We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900
Open access books available

185,000
International authors and editors

200M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



10

E-Learning in Architecture: Professional and Lifelong Learning Prospects

Matevz Juvancic[1], Michael Mullins[2] and Tadeja Zupancic[1]
[1]*University of Ljubljana*
[2]*Aalborg University*
[1]*Slovenia*
[2]*Denmark*

1. Introduction

E-learning in architectural and spatially related fields can be examined from two different perspectives, each having quite specific and complex implications. By discussing e-learning *in* architecture we inspect the scope of e-learning tools and practices within the architectural domain, the visual nature of education and professional training of architects, and the state of the art of e-learning implementations, together with their practicality and limitations. While these are the first areas that come to mind when considering e-learning in relation to architecture, there is another also very relevant and sometimes overlooked aspect: that of e-learning *about* architecture. In the latter, we introduce not only the professional but also the broader, non-expert public into the process of acting within, and shaping of, their spatial environments. This aspect raises burning questions regarding the communication abilities of the actors involved, holding their attention, ingraining sustainable principles and getting the messages across the invisible, but perennial expert / non-expert divide. E-learning *in* and *about* architecture not only offers opportunities for both sides to learn but also to get to know each other better.

The chapter first introduces and highlights the common aspects of e-learning within the architectural domain, followed by e-learning for experts, through what we have named e-learning *in* architecture, describing specifics and presenting an example of one of the e-learning initiatives. It is followed by a subchapter describing aspects of e-learning *about* architecture and sustainable principles of space interventions for broader audience of non-experts involved in the lifelong learning processes (LLP). Similarly, the subchapter concludes with an example of an e-learning tool in action and the reflections on the research presented. The chapter concludes with discussions of 'lessons learned' and ranking of new opportunities in professional and lifelong e-learning prospects in architecture and its related fields.

2. Aspects of e-learning within the architectural domain

Architectural education is centrally concerned with individual design creativity among its students and encompasses an important aspect of visual acuity or training in interpretation of visual representation. These are aspects of human articulation, neither easily taught in the lecture theatre nor transmitted in the computer laboratory.

Education in architecture, be it for experts or non-experts, is also a communication process with an exchange of mainly visual messages. As such it follows (in general) the established Laswell's mass communication model (Severin & Thankard, 1992): *Who? Says what? In which channel? To whom? With what effect?* It is especially useful for articulation of many important aspects of architectural e-learning at the start of our journey and is here used because of its convenient, almost self-explanatory simplicity. 'Who' is usually an expert, a teacher but, as we will see later, can also represent a fellow learner or the learner himself exchanging (feedback) information in the learning process. 'Says what' is the message and in architectural learning it is most probably of a visual nature and of specific content, which has again its implications. 'In which channel', we interpret here as the way the learning is organized (curriculum, learning setting, environment, media used, teaching methods, teaching tools, etc). 'To whom', depends on the targeted learners as discussed in the introduction above, in the distinction between learning *in* and learning *about* architecture. 'With what effect', denotes the learning outcomes and includes the assessment methods. It is now easier to envision the components of the process and our aims to describe them in architectural learning context.

Learning about how to do architecture and how to 'think' architecture requires a great deal of cognitive processing, the manipulation of mental images, understanding of complex cause and effect relationships, functional, technical, performance, aesthetic, cultural and physical aspects. Visuospatial thinking theories are especially suited for the purpose of learning *in* and *about* architecture which both rely heavily on the notion that thinking consists of mental images and principled manipulation of mental images (Mayer, 2005) on the premise that: "a) appropriate visuospatial thinking during learning can enhance the learner's understanding, and b) multimedia presentation can be designed to prime appropriate visuospatial thinking during learning" (Mayer, 2005).

2.1 Blended learning and constructivist approach: a viable solution for learning *in* and *about* architecture

Instead of strictly using *e-* for electronic learning, implying that (ICT) e-learning platform is in the heart of learners' experience, the learning *in* and *about* architecture is more aligned with blended learning practices. Blended learning spans over face-to-face (f2f) and e-learning connecting them, combining learning on site with distant learning under the joint name of distributed learning (Mason & Rennie, 2006). The exchange of messages provides the necessary learning environment and scaffolding to higher-order thinking (Slavik, 1994 as cited in Mason & Rennie, 2006). Blended learning with f2f component can produce a stronger sense of community among participants than fully online course (Rovai & Jordan, 2004 as cited in Mason & Rennie, 2006), socio-cultural context for learning environment and helps maintain the link with traditional design studio practices in the field of architecture.

Architectural learning requires a practical component of 'learning by doing', traditionally in a studio environment, through which students acquire experience and knowledge of professional practice in a social context of peers, thus aligning them with the constructivist learning models. This aspect of learning in realistic settings reflects the view of learning as an active construction of knowledge by the learner who makes his or her own sense of authentic tasks set by the instructor. The learner will in theory engage a variety of cognitive processes including processing relevant information, organising that information into coherent representations and integrating these representations with existing knowledge in order to create solutions to the challenges presented. The term 'constructivist' thus refers to the idea that learners construct knowledge for themselves individually and socially in the

process of learning: "If the view is adopted that 'knowledge' is the conceptual means to make sense of experience rather than the 'representation' of something that is supposed to lie beyond it, this shift of perspective brings with it an important corollary: the concepts and relations in terms of which we perceive and conceive the experiential world are necessarily generated by ourselves. In this sense we are responsible for the world we are experiencing" (von Glaserfield, 1991). The instructors primary task is thus to create environments in which the learner can interact meaningfully with a set of 'real-life' challenges.

Constructivist models, often used in e-applications and learning – situated learning, PBL and simulation – are very much attuned to traditional design studio learning with the benefits (and disadvantages) of ICT environments and capabilities. While these principles have been embraced in architectural schools, particularly in 'problem-based learning' methods, architectural education has also in the past decades sought to experiment with and apply the tools of information and computer technology. These ICT tools represent a relatively new context in which the architectural creative process is increasingly carried out in project groups rather than by independent designers, affording cross-disciplinary, global teamwork, and which leads in consequence to situations where negotiation is required in exploring alternatives to solve problems, often probing the boundaries between disciplines (Fruchter, 2006). ICT has the effect of bringing together for limited periods of time, previously disparate communities of practice for the purpose of solving particular problems. The focus is shifted from individual learning about practice, to extracting the full potential of learning through practice in a community. As Etienne Wenger has observed, when the core of central expertise held by individual communities of practice meets other communities with their cores of expertise, radically new insights can arise at the boundary between the communities (Wenger, 1998). It is often this meeting of apparently very different ways of viewing the world whereby the creativity of new ideas and solutions is encouraged.

In as much as the perspective of learning shifts from the individual to a larger system of the individual's participation in a community of practice, it is more relevant to consider e-learning as a situative context of interaction in which individuals participate and coordinate their activities to achieve meaningful objectives (Greeno, 1998). This strategy implies a focus on the informational contents of the activities undertaken, and a study of how such a dynamic system functions. The task of the instructor can on this basis be formulated to be that of facilitating the active membership of a community of practice that engages for a limited time in joint activities with others to create solutions for authentic problems through adaptation, commitment and social relationships. Specifically, the successful development of community of practice requires the provision of guidance and resources that encourage the negotiation by the participants of a joint project through mutual engagement in a well-functioning social entity. Thereby, participants are afforded the opportunity to mutually construct meaning through presentations, manipulation of design objects, discussions and interactions which allow them to reach mutual understanding through the interpretations of visual and written materials.

E-learning programs which complement or replace traditional architectural education should seek to blend self-study, face-to-face meetings, to stimulate social context and facilitate cooperative work of 'real-life' professional experience. This approach goes beyond merely acquiring knowledge of the technology involved: effectiveness of e-learning is not merely a function of new technology, but rather is achieved through the "adaptation of the learning environment to a changing context which presents new opportunities for an investigation and formation of 'place', as that difficult concept is understood in schools of architecture" (Strojan & Mullins, 2002).

Learning *about* architecture (for non-experts) can follow the same blended and constructivist approaches although the levels need to be adapted in terms of existing non-expert knowledge pool, skills and their understanding of visual language.

