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ARCHI21

Architectural and Design based Education and Practice through Content & Language Integrated Learning using Immersive Virtual Environments for 21st Century Skills

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Abstract. This paper offers insights into innovative practice being undertaken in higher architectural and design education, where both language and content teaching and learning are integrated as interwoven parts with joint curricular roles. Using Expansive Learning Theory as an analytical framework to examine potential tensions and contradictions arising from the educational approach of Content and Language Integrated Learning, reference is made to three very recent pilot studies of the EU funded project, ARCHI21. The experiential learning in these studies adopted a blended approach, where classical face-to-face learning-teaching scenarios were supported by immersive 3D virtual environments together with social networking media and Web 2.0 tools. This paper uses these pilot studies to speculate on aspects of fragility and offers reflection on future project activity.

Keywords. Architecture; education; Content and Language Integrated Learning; 3D immersive environments; Second Life.

PROJECT OVERVIEW

This paper presents the outline and the initial results of the first action phase within the ARCHI21 project (Architectural and Design based Education and Practice through Content & Language Integrated Learning using Immersive Virtual Environments for 21st Century Skills), a two-year project funded by the European Commission as a part of the Education and Culture DG Lifelong Learning Programme. Its first action phase offers an insight into a thematic focus on fragility in physical and virtual worlds, linking research and education within the theme of the eCAADe 2011 conference.

Virtual worlds, a new design field for innovative architectural and design practices, can facilitate language learning and teaching which is relevant to the real-world needs of the future architect and bridge the gap between language and content learning. The combination of immersive 3D virtual environments with social networking media and Web 2.0 are tools of architectural experimentation today for some but are unknown to many architectural and language practitioners, educators and students.

ARCHI21 promotes awareness of the potential of immersive virtual environments in architectural and design education using a Content and Language Integrated Learning (CLIL) approach and intends to reach Higher Education (HE) students and educators, adult learners, language professionals, practising architects and the wider community.

The overall project aims are to: apply semi-experimental research to action learning to gather formative and summative data in the areas of a) CLIL in higher and vocational education sectors; b) the inter-relationship between linguistic competence and design competence building in project-based learning; and c) the intercultural issues to be considered. It creates and pilots: i) 3D in-world induction courses for language mediators and learners, educators and practitioners of architecture and design; ii) a CLIL model for HE and specifically in architecture and design education; iii) a collection of reusable Learning Objects; and iv) best practice guidelines based on architectural and design case studies.

Why CLIL?

Content teaching and learning in HE institutions in Europe is often separated from language teaching and learning or delivered entirely in English. When the medium of learning changes to what is a second or foreign language for both teaching staff and students, as is seen in the increasing adoption of English for part or whole programmes, this history of separation emerges as a problem. The educational approach of CLIL within the European context is a dual-focused 'innovative fusion' (Coyle, Hood & Marsh, 2010, p.1), where both language and content teaching and learning are integral interwoven parts with joint curricular roles. It focuses mainly on meaning-making through integrated approaches developing language of learning, for learning and through learning, without emphasising language over content or content over language.

The overarching aim of the ARCHI21 project is therefore to explore alternative approaches to existing practice to enrich and enhance the language learning experience in architectural and design

