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MINDTHEGAPP™ BETWEEN STANDARDS AND PRACTICE OF MOBILE LEARNING EXPERIENCE DESIGN

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Abstract

Mobile Learning is transforming the landscape of e-learning standards and Learning Design, a field that spans from Educational Modeling Languages to the collaborative development of pedagogical patterns and didactic conceptions that consider teaching as a design science. The Larnaca Declaration on Learning Design and the new Training and Learning Architecture (TLA) of Advanced Distributed Learning represent different approaches to standardization that are ready to face the expectations of openly networked learners. This paper examines the role of standardization in mobile learning design including the TLA Experience Tracking specification, the Experience API (xAPI: the “Next Generation SCORM” application programming interface) in light of earlier educational notations, and technological standards. It traces the needs of connected m-learning exploring the gaps between theory and praxis in learning flow management from the point of view of Learning Experience Design (LXD). The advantages of these new technological initiatives and alternative knowledge map based approaches to navigate, organize, and sequence Web-based content are evaluated parallel with technical requirements of cross-application visual interfaces for creating learning sequences from building blocks of individual or collective activities and designing reusable didactic models of individual or cooperative problem solving. In light of the methodological conclusions of developing MindTheGapp™, a multi purpose Mobile Learning Platform of the EU supported Mobile Multimedia-based Knowledge Transfer project carried out within the framework of the New Hungary Development Plan (EDOP 1.2.1), alternatives for mobile-App integration are reconsidered. It is found that because Massive Open Online Courses (MOOC) engage in networked learning, task-structuring of a course has to be complemented by new interoperable standards not only for content and activity design but also for effective App integration.

Keywords: Mobile Learning Standards, Learning Experience Design (LXD), Knowledge Transfer, Experience Api (xApi), Massively Open Online Course (MOOC), App integration.

1 GAPS BETWEEN MOBILE LEARNING PRACTICE AND THEORY

The mobile learning landscape is changing faster than ever, and our concepts and definitions need to transform with these changes. Instead of seeking to make an analogy between “portable TV watching” or “car commuting” and mobile learning, we should accept that none of the definitions, i.e. “learning by means of wireless technological devices…” or “supported by mobile devices", referred to in, for example, the EDUCASE 2012 Research Bulletin on the Future of Mobile Learning, are sufficient. [1] Nor can the essential attributes (mobility, ubiquity,…etc.) listed in various definitional attempts [3,4], or the diacronic characterizations reviewed by Helen Crompton in the 2014 Commonwealth of Learning's Perspectives on Open and Distance Learning [2], be exhaustive, given the rapid development of smart devices, and the transformation of our learning habits. Even if we conceive the set of all mobile devices as a variable, and the list of essential attributes of mobile learning as extendable, this misses the point that mobile learning is no longer a special form of learning. It has become a natural component of all types of learning, from personal to collaborative, and in every form of life long learning. The 'mobile learning' concept needs to be situated within the technology facilitated 21st century learning revolution. The letter 'm', like the letter 'e' in e-learning, is gradually becoming a historical conception. Just as motor cars have become ubiquitous and in some cases essential modes of transport, so have an ever expanding range of devices that we use for our learning needs. Just as home working has transformed commuting, so mobility has become an elemental component of personal and social cognition. This is not to imply that we should disregard the study of correlations between mobile devices and knowledge acquisition, but this relationship should be addressed more and more as a point of information transfer, within the context of learning tasks, with problems to solve. In the Age of the Internet of Things (IoT) the interoperability and versatility of our technology will not only send desktops to museums, next to portable TVs, but will increasingly make our selection of learning devices *intent* dependent, their use *case-based* and suitable to the *problem-situation*. We are at the beginning of this transformation, but both learners and educators are aware that a paradigm shift has taken place, which when combined with social changes in learning, calls for a reinterpretation of the qualitative standards which accompany the invention of new technical standards of networked learning.

1.1 Where does m-Learning Theory meet Practice?

Mobile learning offered new opportunities for learning and new types of teaching extending both traditional education and on-line learning, and a number of projects contributed to the practice of mobile learning design. It was a concomitant drive of didactic research to introduce new forms of teaching empowered by smart handheld devices within the established educational frameworks such as *flipped classrooms* and to explore new learning methods beyond the accustomed learning spaces e.g., in museums or environmental *field work*. This driving force contributed to the accumulation of learning and teaching practices which encountered new technological and pedagogical problems testing the limits of the capabilities of existing learning design technologies. [3, 6, 15, 39, 47]

In learning *theory* the recent body of literature on mobility attempted to "unpack" the 'm' in mobile learning, in terms of mobility of technology, mobility of learning and of the learner. [5] Following earlier initiatives of Kakihara and Sørensen [6], the concept of mobility was expanded distinguishing

(1) "*mobility in physical space*", (2) "*mobility of technology*: portable tools and resources", (3)

"*mobility in conceptual space*: learning topics and themes", (4) "*mobilit in social space*", and (5) "*learning dispersed in time*". [7, p. 236] Deeper investigation of these interpretations of mobility led to theoretical foundations of mobile learning such as the conceptualization worked out by the *Kaleidoscope Philosophy of Technology Enhanced Learning SIG*, a conception which brought into focus the relationship of learning *contexts* and the "learning flows across locations, time, topics and technologies" [7, p. 237], and contrasted the various aspects of mobility with traditional classroom learning. Members of the group formulated tough statements, e.g., that the latter "is founded on an illusion of stability of context, by setting up a fixed location with common resources, a single teacher, and an agreed curriculum which allows a semblance of common ground to be maintained from day to day" and highlighted that the "fundamental challenge is how to form islands of temporarily stable context to enable meaning making from the flow". (*Ibid*.) The illusion of the stability of context can be given up though, even at a fixed location, just as the methodology of using common resources may be exchanged with other pedagogic methods within traditional classroom learning. Likewise, there are existing forms of pear to pear and group learning in which cooperative and project based activities make "single teachers" accessible on an as needed bases both in F2F and in e-learning frameworks. Curriculum based teaching practice may be contrasted with mobile learning but not only with that. Steiner's first Waldorf School was founded in 1919, the Montessori method has been adopted officially in many public schools "To Educate the Human Potential" for a "New World" from India to the US long before m-learning. Whether we like them or not, curricula are rooted in the history and politics of education more deeply then in textbook culture. They are not necessarily alien to mobile learning as xMOOCs prove it, and the issue of their pedagogic necessity, just as of common core standards, goes far beyond mobile learning. The question is also deeper whether activity design or content standards fit the "exploratory nature" of m-learning or the "peripathetic learner" [8] but similar questions were already raised in case discovery learning, or the Montessouri methods. [9]

