PEN LISTER, PH.D. PROPOSAL, JANUARY 2016

Title

Designing Effective Smart City Learning

Rationale

The main objective of the proposed research project is to evaluate mobile learning using the WAY-Cyberparks Application, which will provide location-based learning in identified places of historical or scientific interest.

As an academic previously lecturing in web and digital media, with a further background in academic professional development for e-learning, I am keen to expand my theoretical knowledge in Technology Enhanced Learning (TEL), particularly in relation to networked learning, and this proposed research offers a rare opportunity to study the effectiveness of learning in a smart city setting, as it is designed, developed and then experienced by learners in authentic contexts. Proposed examples of such contexts include the botanical Gardens at Argotti, Floriana, and the Upper Barrakka Gardens in Valletta as vantage point for history-related learning experiences. This affords a chance to research and record measurable data in the whole 'life-cycle' of a large-scale smart city learning implementation, with all major stakeholders as primary data sample groups. Data will be analysed and interpreted in relation to educational theory considering the constantly emerging learning technologies which hence demand that pedagogy needs to be shown as innovative, adequate and relevant. Though various pedagogical frameworks have been developed, the application of theory to the design of TEL is challenged by a continuous stream of emerging technologies that are so versatile in their affordances for learning. This research seeks to address these evolving needs arising for 'smart city learning'.

This work is grounded in Connectivism (Siemens, 2004) and other theories relevant to connected learning such as Pask's Conversation Theory (Pask, 1976) and Laurillard's conversation framework (2002), Decision Theory (e.g. Hannson, 1994) and Game Theory (e.g. Camerer, 2003). While adopting phenomenography (Marton, 1981, Yates et al, 2012) as the main methodological focus, a relevant theoretical framework will be developed. The sometimes controversial (Verhagen, 2006, Kerr, 2007) theory of Connectivism, with its emphasis on processes, interactions and knowledge as a networked system, will underpin the theoretical approach and consequent evaluation of this research. Drawing on both primary data and on discourse surrounding connectivism and its associated interpretations, a set of factors that link theories for smart city learning with practice will be identified.

Theoretical Framework and Literature Review

Connectivism is an epistemology that now underpins a variety of technologically mediated settings such as online personal learning, socially networked learning, or community developed information networks such as Wikipedia. In everyday life Connectivism is manifested as an interactive system of 'massively interconnected networks [...] critical to learning in the digital age' (Beetham, 2007). Smart city learning is perhaps the most recent manifestation of connectivism, offering learners a way of engaging with learning in a networked community setting, situated in real-world environments. This 'ubiquitous learning' (Bonanno, 2011, Christopoulou & Ringas, 2013) affords immersion in a topic (Koper, 2014) leading to a knowledge construction process (Bonanno, 2010) sometimes even without the student themselves being aware

(Christopoulou & Ringas, 2013). Through self-reflection and personal development (Caldwell et al., 2013), learners construct their various intra-personal (Boyd 1993, Rogers, 1951, p498) knowledge constructions and inter-personal identities (Cook[2] et al 2015, Siemen, 2004) within the community, both networked and in complimentary physical spaces to enhance learning (Jamieson et al., 2000). While interacting within contiguous groups as well as when connected to networked learners who may have previously visited the learning location and interact asynchronously afterwards, knowledge residing in the network can be constructed over time (Christopoulou & Ringas, 2013) by the networked community.

Siemen's vision of connected networks of learners and digital artefacts, with perpetually changing knowledge held in the network and developed by community interactions, reflects the 'interactive system' of learning apparent in smart city learning. These learning interactions are the focus of this research, seeking to establish clear relationships between appropriate theoretical underpinning and empirical evidence for their context. When considering the evaluation of smart city 'interactive system' learning, a number of factors need to be acknowledged and clarified. An 'interactive system' is considered as a context that provides interactions with subject content in a particular area of knowledge, through a digital environment or tool and involving interpersonal interaction within a community. Thus four categories of variables are established: *interactions, content, digital tool(s) and community.* These variables and their possible interactions will form the scope of this research and thus determine the approach, method, sample groups and analysis for smart city learning experiences as mediated by the WAY-Cyberparks Application in the Smart city learning project outlined above.