2.2 Visuospatial thinking, multimedia and visual language skills

What is specific to architectural learning is its reliance on the exchange of mainly visual messages in the process. This requires learners to understand and interpret them in a meaningful, accepted and consistent way. It also requires the participants to respond in kind, with the visual messages composed on their own that also convey an intended message in a meaningful and consistent way. Research has demonstrated the apparent differences how architects as experts and laypersons as non-experts perceive and understand visual representations (Bates-Brkljac, 2007). Introducing architectural or spatial issues, and with that sometimes very specific visual messages, opens new questions of 'reading' and 'writing' of visual messages by different participants involved in the learning process. In general we discern between three groups of participants in terms of visual reading-writing abilities in the architectural planning process [and consequentially learning in- and about- architecture]: 1) the group of experts that is able to read and write visual messages, but less able to express themselves by writing (architects, urban planners, designers, civil engineers, etc), 2) the group who express themselves primarily in writing but are also able to understand ('read') expert visualizations, but much less able to compose them and 3) the largest group of non-experts which is very limited in reading and writing abilities when it comes to visual messages, exchanged in architectural domain (Juvancic et al., 2011).

The e-learning *in* and *about* architecture profits from the graphic capabilities of ICT in the communication process already mentioned, which mainly uses visual messages to represent space and relations in space in two dimensions, while often through means of perspective or isometric, emulates also the third dimension. Readers being aware of immersive environments capabilities and features (i.e. in games and pervasive digital worlds), we will not go into the matter further here.

E-learning, which through ICT supports and includes multimedia possibilities, can offer an especially suitable learning environment for learning *in* and *about* architecture, but it needs to be further extended with specialized learning tools if it wants to satisfy the specifics of expert and non-expert architectural learning (as we will see later in the two showcases). The design principles for fostering visuospatial thinking in multimedia learning as suggested by Mayer (2005): multimedia, contiguity, coherence, modality, redundancy, personalization, interactivity and signalling principles hold true for learning *in* and *about* architecture as well. Some of them were proven through the experimental use of prototypical architectural educational interfaces (see subchapter 4.8) others were and are used assuming their importance as proven for other fields. Although Mayer does not specifically refer to manipulation of objects and presentations within his span of multimedia learning it needs to be emphasized that the principle cannot be overlooked, especially in the light of the situative perspective of dynamic learning (Greeno, 1998) and constructivist learning.

2.3 E-learning platforms, educational interfaces and the acquisition of new knowledge

E-learning extends beyond multimedia learning – it integrates a curriculum, course design, contents (presented in different forms through presentations), learning outcomes, assessment, specialized tools and not least, usually relies on e-learning platform that serves as a medium, a meeting point, a link and a repository for the learning resources and a community forum for

the learners. The e-learning platforms, nowadays most often called Learning Management Systems (LMS), come in many varieties, sharing common aspects and elements that are suitable for a cross-section of common e-learning activities and tools for running and managing (blended) courses (i.e. Moodle is a good example applied to many levels of teaching and used for different topics and in different settings). The common and general e-learning platforms provide modular structure to facilitate specific needs and specialization. Knewton (Fischman, 2011) is an example that can take on different contents provided it follows more or less the same structure and can be framed within the multimedia options available in the system but still adapt the pace of learning to an individual learner.

Multipurpose e-learning platforms might satisfy the management needs of architectural expert and non-expert courses (and activities) but when it comes to learning they need further extensions with special modules and functionalities to provide for suitable interactive and engaging environment. For expert learning, the multidimensional environments and integration of tools used in architectural practices are of the essence, with further extensions of scripting and parametric design highly recommended (i.e. 3D Lab in VIPA case, described later). For non-expert learning, the much needed user friendly upgrades are educational interfaces that can show complex spatial phenomena through different presentation means and engage the learner in constructivist learning activities. Much more about the functionalities, extensions and aims of e-learning platforms in architecture is highlighted through two different examples later in the chapter (see subchapters 3.1 and 4.8).

Not only can the distinction between expert and non-expert learners be drawn on the basis of different levels of 'reading-writing, visual-message' skills and on the expectations regarding the understanding of complex spatial phenomena, but also on the basis of formal knowledge expected from them. While future experts possess certain formal knowledge in the field and need to acquire and complement it through the learning process, non-experts can rely only on their informal and tacit knowledge when dealing with architectural and environmental tasks.

While the future expert learner will, with the help of e-learning, cross the gulf of expertise (Quintana et al., 2002), gaining knowledge and skills to do his job successfully, the non-expert will have to cross the gulf of knowledge in the field of architecture and gain insight into the field he is not familiar with and will not spent his life professionally practicing within its domain. However at the same time, his understanding of the field will play a crucial role in his decision making process and space interventions he will encounter during his lifespan of builder, active and passive actor in spatial environment and its 'inhabitant'. Given the sheer number of non-experts physically ('architecturally') intervening daily in their environments and deciding about it (through democratic processes), the non-experts are the major influencing factor in the environmental equation. This is where common aspects end and the e-learning prospects divide to two separate, equally important directions - for experts and non-experts - each with its own goals and agendas.

3. E-learning in professional architectural training and education

Teaching architecture is not primarily an instructional process but rather a process of interaction and experience. An evaluation of the effectiveness of e-learning cannot only focus on the technology itself but should also examine the potential of technology as a tool for learning and design. Software for 3D modelling, rendering and animation and so on, should be combined with multi-user, interactive environments which support a social learning context. It is not that the 'virtual space' in which learning and teaching occurs

should only represent the vibrancy of an architectural studio when it is best, but that its application offers new potential for architectural curricula. Architecture can be described as a combination of practical, functional and technical solutions to a spatial problem, which gives or explores an aesthetic reflection of the society in which it occurs. It relies on an interdisciplinary teamwork of different professions, each with different visual language abilities and expertise, towards achieving a common goal – a building, an urban design, or settlement – in a non-linear way. Sometimes very technical and sometimes very intuitive, this process is a difficult task to mould into a constructivist e-learning environment.

While the theory of learning in such an environment has been established in the preceding theoretical framework, for application to the scaffolding provided by instructors or mentors, the actual context of the learning environment must receive closer attention. Prevailing learning management and content management systems (LMS & CMS), such as Moodle, lack the integrated tools for visual and 3D based communication exchange in architectural education. The problems of useful, economically viable, and most of all effortless integration of communication, learning management and design tools is such that the field of architecture has yet to find the 'magic' e-learning solution. However, by addressing specific tasks with suitable tools effective, albeit partial, solutions can be developed.

Architecture has also transcended its historically physical domain into the virtual, shaping insistent immersive environments, not only crossing the digital divide but also redefining notions traditionally held to be self-evident, such as the nature of digital tectonics, the simulation or otherwise of gravity constraints, scale, and presence.

3.1 Showcase example: Virtual campus for virtual space design provided for european architects (VIPA)

As an example of an e-learning project, VIPA (Kipcak, 2007) is of particular interest. It has been developed through an EU project to address many relevant issues of e-learning in architecture, using traditional LMS e-learning tools and integrating new ones. The showcased example being complex enough to point out the specifics of e-learning *in* architecture (and the content is, we will assume, more or less known to the reader) we will follow the case and underlying notions simultaneously.

3.1.1 The objectives of VIPA

The overall objective of the project is to expand and enhance education in the field of architecture within a virtual campus through development of pedagogical courseware and appropriate technological platforms. Project goals include:

- A virtual campus integrating administrative, curricular and communicative infrastructures for schools of architecture.
- Competence development in the design of virtual and augmented reality for architecture students.
- Development and coordination of the training of European architecture students in the field of 3D-design
- Use of industrial know-how in the field of interactive 3D-authoring for the training of architects
- Content and conception input for these industries from the field of architecture
- Coordination and research at European architecture universities in this field
- An internationalisation of curricula into joint or double degree developments for architectural students and/or graduates.

- Additional and more intensive cooperation between the respective educational institutions across Europe.

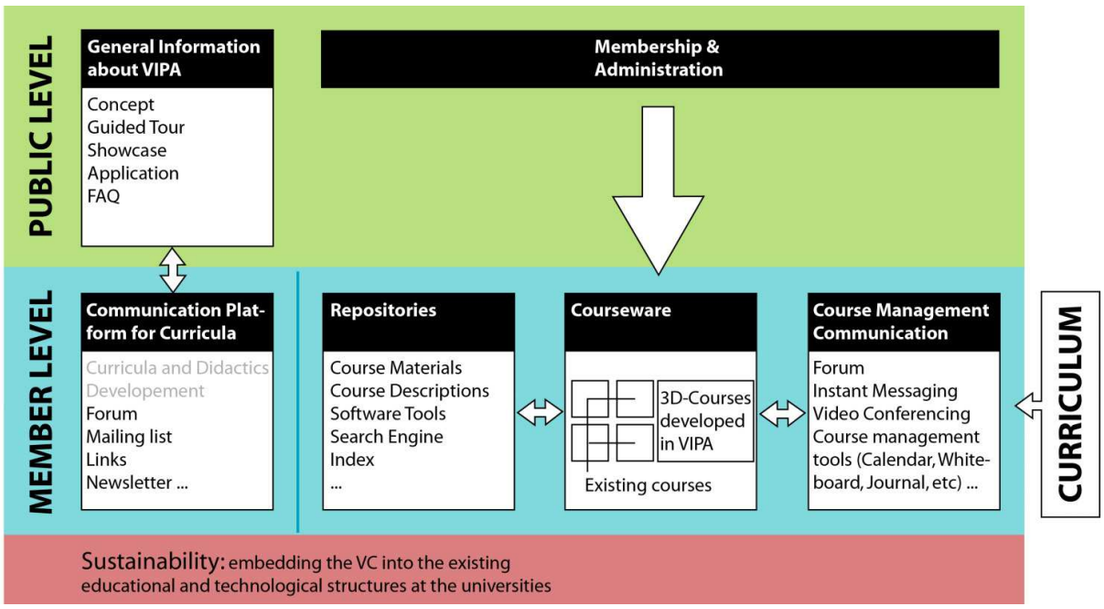


Fig. 1. The organizational and structural layout of VIPA virtual campus (Kipcak, 2007).