Mobile subscriptions, however, surpass the world population this year and have a much greater impact on learning activities worldwide then Montessori schools. Not only in result of the global statistics of subscriptions, but because the demands of mobile learners are satisfiable *outside the classroom*. As a consequence of a technology which is becoming almost as readily available as paper and pen, mobile technology influences our learning habits via new forms of 'out of school', and informal learning from our work place to the play grounds and its effect is much more profound than of the introduction of m-learning in formal settings. Harnessing the opportunities of mobile devices to facilitate formal learning is a much slower process than the everyday transformation that takes place in various forms of 'just in time' learning and mobile knowledge management. While educational institutions are trying to reengineer themselves, both pedagogically and technologically, to deal with the newly found power of 'mobility' in all its above senses, they face an apparently wide gap between *formal* and *informal learning*. Significant part of the dichotomy between m-learning and traditional classroom learning, or between lecture-based university education, comes from the identifiable disconnect between formal and non-formal knowledge acquisition methods which are powered by mobile technologies. To a large extent the theoretical yield of m-learning research is due to the fact that it directed attention to the catalyzaton of new patterns of learning from the already existing and the emerging non-formal knowledge acquisition and knowledge transfer practices in the area of informal learning. The relationship of informal, and m-learning is a field which is in rapid development and represents a major challenge to the theory and practice of Learning Design [8, 10, 13]

1.1.1 Widening or bridging the gap between formal and informal learning?

The disconnectedness of formal and informal learning (plus non-formal learning as defined by OECD) is usually considered as given and eliminating the gap between them is rarely treated as a real option even by holistic approaches. [12] However, Web 2.0 and mobile technologies are often considered as tools for bridging the gap. [13, 14, 15] It is difficult to judge that by increased anytime, anywhere access new modes of mobile empowered informal learning are growing faster, widening the gap between rigorous formal courses and informal learning, or we eventually see them converge to common learning practices in result of the penetration of m-learning in formal settings as turning to mobile devices is becoming more and more conventional. From the point of view of four among the six alternative scenarios of the transformation of learning habits and the shift in the social position of education, projected to 2025 by the research group of „Beyond Current Horizons", closing the gap may be not even desirable. [16] The issue is rather complex, hence there are relatively few empirical research projects for measuring the actual distance, the direction and rate of change of the social position of formal and informal learning. It would entail the investigation of augmented cognition, knowledge organization practices, social attitudes and a constantly growing range of services, applications and use cases which allow the users to combine different methods of learning.

ICT skills are clearly crucial in measuring this distance and one of the accessible comprehensive empirical studies, the ESSIE survey of DG Connect [17], detected a considerable gap between *in school* and *out of school* settings concerning both students' and their teachers' use of ICT (including mobile technologies) all over Europe. UNESCO statistics confirm similar findings concerning other parts of the world: mobiles are often forbidden to turn on in school and their use in the classroom for learning is still infrequent. [18] Even at university ICT departments it is common to have policies of not supporting internet access for mobile devices. Despite the fact that the practice of BYOD/T (Bring Your Own Device/Technology) is spreading in higher education, at other levels it is rare. There are several obstacles, in addition to the problem of standards discussed below, which call for investments in learning experience design and teachers' training. [12, 19, 22]

1.1.2 Personal Knowledge Management and Social Knowledge Sharing

The social phenomena of networked learning and the inherent affordances of smart mobile devices represent tectonic forces which are capable of widening as well as closing the gap between formal and informal learning. The study of these forces and the emerging new knowledge management technologies motivate the convergence of theory and practice from both sides of the gap. What Beale formulated in (2007), namely, that “[n]ew technologies allow us to develop full digital records of our lives and experiences” [20, p. 10] has become subject of everyday personal knowledge management practice which forms a bridge between formal and informal contexts of learning with due respect to the autonomy of institutional and personal tendencies of preserving *versus* reducing their distance. As Sharples, Taylor and Vavoula note this “convergence is occurring [...] as a personally-managed lifelong activity” [23, p. 223, cf. 26]. One constituent of this activity is that it reaches over the gap between informal learning and formal education, since students, just as teachers, adopt new technologies in preparing for their formal tasks. For designers it was a basic task to integrate social knowledge sharing surfaces into institutional e-learning environments for this reason. Accepting that students live logged into their Facebook account, the former practice, namely, that the LCMS provides its own social environment within its learning space became questionable. Personal mobile learning environments merge with the existing social softwares more naturally because the users prefer to use their existing accounts and maintaining a multitude of user profiles is a nuisance. The growing evidence obtained within the framework of MindTheGapp™ (the m-learning environment developed in the framework of our Mobile Multimedia based Knowledge Transfer project [61]), just as surveys on mobile use, confirm that sharing personal knowledge management practices within student and teacher communities is one of the main acting force which has led to new theoretical and experimental design approaches to knowledge transfer and acquisition. [19, 20] It increased reflection on their nature and called for empirical studies of their variability.

1.2 Surveys of perceptions and definitions or empirical research for design?

Geoff Stead in his UNESCO presentation refers to John Traxler claiming that “there is no way to summarise mobile learning comprehensively across the world” and declares that “if we are looking for one unifying theory, there isn’t one”. [24] The recent empirical survey of the Australian Digital Futures Institute developing a Mobile Learning Evaluation Framework used Delphi technique to explore personal meanings and perceptions of mobile learning since they have also found, using formal consensus techniques, that there is no common understanding and the personalization of smart mobile devices implies different perceptions of m-learning. They draw the conclusion that “[c]urrent definitions of mobile learning tend to be overly inclusive, in that just about any e-learning activity can be classified as an example of mobile learning, or overly exclusive through only allowing the inclusion of learning activities mediated through very particular mobile devices.” [25, p. 287] One can go along with Traxler who reversed the question considering the exploration of the meaning of mobile learning as an open subject to a point. [21] But the recent upsurgence of studies and surveys investigating expert’s definitions, students’ and teachers’ conceptions of mobile learning or the clustering of scholarly publications cannot fill in the gap between theory and practice and will not substitute the *actual* study of users’ behavior and the detailed analysis of emerging new learning habits. If we accept that “mobile learning is not about ‘mobile’ or about ‘learning’ as previously understood, but part of a new mobile conception of society" [28] this acceptance implies that we should investigate not only conceptions but also the state of affairs, the actual patterns of personal and social organization of knowledge work and those decisive factors in the "neoevolution" of human cognition which alter our knowledge sharing and social learning strategies. [29] The emerging new theoretical approaches has drawn attention to the fact that mainstream educational practices are tied to outdated technologies and past social circumstances but also underlined the need for a more sophisticated understanding of students' experiences of technology. This awareness of empirical research is reflected in more detailed studies emerging from the "digital natives" debate and the recognition of more nuanced dichotomies in technology related stereotypes. [11] Similarly, the xMOOC vs. cMOOC controversy [31] seems to boil down to fundamental technological problems and didactic questions concerning the design of learning environments as it leads to more subtle studies of learning needs. Althogh the debate apparently concludes in the recognition that current needs are influenced both by the history *and* the actual supply of the educational market the problem of designing effective learning experiences arrived at an experimental, empirical phase in which it is impossible to disregard from the initiatives of mobile App developers and the self-organization of a users governed knowledge market.