The mediation of smart city interactive learning is significantly affected by learning design and the modality of human computer interaction. ***Learning design*** impacts the quality of how a learner interacts and engages with their different modes of learning. Beetham (2007) describes a learner-centered approach (p36) based on the promotion of both intrapersonal knowledge constructions and also on interaction with others (p44), acknowledging the learner immersed (p38) in a context of technological artifacts that mediate learning. Focusing on both technical functionality and interface design aspects, ***Human Computer Interaction*** impacts the learning journey through facilitation and engagement (Ingram, 2002 in Koslow & Piña, 2015, Pangaro, 2009, Laurillard, 2002, p111). Thus usability techniques (Kultawanich et al., 2015) may therefore also contribute to a wider contextual interpretation of user reported learning experiences and their assessment.

The evaluation of 'interactive learning systems' considering learner conversations (Pask, 1976-1987, Laurillard, 2002), their nature and structure (Ravenscroft, 2011, Laurillard, 2002, Rogers, 1962, p222) and of the nature of the community in which these develop (Siemens, 2004, 2005, Pask, 1980, Boyd, 1993, Downes, 2012) are critical to building an empirical evidence-based analytical understanding of smart city learning experiences. Recognizing relationships between interactions and the processes of connection building (Pask, Siemens, 2005, Downes, 2012) and how knowledge is constructed in the network (Siemens, 2004, 2005, Ryberg et al., 2012, Cook[1] et al., 2015) will attempt to be investigated. The measurement of that knowledge for evidence of presence, quality, relevance to learning outcomes (Ravenscroft, 2011), trust (Siemens, 2004, Cook[2] et al., 2015) or signs of experts are all potential factors for applying connectivist related theoretical perspectives to establish levels of their relevance to smart city learning. As stated previously (Cook[1,2] et al., 2015, Koper, 2014), the hybrid nature of smart city learning enhances and facilitates identity building,

knowledge construction and internalization (Rogers, 1951, p498) both within individual learners and within the wider contiguous and virtual communities. Taking Cook[1,2] et al.'s (2015), proposed Zone of Possibility as an example, an attempt could be made to measure the effectiveness of learning and community knowledge building in a Zone of Possibility (ZoP) within a smart city learning context, using factors outlined as constituting a ZOP: 'formal and informal social structures in an activity system, [...] a hybrid combination of physical and digital tools [...] (to) mediate the individual's relation to the world...'. This might then be investigated in relation to theoretical factors underpinned by connectivism.

Connectivism as a learning theory arose from the need to theoretically acknowledge new learning phenomena in a connected 'networked' world, where the appropriateness of existing pedagogical theory appeared less than adequate (Siemens, 2004, 2005, Downes, 2012). It attracts heated debate (Kop & Hill, 2008, Clarà & Barberà, 2014), on whether there is a need for new pedagogy for a networked society at all (Siemens, 2004, 2005, Downes, 2014) or whether pre-existing pedagogy is adequate to describe networked learning (Kerr, 2007, Kop & Hill, 2008, Wade, 2012, Ryberg et al., 2012), as well as the nature of what constitutes a learning theory (Kop & Hill, 2008) and how it is interpreted for learning in todays connected world (e.g. Ryberg et al., 2012). Therefore, placing connectivism at the centre of this research may shed further light on its currency, value and usefulness as a theory in the context of smart city learning.

This research is concerned with gathering data from smart city learning stakeholders (learners and providers) for their views and interpretations of their own experiences of smart city learning. In that context, Yates, Partridge and Bruce in 'Exploring information experiences through phenomenography' (2012), along with Laurillard's pointers for the assessment of learning experiences (2002, p29, p69-72) provide clear indication of the potential of using a phenomenography approach for this research. For example, the concept of the 'anatomy of experience' (Marton & Booth, 1997, in Yates et al., 2012) may help provide clear structured analysis ideas and methods for this research. Booth (2008) discusses in detail the use of phenomenography and 'variation theory' providing descriptions of data analysis that are highly relevant to this investigation.

The nature of reality itself is not in question in this project (Yates et al., 2012, Marton, 1981), but rather those experiences of each individual and how they perceive them (Laurillard, 2002, p29, p69). The knowledge conceptualisation process as it is perceived by each person is what is being measured, and then an attempt to map these experiences to accepted theoretical frameworks as they currently feature in pedagogical discourse. This is what makes phenomenography a very relevant framework for developing this research design.

Research Questions

1. How can we formulate an effective pedagogy for Smart City Learning using Connectivism as a foundation?
2. How does this pedagogical framework inform the design of smart city learning?
3. How can we measure the effectiveness of smart city learning involving both assessment of learning (content) and assessment for learning (process)?

