system enabling users and developers to create their own worlds and add new features to the worlds in the form of modules. The virtual world will support a range of language learning competences and skills (e.g. listening and spoken interactions) as well as being a realistic and meaningful representation of British life within the capabilities of the technical platform. Representations of British life will be provided by offering a variety of contexts in which interactions can take place. These contexts are a coffee shop, supermarket/general store, a train station, a travel advice centre/travel agents, a bank and a post office. Within each of these contexts a number of objects are required to facilitate the learning activities. Teachers and Students will have the ability to adopt a particular persona as required by the learning activity. Example personas so far identified in the project scenarios include: Bank Teller, Post Office Teller, Ticket Sales Clerk, Train Travel Information Advisor and Travel Agent.

In addition, the Moodle Content Management System (CMS) at the University of Essex will be used as a repository for all the support resources required for the project trials. This will include the Activity Plans, Role outlines, teaching support material and online help and support materials for the SIMiLLE users (eg. user guides).

Wherever possible the use of the Wonderland virtual world will be scheduled as part of a planned teaching activity, which will be described and supported on a Moodle course page. Hyper-links will be used to allow users to seamlessly launch the Wonderland virtual world from a link embedded on an activity description on Moodle. All staff and students taking part in the SIMiLLE trials will be provided with account login information to allow them to access the core Moodle course website.

User authentication will also be provided to control access to the Wonderland virtual world. This will require the installation of an LDAP (Lightweight Directory Access Protocol) server to maintain the user account information required to authenticate users when they login to Wonderland (Koutsonikola 2004).

One of the strengths of the Wonderland platform is the ability to drag content (documents) from the PC desktop into a Wonderland world. These documents are then presented as objects within the 3D world. Any Collada compliant object can be imported and viewed within the world. Once the user is happy with the new object, they can then save the state of the world and the new object will be uploaded to the Wonderland server, so that other users can view it, and it will be available for future use. This feature supports one of the scenarios identified in

the requirements, which is the ability for teachers to customise the virtual world with new objects. A useful repository for publicly available Collada content is the Google Sketchup 3D warehouse[10], which contains thousands of freely available content objects. We plan to make this available during the trials to explore the issues associated with teachers modifying the world with new 3D content.

The virtual world will be made up of a collection of 3D objects. These will be uploaded into the world and positioned where required. Also shared applications will be placed in world to support the local context or task requirements (eg a web browser may be used to access dynamic data such as exchange rates). The world is being created using Google SketchUp to build the initial models. These are then exported into the Collada format as either .kmz or .dae files which Wonderland can import. The world itself consists of a village and a representation of part of the University campus. The village contains a railway station, shop, travel agent and restaurant. The campus contains a Post Office, Bank, Shop, Restaurant and Lecture Theatre.

As far as the behavioral requirements of the world are concerned, we are investigating Wonderland's new scripting capabilities, which is available as a plugin module. We hope to use this to enable avatars to initiate dynamic behaviors in-world (eg. carry coffee or collect tickets).

The system should also support multiple separate versions of a world to allow simultaneous use by separate groups of students.

Figure 3 illustrates a screen from the current implementation of SIMiLLE with an avatar standing in front of a building in the virtual University of Essex campus.

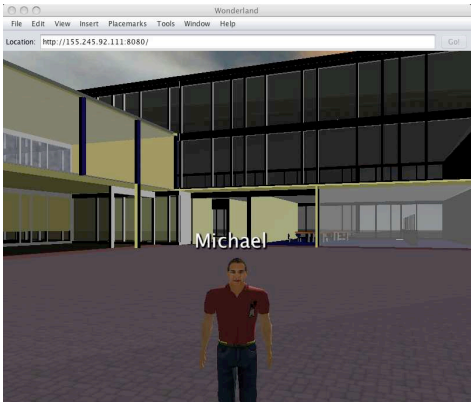

Figure 3. SIMiLLE virtual University of Essex campus

2.4. *Evaluation*

The framework for the evaluation of SIMiLLE is underpinned by theoretical and methodological considerations reported in research on related fields such as general education, e-learning, computer-assisted language learning (CALL), and more specifically, computer-mediated communication (CMC). In this context, a core goal of the SIMiLLE project is to contribute to the body of research aimed at identifying and exploring the specific traits and characteristics of technological applications such as Virtual World environments that might contribute to the learning of second and foreign languages.

The importance of providing instructed second and foreign language (L2) learners with opportunities to engage in interaction and activities that can prepare them for 'real-life' communication has long been recognised by language educators. For the last 30 years, computer applications have increasingly permeated and transformed L2 learning and teaching by providing a new dimension and opportunities for students to interact and communicate with other learners and with native speakers. Furthermore, "there is a substantial body of data that indicates that student perceptions of CALL are on the whole positive" (Felix, 2008: 156). However, the nature and complexity of this field can result in a tendency to shape pedagogical practice driven by technology which might have not been adequately researched. We are therefore, challenged "to integrate technology appropriately into our practice… and this requires reflection, research, and innovation" (Gillespie, 2008: 122).