University curricula have developed out of local core competences, teachers and researchers. These local factors are woven into the fabric of a transnational VIPA curriculum and supported with organizational layout, platform, user interfaces and their features. It has been therefore proposed that all participants offer their existing courses in virtual space design, as well as developing new ones. This offers the option for both present and future participants to adjust the VIPA courseware to suit local curricula demands, while offering a large range of courses and knowledge. The professional fields that students of these curricula may enter range from well-established fields like architectural design to emerging fields like information design and the provision of virtual environments as extensions to existing institutions of complex social networks. An additional feature of VIPA is thus as a platform for curricula development for virtual space design to cope with the demands of a highly multi-disciplinary and emerging field of knowledge.

3.1.2 Reluctance of e-learning use in architectural schools

Virtual campuses are already established at most universities in the European Community, yet surprisingly e-learning is not yet widespread in architectural schools in Europe and is arguably still in its initial research phase. Although there are best practice examples where e-learning is replacing traditional study forms in other teaching disciplines, it has been found in the participating architectural faculties that there is a considerable resistance to e-learning. Among various other concerns, there is a common doubt that e-learning can be as equally effective as traditional face-to-face architectural studio teaching and culture. This is not a problem related only to architectural education and has been addressed in other projects such as OMAET, a pioneer in offering online degree programs for mid-career education professionals (Stager, 2005). Here, learner-centred theories and practices built upon the writings of Vygotsky, Lave, Wenger, Piaget & Papert stress that the course

compensates for the lack of face-to-face contact between students and faculty "in ways that actually lead to greater intimacy and access" (Stager, 2005).

3.1.3 The didactics of VIPA

The concept of VIPA didactics is based on the constructivist e-learning model. The constructivist learning concept provides prompts, stimuli, coaching and support instead of guiding a student through knowledge and is in that aspect close to established teaching in the field of architecture (and other related sciences). VIPA supports blended learning – the combination of traditional and e-learning practices. In that sense it combines local specifics with the collaborative and sharing possibilities, strengthening the sense of affiliation among its members. VIPA is an environment which supports problem-oriented, experiential, collaborative learning with media-rich contents based on grounded pedagogical methodologies, with a high grade of interactivity. Learning and teaching of virtual space design stand in the focus of VIPA effort. Combining constructivist and blended learning models, the main virtual campus features are oriented towards creative, intuitive, user-friendly didactical environments and tools.

3.1.4 The VIPA e-learning platform and its architectural extensions

The design and implementation of space and place is no longer wholly reliant on physical processes. The conceptual design of virtual spaces is creating new places in which to live and work. In consequence, new opportunities for work and employment are opening up for architects as well as for architectural educators. In response to this challenge, VIPA contains an e-learning and research platform for European architectural schools with a focus on virtual space design. The virtual campus integrates administrative, curricular, and communicative infrastructures, interactive, multimedia 3-D contents, and pedagogical considerations in respect of the aims, content and technologies employed.

VIPA effort is oriented towards development of tools for Virtual Space Design and teaching in that environment. Special emphasis is put on longer term aspects of virtual space, as students will be encouraged to experiment with, design and develop virtual space as a new emerging environment. Virtual lab is considered to be one of the crucial VIPA strengths and is the focus of the VIPA curriculum. The course should present and enable students to create personal environments, make generic spaces and forms, collaborate, interact and communicate, and experiment with forms and environment responses to user actions.

The strongest points of VIPA platform are: extensibility, modularity, comprehensive services and means of communication among users, towards future oriented tools for e-learning (especially for virtual space design), where partner universities and partners from the private sector may profit by sharing resources, competencies and contact networks. VIPA is at present a prototype that tests the feasibility of the curricular, didactical and technical concepts. Issues partially addressed and the ones to be developed still further include its development into a working model and include:

- Different types of degrees/coursework offered
- Part or whole of a MSc.
- Coursework in the doctoral degree
- MPhil or PhD research platform
- Quality control where VIPA combines courses from various schools
- Quality criteria

- Choice of evaluators
- The organisation of VIPA as an institution in the future
- The CLUSTER consortium is a possible model (www.cluster.org)
- The appointment of teaching staff
- European accreditation of titles, modules

Tools for Course Management - learning management system (LMS)	**Repository of course materials and Software Tools - content management system (CMS)**
• modular student/teachers features • calendar • journal/web log • wiki • course summary • online users • glossary • topics of the week/course • recent activity • upcoming events • courses • tools for teachers administering their class • registration of students to courses • tools for assessment/grading	• database structure: course materials, course descriptions, software tools, shared documents • tools for manipulation of files (up/down-load, deletion, modification, track changes, notes, etc) • search engine • automatic indexing of databases / lists according to search criteria (thematically, successively, alphabetically, similar media)
Communication	**Cooperation platform for didactics and curricula**
• video conferencing tools (possible use of existing external applications) • audio conferencing tools (possible use of existing external applications) • instant messaging (possible use of existing external applications) • forum • mailing lists	• forum • document up/down-load • mailing list • links
Virtual design laboratory	
• creating of 3D primitives, mapping • scripting • manipulation and modification of objects • changing the virtual space parameters and behaviour • collaborative interaction and modification of spaces and forms • simple modular integration of additional tools • working on different levels (novice, expert users) • personalization of the environment • interaction with other documents and programs • import of data (especially 3D) from established programs for 3D modelling and design (dxf, 3ds, dwg, etc.) • the virtual lab has to be prepared with both end users and developers in mind (basic functionalities have to be already present after installation and easily used in VIPA courses)	

Table 1. VIPA e-learning platform components and functionalities.

4. E-learning about architecture and sustainable spatial practices for non-experts

Architecture as profession has been recently dealing not only with the design and planning but more and more frequently engaging in awareness-raising and education about spatial values and sustainable practices as well. In these processes different participants that act in existing natural and cultural contexts are addressed. The participation always brings to the surface the questions of who the participants are and what, if any, intersection of knowledge, (visual) communication skills, attitudes and values they share.

The proverbial lack of common visions regarding architecture, eco-spatial values and spatial interventions does not arise merely from misunderstandings and expression disabilities, as already highlighted at the introduction. The national surveys (in Slovenia) indicate (Tos, 2004) that there is a wide overlap of professional and general public values regarding natural and built environmental issues. But as in many similar cases the divide between declarative statements of respondents and their actions and interventions when it comes to materialization becomes painfully obvious as they start solving their everyday living and housing needs.

The Lifelong Learning Process (LLP) presents an opportunity to address such problems before they emerge (prevention), it presents them to wider audience (who is not always even aware of wrong-doing) at different stages in life, especially at times when changing attitudes does not re-quire as much effort as in later years.

The basic presumption when addressing the LLP, architecture and space is axiomatic: the awareness and education of the non-experts and the inclusion of sustainable spatial topics into the process of LLP can improve the comprehension of professional baselines and values. Furthermore they may contribute to more prudent space management and spatial interventions as well as in decrease of spatially related problems and conflicts. By means of education and educational system it is sensible not only to administer the values and motives which underlie the legal acts and experts' positions but also to explain them. Assuming comprehension is the solid foundation for acting, building and the decision making regarding space the actual behaviour of individuals in space is influenced by more factors than knowledge alone (affect, values vs. needs, etc) - blind belief the education is the cure for every perennial spatial issue is thus contra productive and exaggerates its potential and we are giving it some thought later on (see subchapter 4.7).