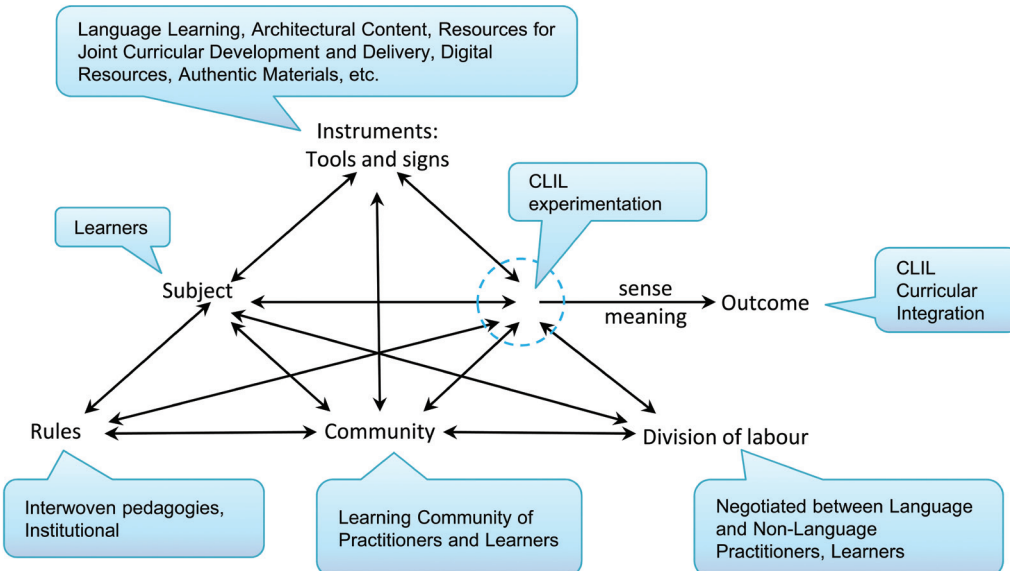


Figure 1
Activity system for CLIL
Implementation (Hunter,
2010).

education, promoting cultural diversity and lifelong learning. Integrating content, language and 2D/3D technologies, scenario based learning provides the theoretical underpinning and conceptual framework to suggest possible CLIL implementation in HE.

The educational approach of CLIL can be termed 'fragile' in itself within the project's specific thematic focus on fragility. Sound foundations for successful CLIL implementation in the ARCHI21 project rest upon cross-disciplinary respect, trust, collaboration, co-design and the construction of a learning community (Hunter, 2010). Members of the learning community include students and educators of architecture and design, language educators, practising architects and the wider community. Engeström's Expansive Learning Theory (2008) offers an analytical framework to map the CLIL experimentation terrain within ARCHI21's multiple interacting activity systems, where each activity consists of interrelated elements (subject, object, mediating artifacts, community, rules and division of labour) in three central theoretical constructs: activity system, contradiction and zone of proximal development.

Figure 1 illustrates the long-term intended collective activity system in ARCHI21 for CLIL implementation to be explored in the reiterative process guiding CLIL inquiry from recent, ongoing and future experiential pilot studies, each with their own multiple interacting activity systems. The learning community is itself an object of an activity and a major collaborative feature of the ARCHI21 project's approach. The analysis of potential emerging tensions and contradictions will advance knowledge creation concerning the feasibility, validity and potential learning gains of joint curricular roles for language and content.

Virtual space: a fragile place for building and learning?

Places in a virtual world have aspects of fragility that are both similar and dissimilar to those in the physical world. According to Kalay and Marx (2006), cyberspace is more than a means of communication; it is also a destination to shop, be educated

and entertained and must be designed according to place-making principles practised for centuries by architects, landscape architects, town planners, and interior designers (in physical space) and adapted to the cyberspace. They proposed eight criteria for cyber-place-making: (i) events; (ii) presence; (iii) relative locations; (iv) authenticity; (v) adaptability; (vi) variety of experiences; (vii) transitions; and (viii) memorable. Amongst other criteria that can be considered are context, gestures, improvisation and graphic representation.

The existence and state of a physical space may be subject to economic, political, social and natural (i.e. physical) factors, amongst others. Virtual spaces may also be determined by the first three, but in a virtual world physical factors are non-existent but may have analogous counterparts. The existence of a virtual space is dependent upon the physical world as well, i.e. computing hardware and software, often consisting of client and server computers and a network infrastructure through which they communicate. The state of any of these physical components determines the possibilities available in the virtual world (e.g. computing power, storage space), and indeed, whether one can even access (i.e. exist in) the virtual space.

The ease and speed with which one can build and destroy virtual spaces is a fundamental difference to the physical world, an issue explored in the design workshops throughout this project. How do we preserve meaningful virtual spaces with limited resources? ARCHI21's virtual islands will be built and rebuilt several times over during the course of the project. Negotiation, selection and archiving are key aspects of this collaborative process within the virtual world (Chase et al., 2008).

PILOT STUDIES

This paper reflects work in progress, as not all pilot activity presented here has been concluded and formal evaluation has yet to be conducted. At this early stage, the results offer tentative answers in the overall objective to consolidate a CLIL model for architecture and design in HE. During the project's

first action phase, various experimental pilot studies were carried out in local institutions. This section of the paper reports on two pilot studies carried out at the École Nationale Supérieure d'Architecture Paris-Malaquais (ENSAPM) in France using Second Life (SL) [1] as the learning environment and one pilot study undertaken in the University of Ljubljana, Slovenia.

