A Connectivist Approach to Smart City Learning:
Valletta City Case-study.

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Abstract – *A connectivist approach will be adopted to design and evaluate learning in technology-enhanced open spaces in Valletta city. Learning is considered as a process of creating connections between learner's inner cognitive and affective systems with the external physical and social worlds. These interactions are organised within a model comprising dimensions and levels of interactions. The experience for a learner in a technology-enhanced historical place will be designed considering interactions with the content domain (history, botany, art), the technological dimension (interaction between handheld devices and the available signals such as 3/4G, Wifi or GNSS) and the social dimension comprising interactions with fellow learners /citizens and domain experts. The levels of interactions are related to learner's experience within the subject domain, with technology and one's status or role in learning community or community of practice. Thus learning experiences have to be designed considering acquisition level for novice learners, participatory learning for more experience learners and contributory learning for highly competent learners. This connectivist model will be applied to identified places of historical or educational interest in Valletta city to design different modes of learning mediated through interactive technologies. The concept of Personal Learning Environments in Smart cities [1] will be used to provide technology-enhanced experiences in Playful learning, Seamless learning, Geo-learning, Citizen enquiry and Crowd learning.*

A number of these technology-enhanced learning experiences, developed in collaboration with CYBERPARKS ACTION's WG1, will be contextualized in Valletta city. University of Malta will provide the domain content and resources, together with the pedagogical strategy for each learning experience. Researchers from WG1 will design and develop the technological model and infrastructure, mainly the Android-based Way-Cyberparks App that will integrate GNSS-based learning, Augmented Reality, Navigation tracing and other functionalities used for specific tasks and type of data collection. An interactions-based methodology will be used to evaluate learning along the identified dimensions.

Keywords— Smart City Learning, Connectivist pedagogy, Mobile Learning, Augmented Reality, Technology-Enhanced Learning, Cyberparks.

I. INTRODUCTION: SMART CITY LEARNING

The combination of emerging digital technologies together with citizens' increasingly elaborate digital competence is radically changing every aspect of our lives – how we interact with our physical and digital surroundings, how we communicate, learn, share knowledge and experience, how we socialize and entertain ourselves. The increased levels of flexibility, immersion and engagement provided by ubiquitous digital technologies, social media, virtual and augmented reality are continually challenging our established pedagogical models and directing us to consider innovative approaches and learning ecosystems. The infusion of all dimensions of our lives with digital technologies is leading us to live a 'Hybrid Reality' [2] through our interactions with the 'Internet of Things and People'. This 'Hybrid' mode of living in a technology-intensive environment increases the pedagogical potential of these contexts with strong impact on both formal and informal learning.

Technology-enriched environments support the vision of Smart Cities by influencing and improving key factors like mobility, environment, people, quality of life and governance. In Smart Cities, learning is not only a way to train an adequate human capital, but becomes one of the driving forces of the 'smartness' and well-being of a community. Buchem & Perez-Sanagustin [1] define smart city learning from a human-centred perspective as the 'learning experience of locally and globally interconnected citizens who use smart technologies to learn by using, sharing, remixing and co-constructing learning resources, and in this way actively contribute to solving societal, environmental, political and economic challenges'. The same authors claim that "From this perspective, the 'smartness' of the learning environment is determined primarily by the citizens and their uses of smart technologies rather than technologies themselves" Unavoidably, the underlying and ubiquitous techno-ecosystems - whose embedded intelligence, sensitivity and responsiveness surround the individuals - challenge the future of learning and call for a redefinition of spaces, contents, processes, skills and assessment approaches.

The potential of Smart cities to serve as an open macro Personal Learning Environment [1] comprising a wide range of localized micro learning contexts triggers reflection about how these macro and micro PLEs can be enhanced and enriched through digital technologies. The idea becomes even more exciting when one considers capital cities, like Valletta in Malta, that are endowed with a plethora of artistic, historical, architectural and cultural heritage. Combining this resourceful physical environment with the versatility of digital technologies can provide an intensive and comprehensive learning experience that contrasts with formal learning contexts that citizens might have experienced many times and possibly criticized.

Learning in such open environments is profoundly different from that occurring in formal contexts like the classroom. This compels learning designers to look for new conceptual and theoretical frameworks that describe these experiences from a different perspective

to teacher-driven, didactical approaches that characterize formal education. Though instances of constructivist (learning through exploration, experimentation and collaboration) and constructionist (learning by designing) may also be included in the formal curriculum, learners are only marginally involved in the planning, management and evaluation of their learning. On the other hand learning in Smart cities draws more on a connectivist epistemology [3] that focuses on 'connections' created through digital technologies.