1.2.1 Reconsidering the Spectrum of Multimodal and Social learning

The new theoretical approaches wich readily associate with *connectivism* and *interactivist* methodologies return to Dewey's (1916), Pask's (1976), Engeström's (1996) and Vygotsky's (1930) ideas and consider *explorative* [32], *conversational* [32, 33] and *collaborative* learning [34] as "the fundamental processes by which we come to understand the world". [7, p. 237] There are good reasons for highlighting activity theory, conversational learning or connectivism as capturing *inherent* features of mobile learning, though it is just as easy to pick other aspects of learning/teaching practice which can be given a good account in terms of other approaches. [33] Keskin and Metcalf [36] drew up a table of "mobile learning theories" listing *Behaviorist, Cognitivist, Constructive, Situated, Problem-based, Location based, Context Awareness, Collaborative, Conversational, Informal, Lifelong Learning*, as well as *Activity*, and *Socio-cultural Theory*, *Connectivism,* and *Navigationism*. They give a brief summary of the focus of all these theories in the field of mobile learning and specify examples with the applied mobile technology. The list itself and its extensibility raises the question whether it is 'm-learning' itself, as a social phenomenon, and as a subject of conceptualization, that we are trying to capture when we elaborate the theoretical foundations of the new forms of smart device based knowledge building and mobile learning habits? Or are we rather witnessing a *theoretical turn* in the *Learning Sciences* reconsidering the full spectrum of *multimodal* and *social* learning from a wider perspective, an inevitable move forced by inventive knowledge engineering, which combined mobile augmented reality with multimedia learning environments in ways which were hard to imagine even not long ago?

1.2.2 Theoretical Synthesis in m-Learning Design: Possibilities and Limits

Working Group-2 of the 2013 International Summit on ICT in Education has summarized the recent developments in finding the essential determinants of m-learning in these words "[w]e see a gradual shift of understanding of the theory and practice of mobile learning in the last ten years, from a technocentric perspective focusing on the attributes and affordances of the technology, to a *learner-centred perspective* focusing on the mobility of the learner (not just space and time, but also access to *people* and *resources*) and *contexts"* [19, p. 3, emphases added, cf. 37)] This is a reference to Winter's four main perspectives of m-learning, (1) technocentric, (2) as an extension or a subset of e-learning, (3) use of mobile devices to complement and augment formal education (4) student-centred learning which is about mobility and context (40, pp.4-5). Arguably most definitions focus on the first three perspectives, dispite of early warnings that according to some approaches "e-learning simply becomes m-learning, without any particular changes in content" or "m-learning will characteristically aim at specific kinds of knowledge, namely knowledge that is location-dependent and situation-dependent". [38, p. 124] "Taking its point of departure from the ubiquitous nature of communication" Nyíri clearly stated as early as at the time of 2G cellular phones that "just as our everyday conversation is indifferent towards disciplinary boundaries, so, too, is m-learning. Situation-dependent knowledge, the knowledge at which m-learning aims, by its nature transcends disciplines; its organizing principles arise from practical tasks; its contents are multisensorial; its elements are linked to each other not just by texts, but also by diagrams, pictures, and maps" and the "contents have to be designed […] in relation to practical problems […] to fit the conditions of person-to-person communication". (*Ibid.*) Farley, Murphy and Rees detach themselves from the characteristics of the mediating technology, even from the mobile nature of the learning activity to a certain degree, and look for a robust but flexible, dynamic definition inspired by Wittgenstein's theory of family resemblance "drawing from a collection of characteristics that may change over time". [25, p. 285] One may expect a happy confluence of theory and practice growing up alongside dynamic series of resembling definitions, but the design of effective learning experiences and new knowledge architectures requires insight both into the microstructure of learning patterns and the nature of the global forces that drive social cognition. Of course, theoretical definitions help to define the scope of empirical research, they improve by studying practice, but learning design draws on the results of theoretical understanding and meta-models. Perseverance in achieving a *theoretical synthesis* may shed light to formerly neglected but essential factors in learning practices, to critical problems of standardization and interoperability, over and above, confronts basic development alternatives from a broader perspective. Learning Sciences have just arrived at the threshold of gaining wider experience in using *mutually supportive systems* "with the human in a leadership position" as envisioned by J.C.R Licklider and Doug Engelbart over 50 years ago. Nonetheless, the alternatives "of making everything looklike a clay tablet so you don't have to learn to use paper" [57, p. 28], *versus* making personal learning environments user designable relying on an intentional variety of task-adaptable tools, reusable code and *bootsrappable* design technologies, are still with us. [Cf. 30 with 57] Theoretical syntheses always have inherent conceptual, historical and technological limits as we could learn from Licklider's and Engelbart's disagreement on the issue whether computer ought to adapt to the human or vica versa. But it is the thinkers' and designers' responsibility to test these limits and wote for increasing our effectivity in solving our problems and learning tasks by the augmentation our knowledge acquisition and organization insisting on the *co-evolution* of learning devices and methods since othervise contingent factors win out in design and development.