Research Design

Label: **Phenomenography**

Expected techniques for devising systems of categorization and comparison are anticipated to be 'descriptive' in relation to observed or correlated participant feedback/results, and 'correlational' for matching and comparing sets of data to derive iterative relationships to theoretical factors of significance relevant to the project. A mixed methods approach using both quantitative and qualitative data is anticipated to be most useful. Systems of analysis to be investigated for their relevance and usefulness to the project might be interaction analysis, qualitative and quantitative techniques for discourse, content and conversation analysis, and quantitative techniques using questionnaires (e.g. for some user experience feedback), and for social network analysis (looking at the analytics data). These systems and techniques are both technical and non technical but may contribute to an analysis of data in a 'comparison of mixed methods data' systematic method.

(1) Sample Groups

Sample groups are envisioned as follows*:

- SG1 - Topic Groups
    - SG1a Built Environment/Location specialists (e.g. Head tour guide, Curator of botanical garden)
    - sG1b Subject Area knowledge specialists
- SG2 - Technical Application Groups
    - SG2a Designers – i.e. interface design, interaction design, user journey design, Information Architecture (IA) design
    - SG2b Application Developers - functionality and technical affordance specialists
- SG3 - Learning Design Groups
    - SG3a Principal Learning Designers
    - SG3b Learning Content Creators
- SG4 - User/Learner Participant Groups
    - SG4a adult learners (preselected)
    - SG4b school student (preselected)
    - SG4c HE student (preselected)
    - SG4d Ad-hoc general public (not preselected, represented by analytics data or observation on site)

*These groups represent stakeholders as anticipated at this stage in the smart city learning project. They would also represent expected stakeholder groups in a variety of digital application developments, i.e. the designers (SG3), functional developers (SG2), intended users (SG4) and commissioning 'clients', (SG1). These are usual stakeholders within a variety of digital projects that would make use of connected application technology such as the Internet or mobile connectivity. As such, they might be said to represent Connectivist stakeholders.

(2) Data Collection Methods

Validity, reliability and authenticity
See ethics section

SG1, SG2 and SG3 would be interviewed using online quantitative questionnaires, semi scripted and non scripted techniques, recording (video/audio) interviews in semi-formal or informal settings (on location, talk through of designs or environment plan etc, in meet-ups), focusing on factors such as:

- Aims and Expectations
- Anticipated outcomes and achievements
- Anticipated problems and setbacks
- Personal perspective on the project

SG1, SG2 and SG3 may also be observed if and where relevant.

SG4 - User/Learner Participant Groups would be researched and categorized according to:

- Demographics:
    - Gender
    - Age
    - Literacy level (highest educational achievement)
    - Digital literacy level (aka technical efficacy level)
    - First language status
    - Socio-economic class *(OPTIONAL - this may not be included for ethics reasons, however is a very useful category of demographic for citizen enquiry target user engagement statistics, and potentially not the same data as educational achievement level)*
- Topic selection offered by Cyberparks App
- Location(s)
- Learning pathway(s):
    - Playful learning
    - Citizen enquiry
    - Adult learning
    - Geo-learning

SG4 Testing and evaluation categories

- By location
- By location based learning stage if applicable
- By type of learning, dependent on learning design interaction affordances (evidence of knowledge building)
- By type of communication directionality - person to person, person to group, person to whole community and perhaps including *emotion measurement*

- By type of content (photo, video, audio, other) for upload, download shared in relation to learning type and communication directionality
- By *level* of interaction – ie. depth of learning, a level of depth structure/interaction could be used
- By feedback on learning experience (interview), in relation to above factors
- By feedback on learning experience (observation), in relation to above factors
- By technology used to access/interact learning experiences: device, third party applications/analytics data
- By time on application - factors such as per location, per learning stage
- By (application) user experience testing (for example including usability laboratory A/B testing using experimental and control groups)

NB These testing categories may seem ambitious, however, smaller sample groups with a spread of data across a wider variety of categories, at least early in the project, may yield interesting areas to focus on later.

(3) Analysis Methods

Though the methodological analysis system is still being developed the principle stages and iterations are envisaged to work as outlined below. Five key stages of work, researching first theoretical factors, then developing expectations, then correlating primary data of experiences from sample groups involved in the construction and participation of smart city learning experiences. This work is concluded by a fifth final stage of work that represents the evidenced 'Theoretical Factors for Consideration in Smart City Learning'.

Section 1: Theoretical Factors of Significance table

A table of 'Theoretical Factors of Significance' would be derived from literature and existing research to create a table of factors which bear relation or connection to Connectivism, in its context of networked personal and 'social' learning. Factors will be evidenced as being connected, and the measurable number of those connections would demonstrate reason for inclusion, i.e. a system based on number and context of citations and mentions (including context of these) for each factor plus the number of connected occurrences would define inclusion in the table. This would be developed to establish threads of connection to Connectivism.