Learning in connectivist technology-enriched environments is characterized by a complex system of interactions comprising various dimensions. The mere presence of a person in these places evokes interactions with domains of knowledge, such as History, Archaeology, Architecture, Science or Technology that are actually prompted by ad hoc interests. Subsequently this provokes a hybrid interactive experience involving the physical environment, the mediating technological infrastructure and other learners or experts present in or connected to that particular context. The underlying epistemology, pedagogy and contextual characteristics of these 'smart', connectivist environments are disparate and many times contrasting to classroom situations.

From an epistemological perspective, smart city learning contexts are characterised by a shift from knowledge representation and simulation to learning by immersion and embodiment [3] of the situated, hybrid experience. In classroom situations, static representations of objects and simulation of processes are negotiated assuming a direct positive correlation between degree of fidelity and learning. Yet this comprises learning through indirect experience using static or animated representations. Learning in Smart city contexts is the outcome of an immersive and highly interactive hybrid activity through which both personal and distributed knowledge is acquired, created and shared. This immersive approach leaves in learners, not only intra-individual cognitive and affective residues, but most important a networked personal experience forming part of the distributed knowledge and expertise that resides within digital systems. Each immersive learning activity in Smart city contexts creates intra-individual connections with learner's sensory-motor, cognitive, affective and conative systems that describes the idiosyncratic experience in that particular place at a specific time under specific external conditions. But it also creates inter-individual connections that describe the social experience comprising interactions with people sharing the same physical space and those connected through mobile devices.

Learning in Smart city contexts is also distinguishable in its organisation and management. While most learning in formal educational contexts is teacher-structured, teacher-managed and predominantly teacher-assessed, learning in Smart city contexts is mostly not prescribed, though prescribed activities can be used as triggers for further explorations and elaborations. Moving away from set curricula and structured activities, it is primarily formulated, managed and evaluated by the learner mainly through ad hoc interactions and improvised personal learning plans. Technology is exploited, not to simulate learning in an environment, but to enhance the immersion, interaction and connectedness of the learner with the surrounding and distant environment. "When mediated through technologies, e.g. by means of mobile

and locative media, the surrounding physical environment and the digital environment can be dynamically merged into augmented, ad-hoc Personal Learning Environments which are not permanent, but created ad-hoc and adjusted dynamically by connecting virtual and physical spaces" [1], p1.

While classroom learning is very static and confined, learners in Smart city contexts are provided with enhanced mobility, interaction and control possibilities. This dynamic environment gives rise to the phenomenon of 'glocality' – "where the local and the global coexists" [4]. Mobility and interaction in Smart city contexts is manifested along different dimensions. Sharples *et al.* [5] differentiate between mobility in the physical space, mobility of technology, mobility in conceptual space, mobility in social space and mobility in time. Through this mobility learners are able to capture and share personal learning experiences in new ways that enable new forms of learning across multiple contexts [6].

In this connectivist setting, interactivity is mediated by the existing technological infrastructure, personal digital devices such as electronic tablets, smart phones, wearable digital gadgets and any task-dedicated apps. Interactions in the identified contexts in Valletta will be mediated through GNSS or Wifi-enabled devices equipped with the Way-Cyberparks App that enables users to interact through various communication channels and actively participate in multi-directional conversations. It also enables *Crowd learning* [1] that harnesses the knowledge of 'surrounding' people and utilizes "the power of the masses" to support learning experiences. Apps like 'Foursquare 8.0' and its companion 'Swarm' create information flow between the crowd and the learner who can access the expertise of the crowd at anytime and from anywhere through the personal device.

Such dynamic, immersive, hybrid environment is capable of supporting *multiple-objective learning* enabling learners to follow personal objectives and learning patterns. At one moment it could be an information-seeking interaction using augmented reality, followed by an exploratory activity on the same App that attempts to establish relationships between concepts, ideas or events. Playful learning is another learning approach mediated by pre-designed interactive systems or Apps that introduces the competitive and fun elements in the learning experience. The Way-Cyberparks App can be used to promote *citizen enquiry* [5] to blend inquiry-based learning with active citizenship as a way to create knowledge and awareness about relevant social issues.