Pilot Study 1

The first ENSAPM pilot study integrated language into the content and context of a face-to-face studio design workshop, jointly lead by an architecture educator (native English speaker, bilingual in French) and a visiting architect (native French speaker). Seventeen students, including native and non-native French speakers from academic years ranging from the first to the fifth, participated in the five day elective workshop, totaling 28 hours. Language based groups were formed according to the working language to be used (English or French). Daily interactive crit sessions on both product and process occurred in the appropriate working language groups (content educator to student, student to content educator, student to student). Critical and collaborative instances were captured using video and voice recording. Negotiated and structured pre-planning integrated the presence of language researchers external to ENSAPM into the workflow of the creative studio process (one physical presence and all others at a distance). Punctual daily language interaction between language researchers and students was integrated into the programme at specific times using an asynchronous audio recording platform, and in a synchronous manner using in-world verbal interaction to collect data from the learning experience.

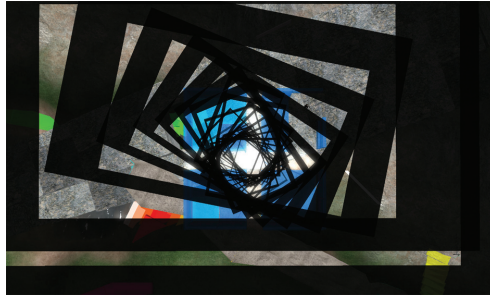
The workshop content focused on the design and fabrication of the immersive, networked environments for the ARCHI21 project consortium which was considered the 'client', whose spatial, communication and social demands were construed as the workshop programme. A two step studio process was employed, based on a) an analytical understanding of ARCHI21 project parameters

through exploration and information gathering; and b) creative decision making through the interpretation, representation and elaboration of design proposals. Taking the role of fragility as its creative cornerstone, four content workgroups were organised: Programme, Identity, Landscapes and Space to develop working models for the consortium's three dimensional immersive environments, its technical infrastructure and graphic expression.

The Programme workgroup developed a synthetic model for the generation of architectural usages in immersive environments based on temporality and filters. The modeled timeline manages all in-world event data (transactions concerning objects, environments, conversations, social connections and networks of people). Past and future events (represented by generational algorithms) are linearly organised; the existence of a specific event can be triggered by filters that are activated by search or other forms of avatar interaction (e.g. movement, building). The Identity workgroup explored the three composing elements of an avatar: an agent, the client's presence within a simulator; an avatar, the visual representation of an agent; and a camera, through which an agent sees the world. The Landscapes workgroup's analysis demonstrated that, while SL's 3D modeling capabilities were adequate for constructing its static buildings, fabricating its organic, vegetative and tectonic features called for a more innovative solution than the SL building toolset had to offer. It was concluded that an essential conflict will persist between the SL built-in global spatial referencing system (the Grid) and contemporary architectural creation due to this contradiction. The Space workgroup built programmed interactive in-world structures capable of both a) orienting avatars in the space, and b) modifying the spaces themselves. As an avatar moved through space, partitions moved to create opening (or closure) indicating possible paths within a space, or an interactive signage, that helped avatars to navigate. In parallel, as a space was modified to indicate its possible uses, the size, proportion, texture and colour of the space

changed. Orientation was achieved through the use of dynamic, self-organising spaces to fabricate the built environment, its spatial texture and its social potential (Fig. 2).

Figure 2
Dynamic structure developed
by the Space workgroup in
pilot study 1



From a CLIL perspective, initial findings based on observation and feedback from both learners and content educators confirm a disruption in the workflow. Initial student appreciation of the integrated language dimension by external language researchers diminished as the need to ‘produce’ architectural content intensified. What began as a ‘relaxed’ and enjoyable approach, as perceived by students, later became a disturbance to their workflow and reflective process. Whilst the perceived presence of ‘language teaching in parallel’ by language researchers’ activities integrated into this pilot may be questioned, the fundamental issue made visible is the recognised pressure to obtain and produce content in the given studio design workshop settings. Despite the fact that students presented their final work in the ‘other’ language, the emphasis from the third day of the workshop was clearly on content over language. This was also reflected in oral exchanges between architecture educator and students.