Overcoming the first barrier - learning the visual language or offering a suitable alternative and support to participate and to express oneself in visual debate can be facilitated through means of e-Learning and ICT. 56% of households in Slovenia have a broadband internet access[1]. With 98% regular users among the population between 10 and 24 years of age this constitutes ever more suitable environment for distance learning: ICT seasoned users and widespread and fast network access. Through e-learning in particular we can reach the ICT 'fluent' generations who know how to use the ICT to their advantage in everyday life and when solving different tasks: not merely as passive users but as creative, responsive and reflecting individuals. Using the required visual-, desired parametric-, logic-, networking- and multiple feedback communication- possibilities of e-learning (existing and future) tools allow us to make the transition, from merely transmitting the knowledge and information to a wider audience, to engaging the non-experts, making the participants and collaborators

[1] Source: Eurostat, 2010

out of a passive audience, which is deemed crucial when it comes to questions of responsible spatial interventions and sustainable spatial behaviour.

4.1 The range of spatial topics to be conveyed to non-experts through e-learning

Learning *about* architecture can take different approaches. The historic, timescale approach comes first to mind. As it can be insightful and informative it also takes a very long time and a reflective individual to draw conclusions and implications for the present state of affairs in built environments. The historic approach can prove to be burdened with counterproductive issues such as style, taste, etc. that sometimes overshadow the conceptual underlays and bias the perception when looked at from present-centric perspective and context, which is often the case how non-experts react, especially younger generation. Rather than discussing what is tasteful and beautiful, which varies greatly between individuals, societies, cultures and where consensus is very hard to reach (and even if reached does not help much) the topics of what is respectful of its surrounding environment, what is efficient, what is functional can be addressed.

Learning about architecture and its context in the present state, pointing and searching for cause-effect relationships and impacts leaps over the historic perspective but offers the connection to sustainability issues and can address actual and burning spatial problems and practices. Combining architecture and responsible spatial behaviour is ever more viable in the recent push to reduce our impact on the environment. The human need 'to inhabit' (be it in terms of residence, working environment, leisure activities, education) has broad-ranging impact on the environment and can consequently play a major role in sustainable efforts (Gauzin-Müller, 2002). Focusing on the 'inhabiting' also represents a viable and meaningful intersection between architectural practices, emerging and existing spatial problems, the role of actors in space and efforts towards more sustainable development.

Content Elements	Characteristics - ways of presenting content elements
• burning architectural-spatial problems • problems indicated by the existent development trends • specific indicators of sustainable development	• the sustainability begins in local environment • focusing of the concept of spatial sustainability around notions of 'living and dwelling' and operating with spatial qualities rather than spatial values • an equal treatment of all three sustainability 'columns' (social, environmental, economic) • the absence of interference and non-materialization are the interventions that should also be taken into consideration

Table 2. Lifelong learning about sustainability focuses around content elements and aspects.

There are many interpretations and dimensions of sustainable spatial development and responsible acting in different environments. Some are leaning towards energy efficiency, others focus on natural aspects, and less often the cultural aspects of sustainability are taken into an account: Stibbe & Luna (2009) go a step further, arguing for sustainability literacy skills that foster a deeper look into the social, cultural and economic systems that gave rise to environmental problems. Combining declared attitudes and values into operative, concise, near-everyday-life experience terms ('spatial qualities'; see Verovsek & Juvancic,

2009) and into useful, rounded, concise topics of content demands a systematic approach that on one hand determines the content elements and on the other the aspects/focus through which the contents should be conveyed (Table 2).

Content elements cover topics connected to sustainable handling of space that the experts want to point at, or change behaviour patterns of non-experts to be more in sync with professional efforts. The elements can deal with burning spatial problems - scattered settlements, unfinished buildings, decaying and energy inefficient facades, building on slopes, greenery and housing, etc. Additionally, the elements can warn against harmful spatial trends and practices that will lead to problems in the future. Not least, the elements can consist of individual indicators of sustainable development (i.e. Able, 1997).

When presenting the spatially related sustainable issues the topics can be highlighted through four crucial aspects:

1. "All sustainability is local" (McDonough, 1998) - the main questions here are: where am I? What natural, cultural and socio-economic environments encompass me? Connect the individual and efforts 'from the doorstep' to broader issues of sustainable development, from top-down to more personalized and on individual actions focused bottom-up perspective.
2. Focusing of sustainability around the notion of residing, settling, dwelling, inhabiting - this changes the optics of spatial intervening to individual actors, where one easily recognizes himself, pictures oneself in that role. The approach jumps scale from global - far away and far above - to concrete, local environment and touches individual everyday actions.
3. Equal treatment of 'tree trunks' of sustainable development, including those that are harder to measure and not prone to statistical analysis, and that are less present in peoples' minds or because their characteristics are harder to generalize.
4. The absence of interference and non-materialization are the interventions that should also be taken into consideration when pondering sustainable behaviour: before the material intervention the questions should be asked regarding its necessity, its timing, ripeness of available technologies and its scale/range.

While the characteristics or ways of presenting content elements remain focused around the four points in every situation, the content elements change depending on target population, age and educational structure, local environment and aims the learning strives to achieve. The same principles of presenting spatial issues around four focuses were later also used in the research study, titled "Education on the built environment for sustainable development" (Zupancic et al, 2009), which has been carried out in the framework of the national Targeted research programme Slovenian competitiveness 2006-2013.

4.2 Communication and interface aspects - feedback, multiple-way communication, interaction: luxury or necessity in e-learning?

As elaborated in the introduction the learning process is, in a way, also a communication process where, in our architectural case, mainly visual messages are exchanged. Dealing with e-learning applications and ICT, where not only pedagogical methods and theoretical approaches apply, but also where the multi-layering and complexity of hardware and software solutions have to be reckoned with, there are many factors that influence the outcome of the learner's experience and knowledge acquired.

Teachers, mediators and experts can and do influence the outcomes of traditional learning by choosing the topics, pedagogical approach, exemplary cases, ways of narration,

engagement with the audience, etc. With the introduction of ICT and e-learning their roles and influence change to some extent (i.e. teachers as advisors, mediators, facilitators; Neville, 1999), and while still being important even more 'mediators' that influence the outcome of the learning come into play. Some of them are experts who specialize in ICT or other participants who make specialized contributions (i.e. professional actors for the re-enacting the scenes, narrators, who excel in narration, artists and illustrators, who specialize in graphic representations), other mediators are artificial (i.e. graphic user interfaces) and usually come in the form of the learning environment, communication tools, etc. As we are dealing with e-learning, and will later be inspecting educational interfaces that can be used without (or minimal) teacher's involvement, we will be highlighting the later – artificial mediators. The statement should not be understood in terms that teachers are redundant with the introduction of e-learning about architecture or that e-learning for non-experts should follow the path of excluding human mediators (although some experimental practices are leaning in that direction, i.e. Knewton[2]). In fact the showcase will prove to the contrary – the combination of f2f and ICT – blended learning – gives the best results at the moment. However for the purposes of the research, educational interfaces had to be isolated as sole mediators for the testing of the different elements and characteristics.

The parts can be arranged systematically, similarly to content part, into (visual) *elements* of interfaces and *characteristics* of interfaces the user is confronted with. The table (Table 3) applies to user interfaces and user experience with the system, which we focus on here. Although many characteristics are joined into five bigger groups that encompass the majority of particular characteristics, there are so many found in the literature (i.e. Shneiderman, 1998; Manovich, 2001; Rhee, Moon & Choe, 2006) some overlapping, some denoting similar things with different terminology, the effort to address them all seems futile. The interface characteristics are the ways the user manipulates the contents and the interface, the exchange of information between the user and the system, the ways of modification, the ways of being immersed in his actions and learning environment, etc.

While we focus on the interface part of the system and the *learner – interface – content experience*, additional parts of e-learning systems that are not addressed here but are relevant for the other actors involved would include characteristics of: experts, teachers or mediators managing the content - content management systems (CMS), learning management systems (LMS) and their interfaces, administrators managing the networks and support systems, and not least, the ICT experts creating the software solutions.

Interface elements	Interface Characteristics
• system/interaction management elements (menus, entry fields, slider, buttons, pointers etc) • 'visual' elements (presentations, icons, windows, descriptions, titles etc) • contents	• ways of navigation • ways of content presentation/narration • ways of interaction with elements • system openness rate • immersion rate and manner

Table 3. Learner–interface–content experience is dependent on elements and characteristics.