Section 2: Theoretical Factors of Significance correlation table showing relationships between Factors of Significance and proposed 'Signals of Similarity'

A 'Signal of Similarity' is a 'reflector' of a 'real life experience' that reflects a theoretical factor of significance (TFoS) in its similarity. In this case, the table in the second stage of research would be a proposed set of reflectors for each sample group, i.e. those reflectors that might be expected to tally with a TFoS.

Section 3: Matrix of measured relationships between Theoretical Factors of Significance (TFoS) and 'Signals of Similarity' (SoS)

This section would form the main body of the research, and consist of a system of recording reflectors from primary data derived from each sample group, as indicated above. Using the proposed SoS table as a guide to

inform research direction for each group, (i.e. types of questions, types of observation, types of analytics data), actual experiences would then be recorded against each TFoS.

Section 4: Correlation Confirmation (Comparison Checking)

A later stage of research would return to section 2 and compare the expected signals of similarity with those derived from actual experiences (section 3, derived from the primary data). This would act as evidence of some expected perceptions about theoretical relationships to networked learning and teaching practice being false, or verifying others to be true.

Section 5: Theoretical Factors for Consideration

The final Theoretical factors for consideration would consist of evidenced traceable theoretical relationships to existing learning experiences, using node/edge visualisations and simple tables including the most common concurrences between TFoS and SoS. This would form the 'Theoretical Factors for Consideration in Smart City Learning'.

Report Format

Findings could be presented in a number of complimentary ways:

- The tables themselves, illustrating the relationships, within explanatory text context
- Data from each primary group and how it coincides (reflects) with theoretical expectations, using quotes, statistical evidence etc
- Visualisation of connections, using tools like SNA (Social Network Analysis) systems, or iNova, or others - a node/edge principle showing how theory is connected to experience
- Detailed discursive section of findings, highlighting those factors with most 'strength of connection'.

Ethics

Ethics, validity, reliability and authenticity

Validity, reliability and authenticity of all data gathered, whether qualitative or quantitative, would be attempted to be verified by using suitable means, including the following:

- Confidentiality statements (English)
- Use of research statement (purpose/risks/benefits) (English)
- Consent form with obtained signed agreement procedure for all participants (English)
- Anonymity of data using participant coding method
- Observation and interview data (video, audio, notes, transcripts), employing anonymity methods wherever possible
- Attribution permission form where appropriate to attribute quotes or observed experiences (English)
- Data records of participant signed documentation and identity evidence
- Screenshots of analytics data or geo-location with date/time displayed

Confidentiality, permission and other ethics considerations would be tailored for appropriateness to each sample group and each setting (context).

Timeframe

Outline of project management, time allocated to the different phases, such as preparation and desk research, data collection, analysis, writing.

*Dependent on progress of the project as a whole - Proposed schedule of research activity.

Year	Stage	Details
Prelim	Dec15/ Jan16	Preparing detailed proposal and post proposal and planning first work
Year 1	Q1 Jan-Mar	Submission of proposal to PhD board Evaluation of proposal by PhD Board Approval by senate
	Q2 Apr-Jun	Argotti piloting using Way-Cyberparks App Upper Barrakka Gdns/Senglea Point piloting, first SG data collection
	Q3 Jul-Sept	Begin writing and scoping first chapters – Ch1) problem, rationale, context Ch2) lit review, Ch3) methodology More SG data collection dependent on development team and others
	Q4 Oct-Dec	Preparing Section 1 and 2 of analysis – theoretical factors of significance developed from Lit review first work, plus provisional expected signals of similarity from SG data. More SG data collection dependent on development team and others.
Year 2	Q1 Jan-Mar	Section 3 of analysis begins – collating primary data with section 1 and 2, to develop the Matrix of relationships
	Q2 Apr-Jun	Section 3 then moves on towards Section 4, the confirmation of correlation – comparing section 3 with predicted expectations of section 2
	Q3 Jul-Sept	Ch4) Data Analysis Section 4 completes, to develop section 5, the final set of factors.
	Q4 Oct-Dec	Ch5) Discussion of all findings
Year 3	Q1 Jan-Mar	Discussion and review, for final Conclusions
	Q2 Apr-Jun	Proof reading, checking, revision, writing final version
	Q3 Jul-Sept	Proof reading, checking, writing final version
	Q4 Oct-Dec	Submitting thesis

My project management tools of choice are Trello (www.trello.com) and Google Excel for Gantt charts.

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Signatures

The proposal is to be signed by PhD candidate, and countersigned by the proposed supervisors.

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