A CLIL success of this pilot was demonstrated in the preparation and final delivery made by three volunteer students to present their work in an in-world annual conference, Virtual Worlds Best Practices in Education [2,3]. Students were given language support and presentation skill support by a language educator internal to ENSAPM, together

with feedback from a non-language educator, in order for them to present their own work from the studio design workshop in their second language, in this case English.

Pilot Study 2

The second pilot integrated specifically focused 3D immersive virtual architectural and design content into the face-to-face Language and Communication Skills class of 17 second year students, led by their language educator (native English speaker, bilingual in French) and an external geographically distant architect (native English speaker) in five in-world sessions, each lasting 90 minutes. The objective was to raise student awareness to the affordances of a 3D immersive environment such as SL as both an experimental and real world design space, using English as the working language. Content focused on site visits of authentic physical, virtual and hybrid projects incorporating authentic documentation such as plans, blueprints, images which students analysed and critiqued in four crit sessions. Adopting a CLIL approach, all course content and delivery was negotiated, co-designed and co-taught by the local language educator and the external architect based in the USA. Interactive site visits were co-designed integrating language learning strategies with task objectives. All sessions in SL with students, language educator and architect were in real-time; therefore timing and technical accessibility were important elements to be considered in the planning.

Pre-pilot study content included text analysis, oral discussion and textual reflective output by students on the concepts of virtuality and virtual space. The first session was a general introduction to SL as a potential design space concentrating on camera skills for future in-world assignments. Resources were introduced covering fundamental design elements, concepts, processes and strategies with examples and culminated in a synchronous real-time building of the student-to-architect negotiated ‘home base’ (meeting point, resource area) for the in-world learning space and group. Although this

was not a building course to generate user-created content, all students were given full building permissions to modify and add to the learning space 'home base' together with a virtual 'studio' where they could conduct building experiments.

The four crit sessions explored 1) a project first prototyped in SL before construction in the physical world; 2) a virtual model replica commissioned to visualise the physical world design concept of a future construction; 3) a site of space creation and form as pure artistic expression, design and conception; and 4) the commissioned virtual counterpart of a physical world building or 'hybrid architecture'. Four set assignments required students to document each crit session with an image and reflective writing for whole group comments using OpenDesignStudio, an asynchronous online design studio environment where students, language educator and architect can post, view and discuss each other's work [4]. Final evaluation includes a survey and reflective essay on the learning experience.

At the time of writing, this pilot is ongoing. However, initial student feedback confirms the success of the pilot in raising awareness to the potential of this 3D environment as a design space for potential future use based on the authentic resources, site visits and real-time presence of the professional architect. Students enjoyed the experience despite the technical problems which arose (e.g. lag, internet connections, griefers disrupting a class session). Integrated language learning was perceived as fluid in the work process, supported by language educator text input, online dictionary use, peer-to-peer and peer-to-language educator clarification using IM or verbal communication. Despite initial resistance to using the OpenDesignStudio platform, students found it very beneficial to complete the four assignments, forcing them to focus and reflect upon the visual representation chosen, the textual language necessary to interpret their perceptions and the sharing of peer assignments. It is important to note that due to the late completion of these asynchronous assignments, not all students

benefitted from the online exchange offered by this platform. One student who did write 'I was thrilled to read a comment from our architect on my work'. Interactive site-based quizzes were found to be highly enjoyable, together with prim manipulations. Student feedback suggests that more should be integrated into the pilot design, together with specific building sessions. Many stated that with specific building skills, they would like to continue using SL but felt 'lost' without the educator presence in this environment. All appreciated however having their own 'homebase'. It is also to be noted the general desire for this type of pilot study to be incorporated into project work. Timing was a tension for a variety of reasons. Ongoing project work was prioritised by some over 'attending language class', despite their expressed interest in the pilot. It would therefore appear, on initial analysis, that this approach can be successful in the students' perceptions if totally integrated into the timing and workload of a studio project.

Pilot Study 3

The Faculty of Architecture of the University of Ljubljana undertook an intensive introduction of CLIL activities in the framework of the content-focused elective course 'Space and Media'. The course represents an integral part of the winter semester activities within the Masters study programme in architecture. The CLIL activities preparation period started during the intermediate stages of the course and they were implemented during the presentation phase of the course.