[2] http://www.knewton.com/

1. *The elements* represent the 'building blocks' that previous studies about interfaces (i.e. Shneiderman, 1998) in general or presentation techniques (i.e. Uccelli et al., 1999); Mullins et al., 2002, etc.) have already looked into: system/interaction management elements (menus, entering fields, slides, buttons, indicators, etc) and visual formulation elements (presentations, icons, windows, descriptions, addresses), as well as content formatted as multimedia itself.
2. *The characteristics* that can influence effectiveness of interfaces have been isolated and are the following:

- *ways of navigation* – how the user 'moves' through the system (discrete or continuous movement). According to Manovich (2001) the navigation within the system is not neutral but already sets and influences a narrative,
- *ways of content presentation/narration* – how the content is transmitted (on demand, automatically, combination of narration and presentation techniques used, etc), some referred to by Mayer (2005) within his principles for fostering visuospatial thinking in multimedia learning
- *ways of interaction with elements* – how the user interacts with the systems (manipulation of objects/contents, reversibility of actions, visual feedback of actions, etc),
- *system openness rate* – how the user can modify the system (openness of systems to modifications, possibility that users add own content or modify the existing one)
- *rate and manner of user immersion* in the system and its environment (Sherman & Craig, 2003)

4.3 Challenging and engaging the learners: Why it needs not only be conveying of facts but also fun to learn about?

Especially younger generations, the population that is already engaging or will soon engage in spatial interventions related to 'inhabiting' needs, has been brought up not as followers of the media only (passive receivers) but learned to engage in the process of active participation (also as contributors) through the widespread availability of ICT solutions (mainly, but not solely, internet). Students enter higher education with greater ICT abilities than their lecturers (Eklund et al., 2003 as cited in Mason & Rennie, 2006). The wide range of complex computer based games (i.e. Sim City, The Sims and Civilization to mention just a few which are directly relating to 'inhabiting' issues) and pervasive digital environments (i.e. Second Life) in combination with development of graphic capabilities of computers and availability of networking within them raised the bar of standards which are tacitly expected from educational software to succeed. As we will later see in the presented case, the more complex and challenging the task is, the more it attracts the learners and holds their attention in trying to achieve the optimum results. Merely translating traditional teaching tools and media into digital form thus not satisfies the usual learner, who is very aware what the present state ICT is capable of and resents to be vowed by 'digitality' only. E-learning about architecture profits greatly from use of ICT firstly because of complex sets of parameters (multiple cause and effect combinations) in architectural and urban settings that can be modelled into the educational software, computed and presented in real-time (Verovsek et al., 2011). For example: by tweaking of the different initial variables of the given urban setting, such as: pedestrian reserved spaces, greenery elements, elements for sojourning (benches, tables, chairs, etc), public transport opportunities, etc the future trends, perennial problems, conflicts and solutions can be tried out by the users themselves, gaining

much more complex insight into the relationship than possible through traditional means of teaching. Knowledge gained in such a constructivist manner has also a much more durable lifespan than factual learning (Dondi et al., 2004; Prensky, 2001). For the educational software to be successful it also needs to be visually challenging and up to the standards of entertainment, social and other commonly used applications.

4.4 Networking and collaboration between learners (and teachers) in e-learning about architecture

Being able to communicate during the learning process with peers and teachers is an important part of the experience of learning. E-learning *about* architecture should be no different in that sense, facilitating the communication through different ICT possibilities (more integrated into the learning e-learning environment the better). Communicating with fellow learners enriches the experience with the social context (Stacey, 1998 as cited in Mason & Rennie, 2006) and when distance learning this can influence the motivation (Rovai & Jordan, 2004 as cited in Mason & Rennie, 2006) and the feeling of belonging to a group of learners.

While expert e-learning *in* architecture uses the networking and communication possibilities for a crucial collaboration on a common task, simulating everyday experience of working in a team of interdisciplinary experts, the non-expert learners can benefit from networking in another common experience: simulating everyday negotiations and consensus reaching, incorporating the effect of the behaviour of groups and crowds in the decision making process, coming to potential clashes of interests between different users of space and within individual priorities (i.e. economic vs. sustainable, self interest vs. interest of the common good, practical vs. moral). Through that the mediator can emphasize how actions of an individual can influence a wider range of people that are touched through individual's actions and the socio-spatial consequences that ensue. Another option is showing the limitations of individual actions (even sustainable) if the group avoids involvement or acts differently. And yet another is highlighting the force of a joint action in positive and negative endeavours viewed from the perspective of sustainable spatial interventions (i.e. asking students to choose a building spot for their fictional house in an fictional but close-to-reality environment, which can lead to dispersed settling and thus showing the problematical issues or it can be coordinated to more sustainable solutions).

4.5 Adaptation to learners and their knowledge level

Learners engaging in LLP learning about spatial sustainability and spatial issues differ in several aspects that influence their reference frame, experience, world view, knowledge base, skills and psycho-physical performance. The ones important for our discussion are: i) the age in combination with psycho-physical performance levels (Svetina et al., 2011) ii) level of formal education achieved (Chou & Hsiao, 2007), iii) interests and motivations. Their abilities to read the visual messages and respond in kind also vary, as mentioned earlier (in sub-chapter 2.2). The elements of contents and the use of e-learning tools thus needs to be adapted to the (envisioned, if not known) least able participants in the learning process from the outset. The showcased example presented in the next subchapter focused on specific population and tried to adapt to its awaited specifics. The survey conducted on younger generations that spanned the broader range of ages and levels (Zupancic et al., 2009) about their spatial sustainable awareness is a good example of how to modify the

contents in a way that it adapts to different ages (through the questions and manner of questions asked, complexity of language, use of capital letters, depth of questions, etc). The teaching plans often point to suitable manners of how to tackle different issues and hint to base knowledge already acquired. However (in Slovenia) architectural and space related sustainable issues are (at the moment) not to be found there directly but are only tacitly implicated in them (Zupancic et al., 2010).

With the initial and general adaptation to the awaited group of learners set aside, the e-learning tools can offer a 'mass-customization' to individual learners by adapting to the individual learner with the setting of learning pace, introduction of additional contents once the base knowledge is acquired, helping and repeating where the learner struggles, offering an in-depth explanations and so forth (i.e., Knewton as reported in Fischman, 2011). Although the notion is more suitable for expert learning *in* architecture there are opportunities available for that kind of adaptation principle in e-learning *about* architecture also, but have yet to be seen in practice.

4.6 Assessment of knowledge gained

Referring to (in subchapter 2.2) discussed visuospatial thinking and multimedia learning, the way to assess the learners' understanding is to ask them to use what they have learned to solve a new problem (Mayer, 2005). This principle was used as the assessment tool in the educational interface showcased later in the chapter. From the strict scientific rigour perspective the results can be misleading as the learner's previous knowledge is only assumed and the level of knowing and ability to learn varies among the individuals in a group of learners. The initial pre-testing is a solution to measure the scale of progress made by an individual, however it is impractical and time consuming in usual learning settings, scientific experiments excluded.

When e-learning *in* architecture, the results are often less important than the process of going through the task solving, teamwork motions, etc. Contrary to that, e-learning *about* architecture and sustainable spatial behaviour strives for the results: the deeper understanding of cause-effect consequences, changing of attitudes, shaping of values and redirecting learners away from future harmful spatial practices. The results however cannot be measured in absolute terms – right or wrong – but can be only compared to the best informed and expert, interdisciplinary opinion what the solution of a given task should be. In a sense this represents also a measure of overlapping views and envisioned steps that experts and non-experts share after going through the learning process.

4.7 E-Learning about architecture cannot offer an answer to every perennial spatial problem: the limitations

Although it seems the (e-) learning *about* architecture is the perfect solution for the prevention of spatial problems and detrimental practices it cannot solve the problems as long as there is a difference between *knowing* and *doing*, different interests of groups and individuals that need to balance priorities that sometimes exclude themselves.

The question about the discrepancy "between words and actions" is certainly an interesting phenomenon of human nature, which is particularly materially expressed in cases of spatial interventions. The reasons for this duality can be found between the awareness of spatial values on a principal level and a different other actual knowledge of every individual, which may differ. One of the view points allows that value formation on a declarative level,

including their normative function of what is and is not allowed, is often not related with day-to-day priorities. It is furthermore far from the role of a strong motivation force giving energy, wish and inspiration for action. It may occur that the "trained" society is aware of global environmental issues and also strives to act towards decreasing them, but with simultaneous interventions (unintentionally) harms their local environment. (Verovsek & Juvancic, 2009)

The scope of complex relations and intertwinement of cause-and-effect relationships is daunting and needs to be systematically approached not only with the e-learning tools but also with the curricula on levels of formal education, combining the efforts and means to achieve better understanding of our (cultural and natural) spatial environment that we live in and should act responsively and sustainably within its carrying capacities.