2 STANDARDS AND PRACTICE OF M-LEARNING EXPERIENCE DESIGN

The term "Learning Experience Design" (LXD) was coined as an analogy with User Experience Design (UXD), the new "professional identity tag" of information architects (Wurman [41]), and only recently has become an elemental component of m-learning design. It inherited from the web designers community the design levels of knowledge engineering, called "planes" of *Information Architecture, Information Design, Interface Design, Navigation Design, Visual Design, Interaction Design*, and in terms of James Garrett's reference work [42] its development model proceeds from the abstract (Objectives, User Needs) towards the concrete through the specification of Functional and Content Requirements. LXD connected the design principles of UXD to Interactive Media and Multimodal Learning in the context of education. Although it started to develop under the impact of LCMS based e-learning environments, paraphrasing the term 'user experience' as 'learning experience' it nowadays answers the needs of the mobile learning market. It addresses problems of designing intuitively usable, *learner-centered* interactive interfaces for m-learning and adapts to informal m-learning habits which are intertwined with Web 2.0 technologies.

The broad conception of Learning Design (LD) is closer to teaching methodologies and to e-learning oriented modeling of reusable pedagogic scenarios. The first applications of LD in e-learning were based on the conception of the *delivery of instruction* and on the a basic methodological insight that any instruction can be described and analyzed in terms of the parameters of the *Learning Environment*, the *Communication Services*, the *Roles* of the participants, the *Tools* which are used, the properties of *Learning Contents*, and the *Activities* of the participants of the knowledge transfer process. The intention of finding a *uniform* way of description for the existing teaching methods and the idea of providing a formal language that is based on a general meta-level terminology for modeling reusable learning scenarios predestined Learning Design for developing into an interoperable "de facto" standard (IMS LD). Its modeling approach is partially reinforced, partially complemented by recent didactic conceptions of "teaching as a design science" which stem "from the conviction that education is not merely a craft of delivering packaged knowledge". [43, cf. 44, 45 with 27, 48, 60]

2.1 Approaches to Learning Design

The specification, initiated originally by the Valkenburg Group of e-learning experts, looks back on more than a decade of efforts to formalize the meta-level description of an "unlimited number of pedagogical approaches" at a higher level of abstraction, called "pedagogical meta-models". [46] Its history spans from Educational Modeling Languages (EML) to formalizing collaborative and

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networked learning scenarios according to IMS LD [46] and learning activities in LAMS [59, 60] or pedagogical patterns in LEARNING DESIGNER [27, 44] incorporating new didactic conceptions. [44, 45] The divergence of e-learning oriented LD and m-learning friendly LXD begins with the "Self Directed Learner" whose *personalised learning experiences* stand in the focus of recent approaches. [48] "Planning the learners' activities always called for different methodological approaches than devising the teacher's own activities, lesson plans, or designing learning objects, although one was never without the other." [47, p. 2611] Education is a field where "design" as an intentional, systematic and reflective process implies paying more attention to planning *someone else's* actions and cognitive processes than in any other courses of human action. "From the point of view of learner centered design, however, the crucial difference consists in exchanging the perspective of stepwise activity planning to the design of properly composed environments and providing pointed solutions for user directed *co-creation* of knowledge." [*Ibid.*] The problem of the relationship between LD and LXD can be considered from two standpoints. The Learning Experience Designer poses it somewhat as follows: is the learning experience bound by the norms of the LD standard? Or perhaps: how does this norm assert itself in Web 2.0 / Web 3.0 mobile learning practice? The designer in the spirit of the LD standard, on the other hand, wants to know above all to what extent the meta-models articulated in the educational modeling languge of LD can be used for ascertaining the LXD norms. In other words, the LXD theorist is primarily interested in the *differences* of the LD standard and the LXD design principles, i.e., in the expressivity and limitations of the educational modeling language from the point of view of designing effective learning experiences, whereas the modeler of the learning activities who applies the LD specification is mainly interested in the consistency of LD based meta models and effective user experience design, i.e., in the *similarities* of the Learning Design methodology and the LXD norms. Reconsidering the usability problems of the IMS LD standard [47] in light of more detailed analyses of mobile training and learning architectures the conclusion can be drawn that it is "worthwhile to maintain its modeling advantages for capturing learning patterns separating issues of interoperability, machine interpretable course management, and the transparency of pedagogical meta models." [47, p. 2619] There is now a body of approaches supporting learning activities within learning environments and several comprehensive R&D project developed tools, LD editors and players, for this purpose. [27, 46, 60]

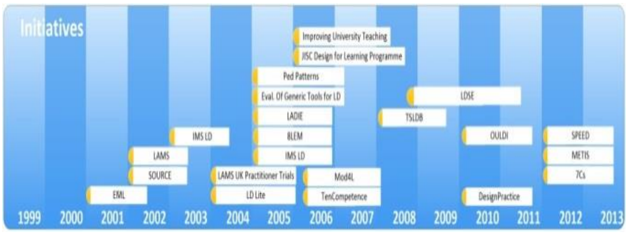

Fig. 1 LD initiatives from EML to recent ones (Source: LAMS)

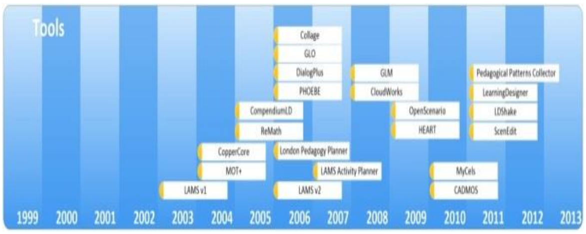

Fig. 2 Timeline of LD tools (Source: LAMS)

The figures above give an overview of LD intiatives and tools. Among them the Learning Activity Management System (LAMS) initiated by James Dalziel stands out with its handy Visual Activity Authoring Environment [59], and "as a system that supports designers from the initial conceptualisation of their design to its enactment with learners" [43]. It provides Tool Adapters, a Video Recorder, and offers knowledge organization services like Mind Map for the LAMS community which by now consists of more than 8000 members sharing over 1000 learning sequences world wide. LAMS has got integrated in leading Learning Managements Systems (LMSs) and Virtual Learning Environments (VLEs) from Moodle, Sakai, to MS Share Point but the community felt the need of explicitely declaring that LAMS is facing the challenge of *learner centered design* and the expectations of *openly networked learners*.