The main topics of the course are: cognitive processes in architectural, urban and landscape space as multimedia space; arts and sciences of cognitive spatial processes; conceptual and experiential space; ideal and real space; information and space; media of learning and interpreting space; and factors of influence of the creative process of spatial design. The normal student population consists of an Erasmus student majority. The 'language landscape' involves non-native English speaking learners and

teachers, native and non-native Slovene speaking learners and teachers where the majority are non-native Slovene speakers. The usual CLIL integration of English for non-native speakers (L2) corresponds to the 'partial CLIL' category (content-focus in L2) as outlined in the LanQua Toolkit [5]. There is also a pre-session optional basic level L2 Slovene 'partial CLIL' (language focus-LAP focus in L2) course available. It is to be noted that English and Slovene are usually not integrated in normal 'Space and Media' course practice, because the actual need to learn Slovene is less than the motivation students have to improve their English fluency.

Within the framework of the eCAADe conference theme, students were asked to: a) interpret the word 'fragility', based on their previous knowledge and experiences; b) define 'fragility in architecture' / 'architectural fragility'; and c) design a concrete proposal related to the eCAADe 2011 conference needs in which they would use their interpretations from the first two steps to communicate the idea of 'fragility' to the conference participants. The design proposals offered virtual simulations of the places at the faculty building which would provide arrangements for the conference. There were ten Erasmus students engaged in this course implementation, together with three architecture educators, one Slovene language educator and one English language educator. The learning environment combined usual face-to-face interactions with 2D language-related courseware (Slovene/English terms about fragility and terms related to presentation of basic architectural ideas) and 3D modeling software. Both L2 English and L2 Slovene were introduced at the 'adjunct CLIL' level. Language educators were involved before the study presentation phase. The content educators' languages were Slovene (native speaker, L1) and English (L2). The learners were encouraged to use both English and Slovene during the course presentation phases.

The group experience shows that L2 English was the primary vehicle of communication

throughout the course. The usage of L2 Slovene differed in relation to the L2 English fluency level. In the cases of low and intermediate L2 English levels, L2 Slovene became a communication 'breaker' or barrier. However, where higher levels of L2 English fluency were achieved, L2 Slovene became a communication stimulator, especially in combination with L1 Catalan, Basque, and Portuguese. The sounds of the term 'fragility' in different languages became stimulators of creativity through its architectural interpretations. In the cases of Czech and Macedonian, the role of L2 Slovene was intermediate: Slovene and Czech sound familiar and the language similarities encouraged students to use Slovene at a level of complexity not understandable to the others. In the case of L1 Macedonian, the problem was identified as the student's low confidence in the ideas to be defended.

There are some clear lessons identified in the Ljubljana pilot study:

- In face-to-face interaction, visual language is the most important integrator of all the 'languages' employed. It enables 'going beyond' the difficulties arising from the diversity of the literacy levels in relation to the English and Slovene languages.
- During the introduction of Slovene as a non-native language (L2), a very high level of pressure on both staff and students was felt during the implementation phase, even though the actions were planned in advance, and in particular for low level English (L2) learners.
- Learning Slovene is more an opportunity than an actual need for students, as long as it is fun. The 'fun element' stops when the real need to express oneself appears, in order to communicate architectural ideas. The aim to improve the most basic literacy in Slovene is questionable when it disrupts the content related communication, which requires higher levels of communication skills. The question of adapting this approach to a 3D immersive environment remains open.

Fragility as a consequence of environment and activity

The nature of virtual environments (as mentioned earlier) and specific workshop activities also contributed to the apparent fragile nature of the pilot study results. This became evident in those studies that used SL and other communications tools in their working environment.

In SL, the number of 'prims' (geometric primitive elements used for building) is restricted by the amount of virtual 'land' one has. Thus, one has to learn ways to build that are often quite different to those one has used with more traditional 3D modeling software. There is an art to building with a restricted number of prims; to develop this can require more than a five day workshop. The result (when one exceeds the prim limit) is a seemingly arbitrary loss of part of one's creation (experienced by students and teachers in pilot studies 1 & 2). This exemplifies the fragile nature of the environment: while there are ways to avoid such loss, what is required is a stable software environment, extremely careful management of the environment by system managers and teachers, careful building, and cooperation amongst the builders, a sometimes difficult set of requirements to juggle.