4.8 Showcase example: Educational eco-spatial Interface[3]

The emerging field of architectural educational interfaces present**s** new opportunities to address younger generations and non-expert public as early as possible. Such systems are only part of a wider selection of means and tools for teaching and transmitting spatial topics to non-experts (other efforts that follow the more traditional path of learning include i.e. Arkki school of architecture for children and youth, Finland, Meskanen, 2007).

The showcased prototypical Educational Eco-spatial Interface (Juvancic & Zupancic, 2008) represents architectural educational interfaces 1) for communicating professional values, issues, problematics, 2) for showing simplified cause-and-effect relationships and 3) for teaching responsible spatial acting through selected cases and learning-by-doing tasks. It acts as the helping hand for teachers who are already besieged with other equally important topics, overcoming the knowledge and time constriction barriers in formal education practices. Being part of the experiment, the elements of interfaces (the contents included) were tested through their use in educational settings in primary schools. Also tested were the independent variables of interface characteristics: ways of navigation, ways of narration and ways of interaction with elements. The system openness rate and rate of immersion were presumed constant (closed system and non-immersive interface) as was the contents (identical in all cases).

4.8.1 Methods and materials

The software application was designed as a collection of five selected tasks - each presented within one screen size (Fig. 2). The screen was divided into several parts: two larger parts were dedicated to education, passing of information and task at hand, the bottom part of the screen was reserved for the title, the top for navigation. The contents of educational part (light-green) – texts and small pictures for reference were visible most of the time, while other multimedia presentations opened on the same page (either automatically or on demand, depending on the variation of interface) and played in bigger quadrant to the right. The same quadrant was also used for presentation of the task solving instructions and tests themselves.

The interface was prepared in 5 different variations, with different levels of interactivity consisting of 3 variables: (i) navigation, (ii) narration/presentation of contents and (iii)

[3] adjective eco-spatial was coined from two adjectives: ecological and spatial to emphasize the interrelation between the two



Fig. 2. Eco-spatial Education Interface (task#3 and the classroom setting).

interactivity of tasks (visual feedback, reversibility of actions, experimenting). Conditions ranged from maximum to minimum interactivity, from traditional face to face (f2f) education method to the test group (which did not receive any information and educational contents, just the task and basic instructions). Several parameters were automatically recorded (i.e. time, user choices, etc) and results of each task graded. The technical requirements for running the application and its IT scope were intentionally scaled down to match the IT equipment in schools (no installation required, application runs even on slow computers).

The educational contents and tasks dealt with eco-spatial topics and most urgent, common and annoying local problems the experts want to warn future generations of-, call to their attention- or change their attitudes toward- were building on sloped grounds, greenery around habitats, unfinished houses and their surroundings, building in the existing environment, adapting to scale, renovation of residential neighbourhoods, etc. The method of learning from (positive) examples, through the analysis of them, and learning by doing in a constructivist manner - simulating everyday considerations and decision making in task contents, was applied and built into the educational interface.

The test group of 9th grade primary school pupils (age 13-15) had 218 units, which were evenly distributed among 5 test settings – 5 variations of interfaces. This population represents the last instant before the whole generation diversifies into different vocational and professional directions, it is mature enough as it has built relatively independent system of abstract, contextual thinking abilities and social responsibility awareness (Marjanovic Umek & Zupancic, 2004; Marjanovic Umek & Svetina, 2004) and not least - the architectural awareness of their parents is still reflected in their way of thinking.

4.8.2 Results

Interactivity has a significant influence on the test results. The traditional f2f teaching with the computerized test solving part at the end still yields the best results. It has the smallest range between the lowest and highest grades. It is closely followed by the maximum interactive version of the interface, with middle and minimum versions trailing behind. In all these versions the range between the lowest and the highest scores extends. The results of

the test group were unexpected - it has surprisingly good and focused scores. Nevertheless, the average scores are not as good as in traditional f2f approach, they are lower than the maximum interactivity group average, equalling middle and beating minimal interactive interfaces.

Results also show that (i) navigation has some effect on the results (moving freely among the tasks contributes to effectiveness), while (ii) narration/presentation of contents (or the lack of it) and (iii) interactivity of the task have considerable influence on the final score, but due to test design their individual effect contribution cannot be isolated. Considering (ii) narration: even though the pupils had an opportunity to look at the informative presentations as many times as they wished ('max' version), they mostly did not bother to do that; on the contrary, nobody even looked through the half of all presentations. On the other hand, in the 'mid' interface version all were able to interrupt the automatic presentation at the beginning of each task, but only two did so, with many replaying the presentations (despite this fact the average grade in this group is lower than that of the 'max' version). The visits to each task (where possible) show similar results – the highest average score is achieved in six visits (which means one visit more than there are tasks).

Considering (iii) interactivity of task: while the possibilities to reverse the actions ('undo') do not play a significant role, visual feedback, possibilities to test different elements or situations, visually evaluate and change selection if needed, and significantly contribute to higher score. Evaluating the amount of time spent compared with the grade, the best results were achieved by the users who spent approximately 20 minutes in the interface – the score up to this time gradually rises and then gradually falls. The majority of users spent between 5 and 20 minutes within the interface. The pupils considered task #3 the most interesting one. The same task was also the most complex of all five tasks and most game like, with different architectural elements, their 'value' and 'financial' balance required. The most difficult task was, according to the pupils, task #4, which was also the most abstract and the least liked.

4.8.3 Reflections and lessons learned

With each prototypical test run of software there are plenty of lessons learned and stories to tell but here we would like to focus on the pedagogical, technological and institutional aspects. From the perspective of the learners the interface and this kind of e-learning has been well accepted not least because it was a welcome distraction from the traditional teaching the learners are used to and freshness of topic as the primary education curricula in its span only briefly touches architecture.

While ignoring the provocative question "feedback, multiple-way communication, interaction: luxury or necessity in e-learning?" in the conclusions of that subchapter and dealing there more with the mechanics of the interfaces, we return to it at the conclusion of the subchapter: interactivity by all means is not a luxury any more. It has many aspects in e-learning, beyond traditional interactionist theories (i.e. Haralambos, 1989), the major two: facilitation of interaction between dislocated participants of the learning process (which is of even greater importance in expert architectural e-learning) and in tune with interactionist theories that meaning is constructed in interactive situations through negotiations and discussion (Haralambos, 1989) and interactivity of learners and e-learning tools (contents included). The sustainable topics highlighted through the spatially related activities of groups and individual have been seen as a positive contribution to the curricula by the

teachers and the interface a tool that they could use for teaching (among many other tools on offer i.e. R.A.V.E. Space project suggestions: Demsar Mitrovic et al., 2007). They also suggested and insisted on more open system that would allow them to insert their own contents (graphics, photographs, texts) related to local environment and its specifics (which also proves that they understand the notion of acting locally and that understanding/explaining sustainability through the cause-and-effect relationships in our immediate surroundings is of the essence). The time constraint is beyond the topics of the chapter but it has to be emphasized, the range of topics to teach is so vast and the competition of themes so fervid that teachers feel an enormous time pressure, mentioned very often, much more than questioning of their competency to teach so specific topics (Demsar Mitrovic et al., 2007).

At the institutional level – the management of the particular schools involved has been a very understanding and cooperative body to work with on the topics of spatial sustainability, often asking for more contents and pedagogical contributions that we were able to provide. The Ministry of the environment and spatial planning on the yet higher institutional level has expressed an interest to implement the interface nation wide at primary schools but the discussions did so far not progress beyond the agreement that it would be a useful contribution provided it surpasses the prototypical phase. The talks however resulted in discussions about the necessity to look into the spatial sustainability issues, common curricula and education through a project in a Targeted research programme scheme (Zupancic et al., 2009).

From the technological perspective the potential improvements point in the direction of adaptability, networking and wider variety of topics covered with multiple tasks per one topic, offering more possibilities to show complex issues and asses the gained knowledge, more feedback to learners informing them whether they are on the right track, how good have they done and challenging them with the complex game-related tasks.

5. Conclusion

A fundamental consideration is that there are two types of learners when it comes to the field of architecture: the future experts, learning the methods, gaining the knowledge, skills and expertise in the field - *learners in architecture* and the non-experts, lay public, learning to understand cause and effect relationships in space, regarding built, cultural and natural environment, gaining an insight into the field, and into the expert logic - *learners about architecture*. Efforts of one group cannot compensate for the efforts of the other when dealing with built environment and spatial interventions as they more often than not, when not in sync, result in misunderstanding, misinterpretation, contradictions, which arise in response to physical manifestations discernable in spatial problems and unsustainable practices.