The interaction possibilities created by the integration of digital technology in open physical environments leads to *multi-context learning*, which enables not only learning anywhere and anytime, but also combines physical and virtual spaces transforming urban elements into learning resources [7]. Sharples *et al.* [5] refers to this as '*Seamless learning*' that extends the learning experience beyond the boundaries of time and location, blending learning with everyday life. '*Geo-learning*' is an instance of seamless learning that utilizes context-aware and position-based technologies to add interactive points and layers of digital information to physical spaces. This offers the possibility of interconnecting locations

and social settings, and facilitates the exchange of information across contexts [8] For example both the Aurasma and the Cyberparks Apps could connect learning contexts by moving themes explored in the classroom to outdoor settings from which further data, observations, media footage and context analysis are taken back to the classroom to enrich lessons and elaborate the learning experience.

Smart City connectivist learning contexts demand a paradigm shift in learning design approaches. Current prescriptive learning design models are inappropriate to capture the complexity, dynamism and unpredictability of learning in such contexts. Learning design models that empower learners to design and organise their mobile learning experience are more applicable for these technology-rich, highly interactive, evolving scenarios. The role of teachers and learning designers thus shifts from prescribing (instructional) activities, on basis of identified needs, to providing the digital (pedagogical) infrastructure and resources to be used by the learner for designing and managing one's personal learning plan and experience. It is not a prescription based on task and content analysis but one based on analysis and identification of processes and interactions that will underpin potential learning experiences [9]. Moving beyond designing structured activities, dimensions and levels of interactions are used as design elements to develop possible patterns of interactions made available to visiting learners who will use them to develop their seamless, inquiry-based, playful, glocal learning experience. This design approach also makes use of emerging technologies and digital resources which are evaluated and employed in smart city learning contexts considering the learning processes they are capable of mediating that will eventually empower learners to develop their (ad hoc) learning plan and experience.

So, the research questions underlying this investigation about mobile learning in an urban context are:

- How does the Way-Cyberparks App mediate user interactions with the surrounding physical and digital environments?
- Which further user-generated interactions are triggered through the use of the Way-Cyberparks App?
- How can one evaluate the potential of the App in promoting different modes of learning?

II. METHOD

This study explores how handheld digital devices like Smart phones or tablets can provide instances of engagement in 'Smart City' learning within Valletta city. Mobile learning activities have been developed for two different locations as shown on the next image.

Upper Barrakka Gardens is a site that provides picturesque views of the Grand Harbour and the surrounding Cottonera region. This was selected to develop a mobile learning experience about a historical event that took place at Senglea Point (on the opposite side of the Grand Harbour) during the Great Siege of 1565.

Senglea Point as seen from the terrace of Upper Barrakka Gardens:

Source: https://www.schulfahrt.de/blog/2010/03/15/malta-eine-insel-zwischen-geschichte-und-moderne/

The other site is Argotti Gardens in Floriana, just outside Valletta city. This was chosen to develop a mobile learning experience about the History of the Gardens and various botany-related themes. The two mobile learning activities were designed to be managed through the Android-based WAY-Cyberparks App (freely downloadable from Google Play) which is being used, in the context of the Cyberparks COST Action 1306, to develop location sensitive mobile learning experiences. Besides navigation tracing and geo-activation functionalities, the App was further developed by the technical team to integrate Augmented Reality (AR) [10] that could be activated through the Global Navigation Satellite System

(GNSS). Using this customised App, two GNSS-activated learning activities were designed for the identified locations with the specific pedagogical objective of promoting the different modes of Smart City Learning discussed above. The App will be also used to mediate, trace and record user-generated (learning) interactions as triggered by the prescribed App-based activities.

Thus a visitor to any of these sites can use the WAY-Cyberparks App on the Smartphone or tablet to learn about a number of proposed themes. When the visitor enters a pre-defined area and is in a pre-defined orientation in terms of GNSS coordinates, the WAY-Cyberparks app notifies the visitor with a welcome message proposing four activities which one can activate by selecting the relevant icon on the screen of the smartphone. Each of these options leads to an Augmented Reality-based category of interactions, namely interactions about 'History' of the location, about 'Structures' in the location, about 'Processes' occurring in the location and also suggestions for follow-up activities as a 'Reflect' activity. The user opens the camera of the smartphone to frame a target object or location and starts interacting with it through any of the four proposed options. On selecting any of these, the user will have different media options (text, images, audio, video) superimposed on the view window of the camera. For example, s/he will be provided with digital images of maps and models that are superimposed on the real background. The objective is to enable the user to develop a better understanding of the composition and function of particular structures or the chronology of a particular event linked with that place. Through the 'Reflect' option the App will propose other on site activities and activities to be carried out in other locations where user can continue his/her explorations and inquiry. The App will provide access to different on-line media management tools and social networks to enable and record further user-generated interactions.