Virtual worlds are complex environments requiring intensive graphics and networking capability to operate effectively amongst diverse groups (with respect to physical location, language facility, culture and work discipline, amongst other factors). This also contributes to fragility of communication. A well planned activity will include both synchronous and asynchronous communication. In such an environment, a variety of communication methods are encouraged, partly due to the experience and preferences of the users, but also in large part due to its fragile nature (always have a 'Plan B' if something doesn't work). Thus, during the workshops, synchronous communication included a variety of tools such as SL voice, SL text chat, Skype, face-to-face communication (where participants were in the

same physical space) and even included the 'old fashioned' telephone (mobile or landline). Asynchronous communication is always essential and includes well tested platforms such as email, virtual learning environments and social networking sites (including Flickr for posting images from the workshop). In any intensive workshop, the limited time can force the participants down a particular path in order to reach the goal of producing something by the end of the workshop. This can also result in a reduced amount of experimentation (participants use what they know and are comfortable with), including the use of a variety of communication tools.

In both real and virtual environments, ownership contributes to their fragile nature. In the real world, disputes over ownership may lead to destruction of the environment. Transfer of ownership often leads to modification of the environment by the new owner. In a virtual environment, the former may not be an issue, but the latter will always apply. Additionally, the management rights (permissions) on virtual objects and land can be extremely complex, even for a so-called expert. Who has the rights to copy, modify, give away or sell a virtual object? How can one manage this for groups who collaborate? One incorrect permission setting can have a cascading effect, leading to the inability for a group (or even an owner) to access, build, manipulate, share or take possession of an object or parcel of virtual land, thus having a negative impact upon what may be intended as a collaborative effort. The opposite also applies, i.e. providing too much access to something that was intended to be restricted.

Given the large number of activities proposed in this project, and the need to reuse virtual spaces, how can one preserve these spaces given limited resources? What are the best ways to capture and archive our results for reuse? Some of these issues are currently being addressed in a pilot study led by Aalborg University on building in SL for teachers of architecture and design ('teach the teachers').

CONCLUDING REMARKS

This paper has presented some initial insights on integrating language and content learning and teaching in higher architectural and design education in three pilot studies of experiential learning. The pilot activity presented here is still to be concluded and formal evaluation has yet to be conducted. However, observed tensions and contradictions confirm the necessity for intensive collaborative design across the disciplines in a context-driven approach. This is further highlighted by the complex and fragile nature of the virtual environments used and the demands placed upon the students. From the student perspective, the emerging fragility of the dual-focused CLIL approach indicates that language learning should remain enjoyable and not perceived as a burden or disturbance to the normal content and work flow. Expansive Learning Theory provides an analytical framework for the evolutionary nature of the ARCHI21 project, ensuring that results of these pilot studies will inform other project activities. Through formative interventions and the development of collective activity systems within the ARCHI21 project, further results are expected from exploratory research that underpins the reiterative process to guide CLIL inquiry.

REFERENCES

- Chase, S, Schultz, R and Brouchoud, J 2008, 'Gather 'round the Wiki-Tree: Virtual Worlds as an Open Platform for Architectural Collaboration', in M Muylle (ed), *ARCHITECTURE 'in computro': Integrating methods and techniques, Proceedings of the 26th Conference on Education in Computer Aided Architectural Design in Europe*, eCAADe, Antwerp, pp. 809-815.
- Coyle, D, Hood, P and Marsh, D 2010, *CLIL: Content and Language Integrated Learning*, Cambridge University Press, Cambridge, UK.
- Engeström, Y 2008, *From Teams to Knots: Activity-Theoretical Studies of Collaboration and Learning at Work* Cambridge University Press, New York.
- Hunter, M 2010, 'Content and Language Integrated Learning: Shifting Boundaries and Terrain Mapping', unpublished manuscript, Lancaster University, UK.
- Kalay, YE and Marx, J 2006, 'Architecture and the Internet: Designing places in cyberspace', *First Monday*, Special Issue #5, <http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/1563/1478>.
- [1] <http://www.secondlife.com/>; 'Second Life' and 'SL' are trademarks of Linden Research, Inc.
- [2] <http://www.vwbpe.org>.
- [3] <http://www.youtube.com/watch?v=YQFEGqXguNc>.
- [4] <http://jiscdesignstudio.pbworks.com/w/page/26080651/Atelier%20D%20-%20OpenDesign%20Studio%20-%20Demonstration>.
- [5] <http://www.lanqua.eu/theme/content-language-integrated-learning-clil>.