Both groups of learners can benefit from architectural e-learning, each group requiring a particular set of e-learning environments, tools, contents for suitable learning settings and positive learning outcomes. While some aspects are shared among the groups, such as blended learning, constructivist principles and project based learning, the use of visual messages, visuospatial multimedia learning principles, and the use of e-learning platforms, other aspects are particular for each group of learners as a whole and yet more particular within the same general group given the specific targeted population (as in the case mentioned: primary education pupils or a group of people who want to build their own dwellings in the near future, or public gathered around a specific spatial interest, etc).

Following the development of e-learning (and distributed learning) *in* and *about* architecture through the literature (i.e. CUMINCAD, a database of resources on the topic of Computer aided architecture and education) and recent publications, it is apparent that the practice has not yet established a foothold in architectural schools' curricula, nor found a place in general education (very few reports and even fewer scientific publications on the topic). However we can still discern two patterns of slow but gradual introduction of e-learning into architectural education: one approaching e-learning in architecture holistically – developing the whole system, including curricula, contents, tools (or concepts of them) and e-platforms (i.e. showcase example in the chapter VIPA: Kipcak, 2007; IMLAB: Gatermann & Czerner, 2003; etc), the other tackling specific and individual issues of e-learning, either developing prototypical tools (i.e. showcase example in the chapter Eco Spatial Interface: Juvancic & Zupancic, 2008; virtual design studios – VDS, etc) or integrating and combining the existing ones into systems. Neither of them is yet in the phase where we could claim that e-learning is institutionalized. It seems that as in other fields, e-learning in architecture is caught between the resistance to curricular change and the established ways of traditional teaching[4]. Mizban & Roberts, (2006) have analyzed e-learning in architectural education and established that a majority of cases in their analysis have been technologically driven – as a 'test bed': trying out the advances in ICT and applying them to architectural teaching or trying out new ways of supporting creativity or simply to develop students' ICT skills - and did not origin from pedagogical needs. On the other hand, some joint projects, due to their nature of distributed partners, teacher, students and teaching involved, introduce e-learning without intentionally emphasizing it. Archi21 is an example of ongoing European project (Hunter et al., 2011) that fosters Content & Language Integrated Learning (CLIL). The content in this case is architecture. The (envisioned and in some cases already executed) learning has all the characteristics of blended learning, with LMS, virtual environment (as a place to learn- and collaborate- in) and other e-communication tools at their core. It seems that such interdisciplinary endeavours are a short-term roundabout to gradual and persistent integration of e-learning in architecture.

In more general, lifelong education the hindrance is not so much avoidance of e-learning practices (the use of Moodle is quite wide spread already, with certain examples of educational interfaces already embraced), but the lack of architectural and spatial sustainability related topics in the learning programmes.

Throughout the chapter we have highlighted the benefits of e-learning *in* and *about* architecture, summing them up as: the ability to promote different types of collaboration, enhance students' set of skills, facilitate a flexible access to multimedia, educational resources anytime and anyplace (Mizban & Roberts, 2006), but also helping teachers introduce topics they are not expert in to non-expert public, enhance the experience of learning, introduce and present complex cause and effect spatial relationships that we are unable to grasp with the traditional teaching tools, simulate and test the processes prior to their physical manifestation, help in efforts for sustainable building practices and support informed decision making.

There are also barriers that hinder the widespread of e-learning *in* and *about* architecture. The main are the lack of pedagogical demand for them as observed by Mizban & Roberts

[4] There are exceptions to this rule in fellow field of design, where the university and consequently also the design programme within is based on the distributed (e-learning) principles that stand at its core of teaching and is thus institutionalized. Such an example would be The Open University, UK

(2006), the rigidity of curricula and inertia – "we have been doing it for years, why change it?" The students themselves often lack the motivation to acquire additional skills required to efficiently work in e-learning environment (students perceive additional learning as extra and non-essential workload). The rest usually consists of variety of technological issues. The systems are staying on the prototypical level, riddled with bugs and technological constraints hindering the usual design process or lacking the functionalities of common tools in use, making expressing oneself more difficult than in traditional learning, lacking the integration, having compatibility issues, problems with communication, bandwidth and simply put: things not working consistently and reliably - in effect, transferring the emphasis from the learning architecture to solving technological problems. All these reduce the motivation of learners and teachers even further. Overcoming the prototypical levels mean also overcoming institutional, investment, ICT barriers and requires a critical mass of teachers and learners seeing the benefits of-, feeling the pedagogical need for- and eventually using the e-learning in architecture.

On the path to maturity, however, there are many opportunities for widening the scope and usefulness of e-learning tools *in* and *about* architecture: introduction of networked learning, adaptive learning systems, extensive usage of graphic capabilities, integration of tools, and more, that the fast technological advance will offer us in the future.

6. References

Abel, C. (1997). *Architecture and identity: towards a global eco-culture,* Architectural Press, ISBN 978-0750607902, Oxford

Bates-Brkljac, N. (2007). Investigating perceptual responses and shared understanding of architectural design ideas when communicated through different forms of visual representations, *Proceedings of Information visualisation 2007 conference*, ISBN- 0-76795-2900-3, Zurich, Switzerland, July 2007

Chou, J. R. & Hsiao, S. W. (2007). A usability study on human-computer interface for middle-aged learnes, *Computers in Human Behavior*, Vol. 23, No. 7, pp. 2040-2063, ISSN 0747-5632

Demsar Mitrovic, P., Miklavcic, T., Resnik Planinc, T., Urbanc, M., Fridl, J., Simoneti, M., Sorn, M. et al. (2007). *R.A.V.E Space: project final report. Raising awareness of values of space through the education process,* Demsar Mitrovic, P. in Rihar, J. (ed), Ministry of the Environment and Spatial Planning, 978-961-6392-56-3, Ljubljana

Dondi, C., Behnn, E. & Moretti, M. (2004). Why Choose a Game for Improving Learning and Teaching Processes? In: *Guidelines for Game-Based Learning*, Pivec, M., Koubek, A. & Dondi, C., pp. 20-76, PABST, ISBN 3899671937, Lengerich, Berlin, etc

Fischman, J. (2011). The Rise of Teaching Machines, In: *The Chronicle of Higher Education, The Digital Campus*, 8.5.2011. Available from http://chronicle.com/article/The-Rise-of-Teaching-Machines/127389/

Fruchter, R. (2006). The Fishbowl™: Degrees of Engagement in Global Teamwork, In: LNAI 4200 *Intelligent Computing in Engineering and Architecture*, I.F.C. Smith, pp. 241-257, Springer Verlag, ISBN 978-3-540-46246-0, Berlin Heidelberg

Gatermann, H. & Czerner, J. (2003). Modular E-Learning-Environment for Architecture, *Proceedings of the 21th eCAADe Conference: Digital Design*, ISBN 0-9541183-1-6, Graz, Austria, September 2003

Gauzin-Müller, D. (2002). *Sustainable architecture and urbanism: concepts, technologies, examples,* Birkhäuser, ISBN 3-7643-6659-1, Basel, Berlin, Boston

Greeno, J.G. (1998). The Situativity of Knowing, Learning, and Research. *American Psychologist,* Vol. 53, No. 1, pp. 5-26, ISSN-0003-066X

Haralambos, M. (1989). *Sociology*, Unwin Hyman, ISBN 9788634303872, London

Hunter, M., Chase, S., Kligerman, B. & Zupancic, T. (2011). ARCHI21: Architectural and Design based Education and Practice through Content & Language Integrated Learning using Immersive Virtual Environments for 21st Century Skills, *Proceedings of the 29th eCAADe Conference: Respecting Fragile Places,* ISBN 978-9491207013, Ljubljana, September 2011

Juvancic, M. & Zupancic-Strojan, T. (2008). Towards effective interfaces for general architectural learning: eco-spatial educational interface for pupils, *Proceedings of the 26th eCAADe Conference: Architecture "in computro : integrating methods and techniques,* ISBN 978-0-9541183-7-2, Antwerpen, Belgium, September 2008

Juvancic, M., Zupancic, T. & Hocevar, M. (2011). Towards effective interfaces for non-professional architectural learning: Architectural educational interface for pupils. *Javnost - The Public*, accepted for publication in 2012

Kipcak, O. (2007). The VIPA Project. What is VIPA? In: *VIPA virtual campus for virtual space design provided for european architects*, Marek, C., Edition mono/monochrom, pp. 6-9, ISBN 3-9500731-8-3, Graz

Manovich, L. (2002). *The language of new media,* reprint ed., MIT Press, ISBN 978-0-262632-55-3, Cambridge, Mass.