III. SMART CITY LEARNING SCENARIOS

The following mobile learning scenarios are being designed to be piloted in two identified sites at Valletta. The conceptual design will identify and discuss the different dimensions of interactions in relation to the predominant mode of learning being promoted through the customised Way-Cyberparks App.

A. A Botanical Experience at Argotti Gardens, Floriana

The mobile Learning Activity (MLA) about the history and botany in Argotti Gardens was designed in collaboration with the site curator Dr Joseph Buhagiar. The WAY-Cyberparks App is customised to inform and provoke reflection about History of the Garden, important structures and botanical processes in the Argotti Gardens. These include reproductive processes of Endemic Trees and botanical collections found in the Garden and the water irrigation system. The 'Reflect' option attempts to extend this informative and reflective activity beyond the site through further questions and suggestions.

A visitor at Argotti Gardens is offered a number of mobile learning activities through an App-based map showing flagged 'Points of Interest' (PoI). Standing at the entrance of the Garden, a GNSS-activated introductory session welcomes the visitor and gives important information about the layout of the site, highlighting the flagged PoIs. The visitor is then invited to roam in the Gardens visiting the PoIs while commenting and recording his/her experience through photos, audio commentaries or text-based descriptions. In case the visitor has access to the internet through his/her mobile phone, these are communicated and shared in identified on-line applications such as Twitter, WhatsApp, Quattro, Facebook, or a personal blog or website. If there is no access to the internet, any comments and created media can be sent when connecting to internet. The objective is to use the prescribed GNSS-activated learning activities to provoke Citizen / Learner Enquiry, Crowd and Seamless learning. The following is a proposed interactions template describing type of learning as a function of interactions with the domain (Botany and History), technology (Way-Cyberparks App and web-based applications) and Community (co-learners including other on-site visitors and those within on-line social networks).

B. Interactions template for Argotti Gardens

Location details	Argotti Botanical Gardens, Triq Sarria, Floriana, Malta. GNSS coordinates: 35.892216,14.503554, (WGS84)
Targeted Smart City Learning	Primary: Geo-learning, Citizen/Learner Enquiry Complimentary: Seamless and Crowd learning

	DOMAIN	TECHNOLOGY	COMMUNITY
Acquisition of Knowledge and Skills	Facts and Concepts about: • Argotti layout • History of Argotti • Identified endemic tree - *Gharghar* • Cacti & Medicinal botanical collections • Argotti irrigation system	Understand the concept of GNSS based learning. Acquire skill in using: • Way-Cyberparks App and addon • Augmented Reality functionality. • Use mobile device to follow GNSS triggered location based media overlays.	Discussion within on-site task groups/on-line collaboration groups about: • How to use mobile device to activate geopositioned learning activities. • The identified domain facts/concepts/themes.
Contributory learning (sharing ideas, creations and reflections) about learner identified queries and themes	For each of the identified domain queries and themes: • Take photos to include in documentary. • Identify info (facts) about each of the documentary themes.	Use relevant applications to record textual, image, audio and video (text editor, built-in camera, sound recorder). Use of Apps embedded in WAY – App to share reflection and creations. Use of online Apps & social media to share knowledge and reflections.	Communications with experts and interest groups in botany, history and architecture. Share creations and documentaries with other site visitors and online.

To promote these learning interactions, the WAY-Cyberparks App will be customised through four clickable options that will be available on mobile interface, mainly 'History', 'Structures', 'Processes' and 'Reflect'. The following tables describe the content and related resources to promote insight, understanding and reflection about identified domain themes.

The 'History' function:

MEDIA OVERLAY IN APP	INFORMATION PROVIDED (DISPLAYED TEXT OR RUNNING COMMENTARY)
Images of: Bailiff Ignatius de Argote et Gusman; Knight/Grandmaster Emmanuel Pinto de Fonseca; Plan of Villa in Argotti Gardens.	History of: Private villa in Argotti Gardens. Garden and collections.