2.2 The Larnaca Declaration on Learning Design

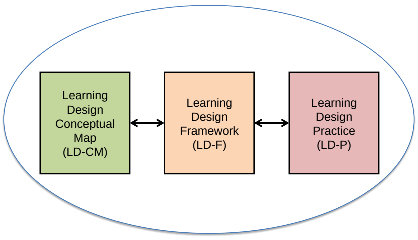

Fig. 3. Components of LD from the Larnaca Declaration

Stephen Downs makes a point when he notes that representatives of Learning Design who have published the Larnaca Declaration [49] "should rather call it 'teaching design', since the focus is on the teacher as, if you will, maestro." [50] The remark referes to the analogy drawn by the text of the declaration between the function of the educational metalanguage and of music notation, in the sense, that the former also desribes a "composition" (of learning activites), however, it is also a criticism formulated from the point of view of connectivism which relies on the learners autonomous knowledge organization and spontaneous collaboration as opposed to their "conduction". The declaration, however, is actually a demonstration of being aware of the problem, that "[m]any educators, particularly in the past, have tended to teach using methods that focus heavily on content transmission, and little on active student tasks (such as student-led analysis, research and discussion as used in Problem-Based Learning)." [49, Part 5.1] They agree that the shift "from being 'teacher centred' to 'learner centred', or from the 'sage on the stage to guide on the side' …" has brought about a change of focus from "how the teacher teaches" on "an 'output' model of education (what do learners know and can do following teaching and learning activities)", hence, "being 'learner-centred' is the foundation of effective teaching and learning". [*Ibid.*] But they call into question that being learner-centred should be taken to mean "that all learning must be led by the learner, and that teaching, particularly any type of direct instruction or drill and practice-style teaching, should be avoided." [*Ibid.*] They underline that "there is usually an important role for the teacher in structuring the opportunities for learning, and scaffolding the learning process to assist learners to learn. These structuring and facilitation decisions can still be described and shared using a Learning Design descriptive framework." (*Ibid.*) In light of the recent controversy between xMOOC designers and cMOOC belivers [31] their remark that "given the many examples of ineffective content transmission-style teaching, […], it is understandable that in […] some circles, 'teaching' is almost a dirty word". (49, *Ibid.*) Their suggested synthesis for the field of Learning Design, called "Learning Design Framework" (LD-F, see figure 3, and cf.

49) complemented by the Learning Design Conceptual Map (LD-CM) gives a transparent but complex enough methodology for describing even learner centered teaching and learning activities in which the latter helps mapping the core concept of the LD-F (together with guidance and sharing) even to current m-learning practices in which the teacher is "just" a coach or playes the role of a facilitator. This way the declaration is not only able to give a good account of the function of LD, finding a more exact position for it on the educational landscape, but also contributes to bridging the gap between theory and LD practice.

2.3 Problems of Standardization

While the EC identifies standardization as a key strategic topic [53], the 2012 Research Report on m-learning by the E-Learning Guild points out that one of the largest barriers to the adoption of mobile learning expressed by e-learning practitioners is the "continuing lack of standards". [51, p. 18] This assertion is not just the conclusion of content developers whose opinion is biased towards the standardization process which unfolded since the turn of the century, or of experts who cannot detach from the traditional e-learning mindset. Learning designers who are engaged in designing m-learning Apps or are authoring content for these Apps are actually the ones who are facing a major challenge with transitioning to mobile because "m-learning is not e-learning on a mobile device". [54]

The transition from the e-learning to the m-learning revolution is characterized not only by a change of terminology substituting 'Mobile' for 'Computer', 'Lightweight' for 'Media-rich', 'Networked' for 'Collaborative', 'Spontaneous' for 'Interactive', or 'Connected' for 'Hyperlinked' with due consequences in the differences of pedagogical terms and new labels turning up in m- versus e-learning environments. [Cf. 52 for a terminological comparison] The new devices themselves are a major barrier to the adoption of m-learning because content developed for other media does not transfer well to mobile devices in result of the size of display as well as for technical reasons including the pixels and aspect ratio and the specialties of the management of task organization in multiple applications across different learning contexts.

2.3.1 Issues of interoperability and reusability

Global standards are fundamental to ubiquitous connectivity. Globally standardized technologies ensure worldwide interoperability between networks, and devices, but that level of interoperability is not enough for learning content or App development. Consequently, problems of *interoperability* and *reusability* take a different shape in the mobile world. If compliance with standardization is valued more than innovation and creativity it can pull back the rapid development of mobile technology. In result of this consideration, *durability* appeared on the wish list of m-learning standards as a requirement to withstand technology changes over time without costly redesign of content, recoding, or time consuming reconfiguration.

Reusability also obtained a new meaning. Since learning content in m-learning frequently comes in the form of a mobile App (e.g., Periodic Table, Solar System) the KISS (Keep It Simple, Stupid) principle often accompanies to the requirement, or else, the reusability of more complex didactic metamodels moves to the level of the organization of learning paths. Of course interoperability of the mobile OSs is also on the wishlist but learning design is about semantic communication and didactic problem solving at the level of educational content, so cross platform adaptability enters the scene as a separate issue.

2.3.2 Mobile Apps, Application Program Interfaces and Personal Knowledge Management

The technology switch (behind the 'm') brings about complex changes which cannot be projected into the term "mobile" even though certain components of the technology shift itself were and are related to it. HTML5 itself, as the media of the Web 2.0, have brought about new opportunities for multimedia including simulations such as Solar Walk, or Augmented Reality Apps. As browsers become smarter and smarter they are becoming close encounters for the former "e-learning frameworks": we trace our activities in its history, integrate it with bookmarking and note taking Apps, with visualization or analyitic tools such as Lucidchart, or Gliffy diagrams, and access our social softwares from them. On the other hand, wast amount of native m-learning Apps are coming out every day challenging our technical expertise of mobile use and multitasking practice. They often provide more local storage capabilities and better support for multimedia then general purpose mobile web Apps. In this respect technology takes a secondary role: what is important for the learning designer is to get the scope of the App right. Because we use a multitude of Apps, not only our devices have to adapt to our learning needs, we, as users, have to learn to configure our personal knowledge/learning management environment. Hence, in the mobile world, Personal Knowledge Management is not longer a 'nice to have'; it is a 'need to have'.