Marjanovic, L. & Svetina, M. (2004). Spoznavni in govorni razvoj v srednjem in poznem otroštvu, In: *Razvojna psihologija*, Marjanovic, L. & Zupancic, M., pp. 408-427, Znanstvenoraziskovalni inštitut Filozofske fakultete, ISBN 8672071468, Ljubljana

Marjanovic, L. & Zupancic, M. (2004). Teorije psihičnega razvoja, In: *Razvojna psihologija*, Marjanovic, L. & Zupancic, M., pp. 28-63, Znanstvenoraziskovalni inštitut Filozofske fakultete, ISBN 8672071468, Ljubljana

Mason, R. & Rennie, F. (2006). *E-Learning: the Key Concepts.* Routledge, ISBN 0-415-37307-7, New York

Mayer, E.R. (2005). Multimedia Learning: Guiding Visuospatial Thinking with Instructional Animation, In: *The Cambridge Handbook of Visuospatial Thinking*, P. Shah & A. Miyake, pp. 477-508, Cambridge University Press, ISBN 978-0-521-00173-0, New York

McDonough, W. (1998). Declaration of Interdependence, In: *Dimensions of sustainability: architecture, form, technology, environment, culture*, Scott A., pp. 45-55, E & FN Spon, an imprint of Routledge London, ISBN 0-419-23620-1, New York

Meskanen, P. (2007). Shaping Spaces; Architecture and Children – Teaching the values of space to children and youth. *Presented at R.A.V.E. Space Project Final Conference,* Ljubljana, Slovenia, December 2007.

Mizban, N. & Roberts, A. (2006). The Place of E-learning in Architectural Education - A Critical Review, *Proceedings of the 24th eCAADe Conference: Communicating Space(s)*, ISBN 0-9541183-5-9, Volos, Greece, September 2006

Mullins, M., Zupancic-Strojan, T. & Juvancic, M. (2002) Experts and Users Efficiency and Accuracy in the Presentation of Design Ideas Across Networks, *Proceedings of the 20th eCAADe Conference: Connecting the Real and the Virtual - design e-ducation*, ISBN 0-9541183-0-8, Warsaw, September 2002

Neville, A. (1999). The problem-based learning tutor: Teacher? Facilitator? Evaluator? *Medical Teacher*, Vol. 21, No. 4, pp. 393-401, ISSN 0142-159X

Prensky, M. (2001). *Digital Games-Based Learning,* McGraw Hill, ISBN 978-1557788634, New York

Quintana, C., Carra, A., Krajcik, J. & Soloway, E. (2002). Learner-Centered Design: Reflections and New Directions, In: *Human-Computer interaction in the new millennium,* Carroll, J. M., pp. 605-626, ACM Press, ISBN 978-0201704471, New York

Rhee, C., Moon, J. & Choe, Y. (2006). Web Interface Consistency in E-learning. *Online Information Review*, Vol. 30, No. 1, pp. 53-69, ISSN 1468-4527

Severin, W.J. & Thankard, J.W.Jr. (1992). *Communication theories: Origins, Methods, and Uses in Mass Media*. Longman, ISBN 978-0801304637, New York

Sherman, W. R. & Craig, A. B. (2003). *Understanding virtual reality: interface, application and design,* Morgan Kaufmann, ISBN 978-1558603530, San Francisco

Shneiderman, B. (1998). *Designing the user interface: strategies for effective human-computer interaction,* 3. Ed, Addison-Wesley, ISBN 978-0-201694-97-0, Reading

Stager, G. (2005). Towards a Pedagogy of Online Constructionist Learning, *Proceedings of 2005 World Conference on Computers in Education*, Stellenbosch, South Africa, July 2005

Stibbe, A. & Luna, H. (2009). Introduction, In: *The Handbook of Sustainability Literacy: Skills for a changing world*, A. Stibbe, pp. 9-16, Green Books, ISBN 978-1-900322-60-7, Foxhole, Dartington, Totnes, Devon, UK

Strojan, T. Z. & Mullins, M. (2002). The Identity of Place in Virtual Design Studios. *Journal of Architectural Education,* Vol. 56, No. 1, pp. 15-21, ISSN 1046-4883

Svetina, M., Istenic Starcic, A., Juvancic, M. , Novljan, T., Subic Kovac, M., Verovsek, S. & Zupancic, T. (2011). How Children Come to Understand Sustainable Development : a Contribution to Educational Agenda, *Sustainable development*, Vol. 20, No. 20, pp. 1-10, ISSN 0968-0802

Tos, N. et al. (2004). *Vrednote v prehodu III. Slovensko javno mnenje 1999-2004,* Tos, N. (ed), Fakulteta za družbene vede, IDV – CJMMK, ISBN 978-3-901941-23-8, Ljubljana

Ucelli, G., Conti, G. & Klercker, A. J. (1999). Visualisation: The Customer's Perception, *Proceedings of the 17th eCAADe Conference: Computing from Turing to 2000*, ISBN 0-9523687-5-7, Liverpool, September 1999

Verovsek, S. & Juvancic, M. (2009). Identifying spatial values in the opinions of teenagers. *Urbani izziv*, Vol. 20, No. 1, pp. 164-174, ISSN 0353-6483

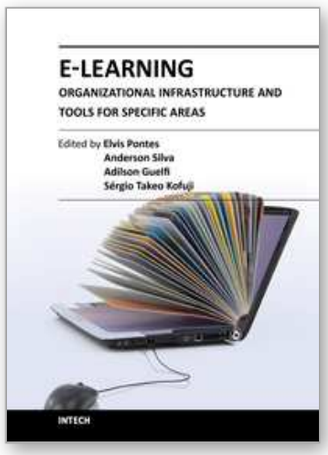
Verovsek, S., Juvancic, M. & Zupancic, T. (2011). Interpretation Model of Urban Space Coherence, *Proceedings of the 29th eCAADe Conference: Respecting Fragile Places,* ISBN 978-9491207013, Ljubljana, September 2011

von Glaserfield, E. (1991). An exposition of Constructivism: Why some like it radical, In: *Constructivist Views of the Teaching and Learning of Mathematics,* R. B. Davis, C.A. Maher & N. Noddings, pp. 19-29, VA: National Council of Teachers of Mathematics, Reston

Wenger, E. (1998). *Communities of Practice: Learning, Meaning and Identity*, Cambridge University Press, ISBN 0-521-66363-6, Cambridge New York

Zupancic, T., Novljan, T., Juvancic, M., Verovsek, S., Subic Kovac, M., Istenic Starcic, A. & Svetina, M. (2009). The concretization of the term sustainable spatial development for the assessment of child and juvenile awareness. *Urbani izziv*, Vol. 20, No. 1, pp. 153-163, ISSN 0353-6483

Zupancic, T., Verovsek, S., Juvancic, M., Svetina, M., Novljan, T., Subic Kovac, M. & Istenic Starcic, A. (2010). Education for Sustainable Development in the Built Environment in Slovenia, *AR - Architecture, Research*, No. 1, pp. 70-77, ISSN 1580-5573



E-Learning-Organizational Infrastructure and Tools for Specific Areas

Edited by Prof. Adilson Guelfi

ISBN 978-953-51-0053-9
Hard cover, 182 pages
Publisher InTech
Published online 17, February, 2012
Published in print edition February, 2012

Technology development, mainly for telecommunications and computer systems, was a key factor for the interactivity and, thus, for the expansion of e-learning. This book is divided into two parts, presenting some proposals to deal with e-learning challenges, opening up a way of learning about and discussing new methodologies to increase the interaction level of classes and implementing technical tools for helping students to make better use of e-learning resources. In the first part, the reader may find chapters mentioning the required infrastructure for e-learning models and processes, organizational practices, suggestions, implementation of methods for assessing results, and case studies focused on pedagogical aspects that can be applied generically in different environments. The second part is related to tools that can be adopted by users such as graphical tools for engineering, mobile phone networks, and techniques to build robots, among others. Moreover, part two includes some chapters dedicated specifically to e-learning areas like engineering and architecture.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Matevz Juvancic, Michael Mullins and Tadeja Zupancic (2012). E-Learning in Architecture: Professional and Lifelong Learning Prospects, E-Learning-Organizational Infrastructure and Tools for Specific Areas, Prof. Adilson Guelfi (Ed.), ISBN: 978-953-51-0053-9, InTech, Available from: http://www.intechopen.com/books/e-learning-organizational-infrastructure-and-tools-for-specific-areas/e-learning-in-architecture-professional-and-lifelong-learning-prospects

INTECH
open science | open minds

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2012 The Author(s). Licensee IntechOpen. This is an open access article distributed under the terms of the Creative Commons Attribution 3.0 License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

IntechOpen

IntechOpen