The 'Structures' function

MEDIA OVERLAY IN APP	INFORMATION PROVIDED (DISPLAYED TEXT OR RUNNING COMMENTARY)
Structural plan of Argotti Gardens	Description of labelled plan of Argotti Gardens
Images of various Nymphaea	Structural and functional features of various nymphaea found in different countries to explain the concept of a Nympheum.
Irrigation system plan; Video of underground cistern reservoirs	Discussion of the need for large water reserves to irrigate gardens during long periods of warm and dry climatic conditions.

The 'Processes' function

MEDIA OVERLAY IN APP	INFORMATION PROVIDED (DISPLAYED TEXT OR RUNNING COMMENTARY)
Digital image/s of the stages in life-cycle of identified endemic tree: Sandarac Gum Tree (Sigra tal-Gharghar).	Use of overlying digital images to describe different stages during the reproductive cycle of the endemic tree referring to leaves, flowers, fruits and seeds.
Digital images of botanical collections.	Use of overlying digital images to describe different moments during the reproductive cycle of the Cacti and Medicinal plants collection (referring to leaves, flowers, fruits and seeds). Pictures of any products developed from plants in collection.

The 'Reflect' function

MEDIA OVERLAY IN APP	INFORMATION PROVIDED (DISPLAYED TEXT OR RUNNING COMMENTARY)
Annotated map showing other public gardens in the vicinity of Argotti.	Questions to reflect about visit. Suggesting other activities to be carried within or in the surroundings of the Argotti Gardens (e.g. visiting other gardens in Floriana and Valletta).

C. An Experience in History at the Upper Barrakka

This learning activity was developed in consultation with historian Dr Emanuel Buttigieg, an expert on the history of the Knights of Malta. He suggested developing a mobile learning experience about the attack by the Turks on Senglea point in June 1565. The terrace at Upper Barrakka in Valletta, overlooking the Grand Harbour, provides an excellent viewpoint on Senglea point across the harbour. This historical event is well-documented in paintings,

engravings and diaries from direct witnesses. Thus a visitor standing on the terrace close to the lift of the Upper Barrakka in Valletta, facing Senglea point across the harbour, will be notified by the WAY-Cyberparks App with a welcome message proposing four activities which user can activate by selecting the relevant icon on the smartphone interface after opening the camera of the mobile. Each of these four options leads to an Augmented Reality-based category of interactions, namely interactions about the history of this event, interactions about key structures in the location at the time of the attack, interactions about processes that took place during the attack by the Turks, and suggestions of other activities to extend user's experience beyond the prescribed site and activities. After confirming access to App, a resource template is activated on the mobile device that guides the user though suggestions to identify the location, structure, special features (or their absence) and other details as compared to historical documentation displayed on screen or referred to in audio / video commentaries. Different moments during the attack can also be reconstructed through the appropriate media displayed on the mobile/tablet. These proposed interactions are described in more detail in the table below.

Interactions template for Senglea Point

Location details	Senglea Point, Grand Harbour, Malta GNSS coordinates: 35.892482,14.501515,18z
Targeted Smart City Learning	Primary: Geo-learning, Citizen/Learner Enquiry Complimentary: Seamless and Crowd learning

	DOMAIN	TECHNOLOGY	COMMUNITY
Acquisition of Knowledge and Skills	Facts and Concepts about: • The Great Siege of 1565. • The military installations in the Cottonera region. • The military organisation and role of Senglea Point in the Great Siege. • The Turks, their assault strategy and tactics. • Outcome of the Historical event.	Understand the concept of GNSS based learning. Acquire skill in using: • Way-Cyberparks App and addon • Augmented Reality functionality. • Use mobile device to follow GNSS triggered location based media overlays.	Discussion within on-site task groups/on-line collaboration groups about: • How to use mobile device to activate geopositioned learning activities. • Facts and concepts for the identified domain themes related to this historical event.
Contributory learning (sharing ideas, creations and reflections) about learner identified queries and themes	Develop digitally enhanced artefacts about any of the domain themes to enrich your knowledge and share with others. Develop a short media enriched documentary about any of the following roles: • Knight leader • Knight soldier • Turk soldier • Local spectator (from Fort St. Angelo).	Use relevant applications to record textual, image, audio and video (text editor, built-in camera, sound recorder). Use of Apps embedded in WAY – App to share reflection and creations. Use of online Apps & social media to share knowledge and reflections.	Communications with experts and interest groups in History, Military Engineering and Maltese Heritage. Share creations and documentaries in class and on-line.