As outlined in previous sections of this paper, the problem we aim to address in this project relates to the need to

[10] http://sketchup.google.com/3dwarehouse

enrich foreign language learning experiences for overseas students who wish to study in a UK HE institution. Second language acquisition (SLA) research indicates that certain conditions need to be met for L2 learning to be successful (Ellis, 1994, 2005), for example:

- Learners need to be exposed to the target language, i.e., comprehensible, rich, and varied input.
- Learners must have opportunities to produce the target language, e.g., comprehensible output.
- Learners need to be able to negotiate meaning and use the target language in a social, authentic context.
- Intercultural and pragmatic aspects have to be addressed in order to help L2 learners become competent L2 users since language is embedded in specific cultural and communication contexts.

A key issue, therefore, for materials designers, foreign/second language tutors, and SLA researchers alike is to establish the extent to which specific CALL applications can support the above conditions. CALL evaluation, however, has historically lacked 'methodological rigor' (Reeder et al., 2004, p. 258), an essential issue we need to address if we want to be able to provide our learners with robust L2 learning materials. To this goal, the SIMiLLE evaluation will be informed by data gathered by means of both introspective and empirical techniques. Furthermore, the evaluation cycle of the project includes the analysis of processes and outcomes during the formative and summative stages of the virtual environment evaluation, an approach which is not normally adopted in CALL evaluative frameworks despite its importance (see Reeder et al., 2004, p. 260).

The two phases – formative and summative cycles – of the SIMiLLE evaluation process will address two general evaluation criteria:

A) Delivery/interaction issues, i.e. the virtual world environment as such (what participants think about it, their experience, motivation, ease of use, etc.). This type of evaluation will primarily use judgmental evaluation methods (e.g. pre- post-questionnaires and focus groups).
B) Knowledge gains in terms of content knowledge (e.g. socio-cultural knowledge: life on campus, life in Britain, academic life) and, importantly, in terms of second language learning gains, will be assessed by means of micro-genetic analysis of interaction. Data collection methods will include observations, in-world recordings, and audio recordings.

More specifically, and taking into account the evaluation criteria highlighted by Chapelle (2001), we aim to determine the value and potential of SIMiLLE to support L2 learning with respect to: (a) practicality and acceptability issues; in other words, it is necessary to determine the potential of this environment for the implementation of pedagogic tasks designed to enable the type of interaction identified as supportive of second language acquisition; (b) authenticity; this issue involves two fundamental aspects: on the one hand, the interaction between the pedagogic tasks offered by means of the virtual world environment and the type of tasks L2 students need to carry out in non-pedagogical contexts, and on the other hand, the extent to which students are able to see that connection; (c) learner fit; this criterion refers to the appropriateness of the tasks in relation to the students' age, computer experience, needs, and so forth, as well as establishing whether or not the difficulty level of the SIMiLLE tasks is appropriate for the learners to increase their L2 ability; this issue is closely related to (d) L2 learning potential; that is, we need to determine the extent to which SIMiLLE and the pedagogic tasks implemented in this environment provide opportunities for learners to achieve the tasks and L2 learning objectives, e.g. in relation to interaction, collaboration, co-construction of knowledge, focus on form and meaning, etc.; finally, (e) impact, which refers to the overall learning experience undergone by the students and includes the extent to which the environment supports learner autonomy or the ability for students to exercise control over the environment, resources, and language.

As outlined above, the SIMiLLE evaluation cycle will comprise of a mixed methods approach to data collection and analysis in order to gather introspective and empirically based information. Data gathered through a series of sessions will provide the raw information to be analysed throughout the formative and summative stages of the evaluation process. The plan is therefore designed to generate the necessary information to address the five overall issues described: practicality and acceptability, authenticity, learner fit, L2 learning potential, and impact. These five issues will be addressed in relation to the virtual world environment, the pedagogic tasks, and the students' performance while carrying out the tasks.

The information gathered by means of the various questionnaires will be collated and analysed primarily to investigate students' perceptions about the environment and their experience while carrying out the tasks. The questionnaires will also provide information about the relationship between the students' background and computer familiarity and their personal evaluation of the activity while interacting in SIMiLLE.

The students' interaction captured by means of the in-world recordings and the focus groups audio recordings will be transcribed in full, coded, and analysed qualitatively. While data obtained through focus groups will complement the insights obtained from the questionnaires, analysis of in-world activity will provide essential information to ascertain the pedagogic value of the environment and tasks. Importantly, these data will be scrutinized for any evidence of interaction and collaboration which might be conducive to L2 learning as outlined by Ellis (1994, 2005) and other SLA scholars. Finally, data obtained by means of the researcher's observations while students are engaged in in-world activity will complement the necessary information to determine the practical and pedagogic value of SIMiLLE.

3. Summary

This paper has described our current work on the SIMiLLE project in using a virtual reality environment (Project Wonderland) to support teaching and learning for second language learning. This is built on previous work on the MiRTLE project that explored how the same platform could be used to augment existing (generic) teaching practice (ie. lectures). The approach we have taken in designing and building the SIMiLLE immersive education space has been rooted in the clear pedagogical needs of teaching second and foreign language learners. The role of the virtual world in this instance is to provide a rich environment for learners to practice their skills in a variety of realistic settings, and allowing teachers and learners to configure the environment and to record and playback their experiences for further reflection and review. A key issue we have been addressing is in supporting the best practice and processes involved in using this new type of environment. As part of this we have developed template activity plans and role outlines which teachers can use to structure their teaching sessions, and we have integrated this and the virtual world within the Universities content management system (Moodle). We are also planning a range of formative and summative evaluation activities, which will help us to assess the effectiveness of this approach, and to validate the pedagogical approach being used, and inform best practice in this emerging field.

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