From this point of view the new "mobile" technological epoch has already transformed the didactic world. App-level mobile information delivery mechanisms have developed to the point where in-situ, context and task dependent knowledge access can be made effectively and efficiently in forms that are considerably more valuable to learners than that provided within robust Learning Management Systems (LMS). [39] This state of affairs often causes a conflict when students work within an institutional LMS, and applies to informal learning even more. One problem in this respect is that 'privately owned' ecosystems force and drive mobile access to educational content and services through their app stores and cloud services. Since most people are connecting to the Internet through smartphones and other connected devices business oriented m-learning platforms represent considerable threat to the openness of the web, a reason for OS evangelists, to call for Open m-content standards for accessing Open Educational Resources (OER). [14]

Another aspect of LMS related challenges facing mobile course authors, or learning designers who want to use already existing materials is how to communicate with the learning management system. Since the majority of formerly developed LMSs were either SCORM or AICC conformant, and we have a rich pool of educational resources available in the SCORM format it appeared to be a plausible move to apply these two standards to guarantee vendor independence. This can be achieved through LMS APIs (Application Program Interface) which can tell you how to communicate directly with the LMS'. But it requires programming expertise to be able to gather data from a course and pass it to an LMS according to the SCORM specification using, e.g., Javascript. M-learning authoring tools, such as mLearning Studio, or Litmos Author, were setting informally a new 'standard' by making it easy to package a HTML5 SCORM or AICC compliant mobile learning course. However, both AICC and SCORM 1.2 can be considered as an outdated 'de facto' standard since its content packaging technology is superseded by the capabilities of HTML5, and because its activity management is built on LMS technology. The arrangement and sequencing of Sharable Content Objects in the run-time environment is based on the XML-type logic of the content package which is essentially a text and play oriented, chapter and link structure. Although the content arrangement and sequencing component of SCORM 2.4 allows the definition of more complex and adaptive interactions, in general practice it serves simple forms of personalized presentation. Degani et al. [55] suggested an m-SCORM extension to deal with mobile use cases exactly because of the differences of LCMS and mobile activity management. Some LCMS vendors and OS development communities, e.g., ILIAS, introduce new OS solutions like the ISN Mobler Cards [56] and other mobile web application which comply with open interoperability and assessment standards (mainly with IMS Global's Question and Test Interoperability), or handle the task of connecting various learning resources and activities over the Web with IMS Common Cartridge, or Learning Information Services, or in case of formal administration with Learning Tools Interoperability (LTI).

2.4 Training and Learning Architecture of Advanced Distributed Learning

The Training and Learning Architecture (TLA) of Advanced Distributed Learning (ADL) represents a new approach to m-learning standardization which is ready to face the expectations of openly networked learners. The Aviation Industry Computer-Based-Training Committee (AICC) joined the initiative of ADL which consists of four components: *experience tracking*, *content brokering* and content 'understanding', *learner profiles*, and *competency networks*. Its Experience Tracking specification, the Experience API (xAPI: the "Next Generation SCORM" application programming interface, also called "TinCan" Api) supports learning flow management "over the Web" in the spirit of Learning Experience Design (LXD). The xAPI specification is now developed as a component of AICC's CMI-5, the next generation eLearning interoperability specification intended to replace the existing AICC & SCORM specifications. According to its official announcement "ADL is focusing its research efforts on a next generation online learning environment […] which will provide learners with richer and more innovative learning experiences. The experience tracking, which we refer to as the 'Experience API,' is the initial phase of the TLA." In 2014 ADL is planning to offer xAPI conformance testing for LRS.

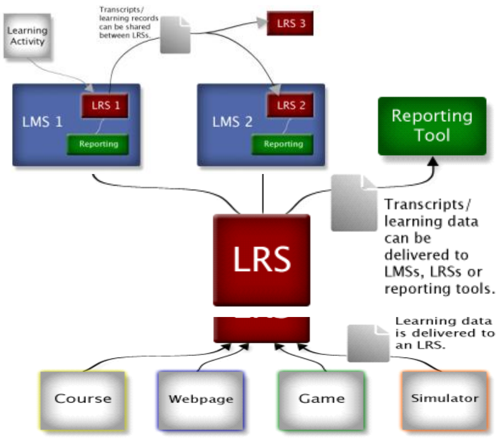

Fig. 3. xAPI communications with the LRS (Compiled from the descriptions of Rustici Software)

The xAPI is a service API for handling activity streams (e.g., JSON, or Atom) generated by different learning services. It exchanges information about the learning processes and links educational tools incorporating functions of activity tracking. It records the information about learning activities into Learning Record Stores (LRS, cf. Fig. 3). It can work with multiple LRSs, admitting communication with LRS servers in the Cloud, with a corporate LRS, with the administrative information store of educational institutions or a private, personal record locker. Using its communication protocol the LRSs are able to talk to one another and the information can be passed between them storing and requesting activity streams. What the xAPI sets out are the parameters and rules for passing data statements about the user's learning activities from one application to the LRS and back, so that it can make sessions possible with other Apps.

Its 'statement' sub-API tracks the learning records while Learning Activity Providers can use its 'state', 'agent profile', and 'activity profile' sub-APIs for extracting and providing information that is needed for creating dynamic web 3.0 learning environments. "Any device can connect to the xAPI which records learning experiences which can take place outside or inside an LMS, collects information from mobile devices (automatically or at the learners prompting), including reports of real world activities.The devices that are used can be camera-phones, sensometers, GPSs, even sonar devices or gyroscopes, enabling simulations, the combination of real life activities with rich media or augmented learning." [47, pp. 8-9] The records from diverse sources which are feed to the record store consist of data about the type of the activities (e.g. reading an e-book, watching a YouTube or Khan video, flying with a flight simulator, participating in a webinar, communicating with one's Mentor, using Apps from Google Play) including the parameters of the sessions, their the duration, the achieved score, success or completion levels, assessments, etc. The xAPI is expected to promote "greater ownership of learning by learners, real world problem solving and the development of complex ideas and knowledge transfer" [35, p. 4] which are key success factors of mobile learning identified by the independent, not-for-profit organization, the Learning and Skills Network.

3 LEARNING DESIGN SOLUTIONS OF MINDTHEGAPP™

Learning Design can take mobile learning to another level by providing contents that are context aware. Therefore we have adopted a "Right Content to the Right Student in the Right Context" approach [Cf. sect. 3.4.1 below] to enhance the main advantages of mobile learning and that move implied the requirement of tracking students' learning activities. Since the preliminary specifications of the required features of a multi purpose Mobile Learning Platform coincided with the purposes of the Experience Tracking module of the TLA, in the framework of the EU supported MMATT (Mobile Multimedia based Knowledge Transfer) project a great deal of activity was devoted to exploring the possible e-didactic scenarios from the point of view of the future prospect of implementing further components of the TLA. The application of the xAPI and an LRS opened the way for accessing OER or using compatible m-learning Apps in a way that MindTheGapp™ had become capable to track learning activites and made possible for the user returning to the recommended scenarios.