The following tables describe the content and related resources to promote insight, knowledge acquisition, knowledge sharing and reflection.

The 'History' function:

MEDIA OVERLAY IN APP	INFORMATION PROVIDED (DISPLAYED TEXT OR RUNNING COMMENTARY)
Lucini engravings	Highlights of the attack on Senglea Point describing how this fits in the sequence of events of the 1565 siege.

The 'Structures' function

MEDIA OVERLAY IN APP	INFORMATION PROVIDED (DISPLAYED TEXT OR RUNNING COMMENTARY)
Siege Model	Buildings and military structures at SP. Conditions of fortifications, palisade, chain across to St Angelo.
Perez d'Aleccio frescoes	Commentary about structures from Aleccio's Frescos.

The 'Processes' function

MEDIA OVERLAY IN APP	INFORMATION PROVIDED (DISPLAYED TEXT OR RUNNING COMMENTARY)
Siege Model	Conflict amongst Turkish military leaders Departure of boats from Marsa Range of Cannon fire Effect of obstructive tructures
Siege Model Photos to show perspective from high vantage point and from waterline.	Commentary about the account of the siege including perspectives other than those of Balbi on the events.

The 'Reflect' function

MEDIA OVERLAY IN APP	INFORMATION PROVIDED (DISPLAYED TEXT OR RUNNING COMMENTARY)
	Questions to reflect about event. Suggested follow-up activities, (Eg. visit Siege model in Maritime Museum, Vittoriosa.)

IV. EVALUATING 'SMART CITY LEARNING' MEDIATED THROUGH THE WAY-CYBERPARKS APP

The different modes of Smart City Learning (SCL) designed to be mediated through the WAY-Cyberparks app have to be evaluated through a Connectivist interactions-based methodology as detailed in [11]. A valued technology-mediated learning experience is considered as a function of five factors: Pedagogy, Content, Community, Technology and Metacognition. This proposes an assessment framework for SCL that organised interactions along three dimensions. In line with the learning design methodology adopted in this study, the interactions recorded in the App and associated on-line tools can be categorised into the domain, technology and community dimensions. Each dimension comprises two

categories of interactions: those at the experiential level and those at a metacognitive level. The former include all interactions with the external environment, mediated through specific digital tools that comprise task-oriented and person-oriented activities. Interactions at the metacognitive level include all those intra-individual or collective reflections about the activities at the experiential level. But these experiential and metacognitive interactions are determined by the pedagogical orientation of the (technology-mediated) organizing context in this case the identified modes of SCL.

These modes of SCL will be assessed considering the type, frequency and directionality of interactions. Interactions along the domain dimension will be categorized according to content or task analysis characterizing the Associative design approach [12] considering the hierarchy of learning outcomes (facts, concepts, rules, procedure, problem-solving; psycho-motor skills, cognitive strategies; and attitudes).

Along the technology dimension interactions with the 'surface' and 'deep' structure of the digital tool or environment will be considered in relation to the acquisition of domain knowledge and skills and to one's participation and collaboration in knowledge building and sharing. The surface structure deals with the physical features of the Way-Cyberparks App, mainly interface layout, menu options, navigation and other action tools. The deep structure considers the interactions mediated by the App with the internet of objects, people and locations.

The evaluation of the Community dimension analyses the *type*, *frequency* and *directionality* of interactions for assessing App user's evolving role and identity. Interaction patterns can be developed to determine one's evolving role within the learning group starting from the basic receiver role that moves on to a supporting, guiding and ultimately to a leading one. Type, frequency and directionality of interactions can also be quantified using learning networks such as those linked to on-line collaborative tools or social networks.

Through this process-oriented methodology the interactions profile of an activity or a user can be created. If this profile is linked to adaptive assessment systems involving pedagogical agents capable of analyzing and comparing interactions profiles and patterns against stored data based on previous experiences of the same user, an adaptive Smart city learning system can be developed. Such adaptive systems can be used to propose lines of action for the learner to further his/her inquiry at the same site or beyond. Thus this process-oriented approach provides one example for promoting the pedagogical shift that considers Smart Cities or technology-enhanced open spaces as Personal Learning Environments.

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