3.1 xApi and LRS for Mobile Activity Tracking and Learning Analytics

Confirmed by surveys on user expectations with respect to the applied learning environment our starting point was that the realization of *personal learning paths* needs m-learning support based on standardized technology and adequate methodology. Convinced that learning-paths were not only metaphorically but literally the way to go, it was clear that for offering alternative task sequences, in the teachers' role view, course authoring must provide tools for editing tasks, activities and content in a *conditionalized* way with *milestone dependent tasks* and *preconditions* for the alternative learning paths. Tracking learning activities in an m-learning framework required the implementation of a LRS and the already mentioned so called "next generation SCORM standard", the xAPIor, the so called, 'Tin Can'. Since the Tin Can statements about the learning activities on mobiles are tracked by the LRS, the learner can continue her training activities on mobile devices anywhere, anytime no matter where the learning process was started.

We also projected that the implementation of a Cloud-based LRS would be a firm technological basis for *learning analytics* which promotes the future development of the MMATT knowledge transfer framework in the direction of *adaptive learning*. Since student tracking assists the course provider in collecting data about students' progression she can offer alternative learning tasks and adapt learning materials according to personal needs. Comparision with the performance of fellow students is a strong motivation in all age from primary school to university students. "Progress indicators can offer guidance and encouragement to students and make learning exciting and fun". [19, p. 2] Monitoring sudent activities not only assists the educators it also provides feeback to students. The figures (4-5) below show the monitoring views of MindTheGapp™.

Fig. 4. Comparison of students' performance

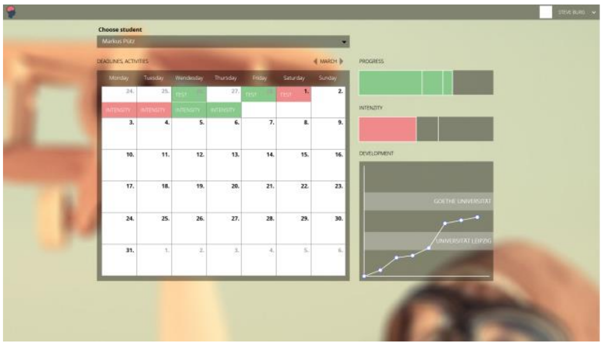

Fig. 5. Monitoring one student's performance

3.1.1 Graphic Editor for Course Authoring, Touch Navigation, and QTI

The methodological conclusions we have drawn from the need of providing didactic support for editing learning paths during course authoring included the development of a graphic editor. The known tension between the advantageous functionality and the relative complexity of Learning Design (LD), the implementation problems of adapting it to mobile learning led to usability requirements which forced simplification. A LAMS2 type graphic editor [cf. Fig. 6-7.] seemed to be suitable for task composition which was complemented with the option of creating alternative *milestone dependent* learning scenarios. The latter is displayed on the students' mobile device as a preorganized task sequence and the obligatory tasks for the milestone are highlighted as preconditions.

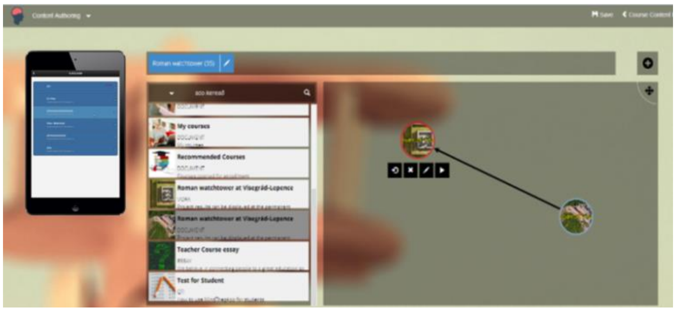

Fig. 6. Milestone dependent task editing of MindTheGapp™

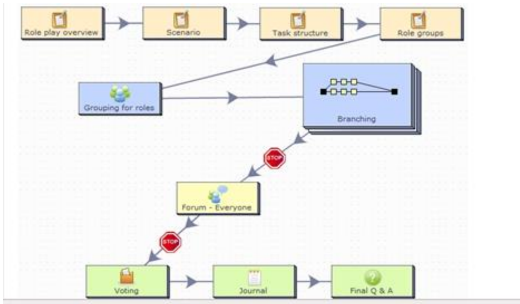

Fig. 7. The LAMS2 graphic editor

Milestone dependent tasks and content objects can be organized into Units of Study and the same tool encourages adjustments, customization and the inclusion of collaborative tasks which can be carried out via mobile collaboration Apps. Interviews with students confirmed that next generation learners intend to realize their personalized learning paths using their smart devices, hence, tend to interrupt the activity sequences using communicative and search features of their device. Just as global educators they are happy to share their learning experiences with others, insist on collaboration and access OERs for user generated content.

The research phase of the MMATT project also confirmed that both formative and self assessment requires the implementation of self, and formative assessment capabilities complying with IMS Global's Question and Test Interoperability (QTI) specification. We also considered the adaptation of IMS Common Cartridge and LTI, however, at the moment we see the potential of the xAPI for further development of current xMOOC environments more promising for the integration of a wide range of mobile Apps with the MOOC frameworks and count on the further components of the TLA (Learner Profiles, Competency Networks) for designing didactic models and a *recommendation system* for adaptive learning based on learning analytics and accumulating data about user practices.

3.2 Course Aligned Facebook Group

It was a basic methodological principle that for MindTheGapp™ that the m-learning environment developed in the framework of the Mobile Multimedia based Knowledge Transfer project, must rely on social sites for distributed cognition, communication and learning group formation. It did not seem reasonable to duplicate services (cf. section 1.1.2 above). Our experiences with development support groups (students as well as teachers) convinced us, that for MindTheGapp™ it was a more m-learning friendly design strategy to generate a Facebook account for each course utilizing the users' already existing Facebook accounts to log in automatically. In this way, users are able to continue their accustomed knowledge sharing pactices, and the same design strategy can be extended to other applications via open ID.

3.3 Mobile Apps as a Toolkit and the VIDra™ video-recording, editing and presentation module

Mobile Apps play an important role in the informal learning as it was discussed in section 2.3.2 above. They can be used for communication, collaboration, gathering and sharing of information, simulation, but also as content presentation tools. *Jeff Dunn* of Edudemic and *Diane Darrow* on Edutopia provide a selection of such mobile Apps in an arrangement according to Bloom's taxonomy.(Figures 8-9.)

Fig. 8. Edudemic's selection of m-learmig Apps

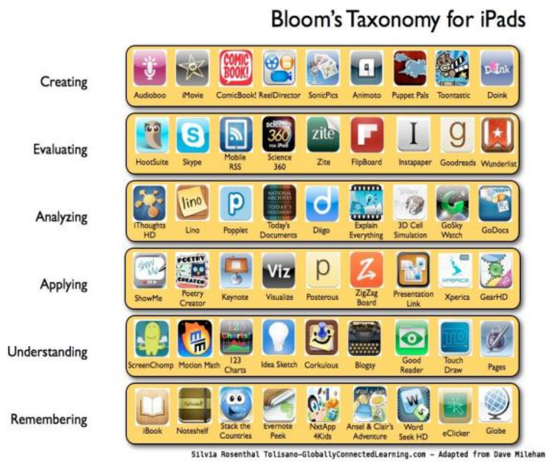

Fig. 9. m-Learning Apps for iPad

Mobile video recording supports that students can make use of their surroundings, collect material during field work and share their experiences with others as part of an informal learning process. In this way they have the opportunity to reflect and share ideas and get instant feedback using their mobile devices. However, the adaptation of video technology (v-learning) in m-learning is also of crutial importance on the teachers' side. The basic toolkit of MindTheGapp™ incorporates the VIDra™ video module capable of automated recording of lectures, or collective learning processes and demonstrations.

Fig. 10. The VIDra™ video module

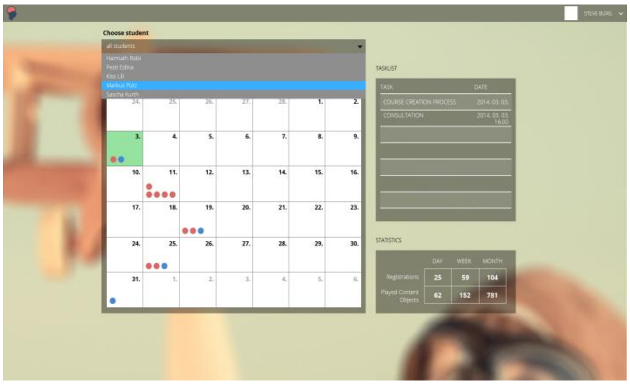

Fig. 11. Actvity Monitoring

It can *record automatically* and display in a scalable presentation-window, simultaneously with the video stream, *every screen change that takes place on the teachers' device*, let it be a Power Point presentation, a mockup, or a PDF. This innovative feature facilitates meta level reflection: after recording users are able to replay and analyze their stuff, can retroactively assess their activities and interact with their own recorded artifacts let it be a visual presentation of an experiment or any demo material shot at an external location. Shooting their own films, using mobile Apps, like WeVideo Magisto, Instagram Video, Vine, or Pinnacle Studio students themselves can create video-records of their learning experience or field work via smart devices and co-edit the records (e.g., collections of pictures of plant species, clips of animal behavior, or situational practices in foreign language learning). Within the VIDra™ framework they can post-edit and synchronise their video with other complementary or illustrative materials making it suitable for presentation or further study and investigation. In former reports [61, 31: *section* 3.5.3], wich described the VIDra modul, it was suggested that its integration with MindTheGapp™ could work as a generator of innovative (v+m) learning models saving the legacy of the LD-type representation of pedagogical knowledge. During the test phase of the alpha version of MindTheGapp™ teachers who tested the module confirmed that it opened a "new world" both for improving presentation techniques and collaborative work.

3.4 Synergies with SziMe3D and Further Developments

In the research phase of the the EU supported Mobile Multimedia-based Knowledge Transfer project (MMATT) alternative *knowledge map* based approaches to navigate, organize, and sequence Web-based content were evaluated parallel with technical requirements of cross-application *visual interfaces* for designing learning sequences from building blocks of individual or collective activities and for creating reusable didactic models of individual or cooperative problem solving. Since the integration of such web services required extra implementation effort this area was singled out as the main target of further developments. Alternatives for mobile-App integration are considered ATTOW.

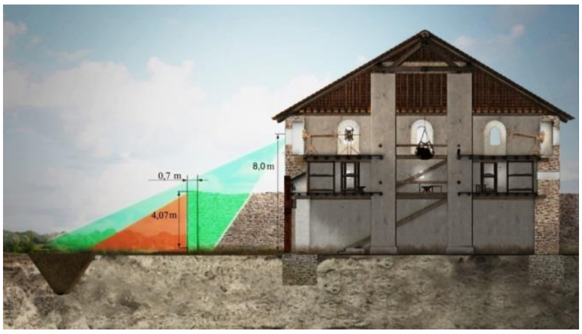

Fig. 12. 3D model of a Roman watchtower at Visegrád-Lepence from a history course

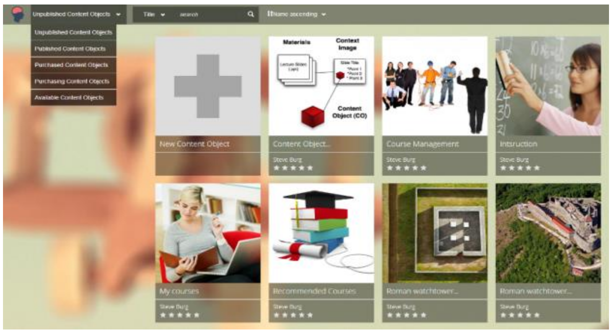

Fig 13. Content with objects of the history course

Since both the MMATT and the SziMe3D AR project was carried out within the framework of the New Hungary Development Plan (EDOP 1.2.1) with HUMANSoft as the project leader, it was a plausible opportunity to exploit synergies between the two projects. The state of art 3D technology of SziMe3D is ideal to visualize the selected objects and artifacts in cultural, touristic, educational and research environments. By its 3D technology records of 3D models of cultural heritage or artifacts of outstanding importance, historical sites such as the Shrine of Mitras, the Franciscan Friary of Visegrád or the Benedictine Abbey of Miskolctapolca can be integrated into the video module of MindTheGapp™ which helps the students to understand building constructions or evaluate archeological findings. [58] The same technology is also applicable in health education or in digitizing processes of surgery or scenes of forensic evidence. The figure above (12) is a model of a Roman watchtower at Visegrád-Lepence, reconstructed for the educational purposes of a history course in MindTheGapp™ (lower right corner of figure 13) as a presentation for CeBit2014.

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NEW SZÉCHENYI PLAN

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