Lister *Smart Learning Environments* (2021) 8:8
https://doi.org/10.1186/s40561-021-00154-x

Smart Learning Environments

RESEARCH Open Access

The pedagogy of experience complexity for smart learning: considerations for designing urban digital citizen learning activities

Pen Lister

Correspondence: pen.lister@penworks.net
Dept of Leadership for Learning & Innovation, Faculty of Education, The University of Malta, Msida MSD2080, Malta

Abstract

The Pedagogy of Experience Complexity for Smart Learning (PECSL) is a four-tier model of considerations for the design and development of learning activities situated in real world hyperlocal locations, mediated by smart enough technologies. Learner experience is placed at the centre of learning design, focusing on the complex interrelated experiences that may be possible. A wider awareness of types of learning may enhance potential for gaining value for learners and offer more flexibility for instructors or others. Learning is considered as any potential object of vital interest for the learner, and may include making connections with others, dialogic space expansion between learners and wider relevance of topic or location as much as any intended learning outcome.

Taking inspiration from digital artefact user centred design, the PECSL adopts a position of flexible layers of considerations that impact stages of design for complex smart learning activities. Each tier being interrelated to the others, these iteratively adapting as a result of decisions being made throughout the design and development process. Categories of learner experience variation derived from a phenomenographic study of smart learning journeys inform the foundation of the PECSL, providing concepts of experience relevance structures leading to related pedagogies, further pedagogical relevance considerations and deeper epistemological reflections. Acknowledging significance of the context, process and content of learning in these activities, considerations expand to enable pragmatic support for much of value towards effective learning. This paper seeks to provide a means for learners to learn from each other as much as any specified learning goals or assessment.

Keywords: Smart pedagogy, Smart learning, Digital citizens, Digital society, Phenomenography, User-experience

Introduction

This paper discusses the concepts of a pedagogical model based in participant experience complexity to support smart learning activities. Taking inspiration from digital artefact user centred design (UCD) (Gibbons, 2016), and user experience considerations such as those described in key UCD texts (Garrett, 2010; Saffer, 2010), the Pedagogy of Experience Complexity for Smart Learning (PECSL) adopts a position of flexible layers of considerations that impact stages in learning design for complex smart learning activities. For the purposes of discussion, activities are generally conceptualised as journeys in real world urbanised digitally connected spaces, formed from several hyperlocal (Carroll et al., 2017) locations related by topic of activity, with digitally mediated participant interactions using 'smart enough' technologies (Green, 2019).

Urban citizen smart activities may have explicit learning aims or learning may be taking place implicitly, or learning might perhaps be a covert aim (Lister, 2020). For example, learning about a topic or aspect of locations might be a specified aim of an activity, however for many activities this might not be the case. Many activities are community orientated such as focused around gathering feedback about a local area, community arts participatory experiences or adventures of discovery about a group of locations. Participants take part voluntarily, choosing what they might find of interest, and often using their own devices to digitally interact with aspects of the activity. Smart learning activities can be particularly suited to creative participation, such as digital 'writing the city' (e.g. Taylor, 2017; The Ambient Literature Project[1]), or taking photographs and mapping them into digital map platforms (e.g. Horn, 2018; Wood Street Walls[2]). Culture, art and local heritage discovery are well suited as topic and scope of smart learning activities around a local area (Lister, 2020, 2021b), and might even be applied to mapping independent retail and maker premises at hyperlocal scale to support and contribute to discovery of local economies (e.g. Indie Hastings & St Leonards, UK[3]). Learning is not therefore always the aim, however learning might still be present in more general terms of advancing the communication, agency and digital skills of participant learners. This may highlight the "complex conversational process that can and usually does lead to much that is of value beyond what is planned" (Dron, 2018, p. 3). This paper seeks to provide a "means to learn from the learners" (p. 3), as opposed to in "predefined ways" that tend to rely on seeing "learning as the achievement of specified learning goals" (p. 3).

This paper examines considerations for designing and developing urban digital citizen activities in a context of learning opportunities afforded by participating in them, and how pedagogical considerations may contribute to improved participant experience overall. Adding learning value, whether explicitly or implicitly, may increase the sense of 'time well spent' for participants, and may additionally contribute to further reasoning for gaining civic permission to conduct such activities or for securing civic, educational or non-government organisation funding support. Multiple gainful factors to encourage citizen participation in their own urban locale foster a deeper engagement with local environment and increase quality of life and richer sense of day-to-day satisfaction (MacGregor, 2018). Therefore, it is useful to consider how pedagogical aspects

[1]The Ambient Literature Project https://research.ambientlit.com/
[2]What3words tweet on Wood Street Walls https://twitter.com/what3words/status/1030489280962068485
[3]Indie HSL The Sellers https://mappermonday.github.io/IndieHSL/#13/50.8721/0.5935

of learning might be brought to bare in the planning, designing and developing of digital citizen urban locale activities with a potential for learning.

The pedagogical considerations discussed in this paper are founded in participant experience gathered from primary research into smart learning journeys (Lister, 2021a, 2021b). Using the methodology of phenomenography, emergent semi-structured interviews were conducted with participants to elicit their perceived experiences of taking part in smart learning journey activities. The resulting phenomenographic categories of experience complexity variation produced descriptive guidelines that were interpreted as relevance structures of experience for each category. This in turn formed the foundation of the pedagogy of experience complexity for smart learning (PECSL), permitting a direct relationship between pedagogical layers of considerations and participant experiences as they had naturally emerged. Founding a pedagogical model in experience variation seeks to offer a participant-centred approach to design and development of smart learning activities, acknowledging the participant (learner) in a shifting territory of intersubjective 'lifeworld' (Sandberg, 2005) re-constitutive experience complexity. This paper explores these ideas and interpretations, seeking to demonstrate how the PECSL might be a pragmatic pedagogical guide for smart learning. In exploring these ideas, some older texts are referred to for purposes of demonstrating theoretical, methodological or epistemological pedigree and quality.

This paper focuses on what the PECSL is, how it came about and why it might be useful and relevant to smart learning and smart learning environments. A future publication by the author addresses issues of applying the PECSL, using real world examples to demonstrate concepts and stages of developing this kind of activity with pedagogical considerations as part of that process. (Lister, Applying the PECSL: using case studies to demonstrate the Pedagogy of Experience Complexity for Smart Learning, submitted). In following sections I define urban digital citizens in contexts of supporting twenty-first century skills and literacies.

Urban digital citizens

Within the context of this paper the urban digital citizen is interpreted as an individual who is a digitally connected citizen inhabiting an urban environment, either as a resident or visitor. Urban, digital citizens (Tristán-López & Ylizaliturri-Salcedo, 2014, p. 324) are able to connect digitally and in real life to places, people, networks and objects, partaking of the culture of a city or town that exists within a functioning, accessible and digitally connective infrastructure of wifi, apps and services. These fluid actants, bringing together people, places, objects, communications and digital interactions offers a useful basis for understanding the context of participant, activity and locale. This sociomaterial interplay, meshing the technological with the human "in a co-constitutive relationship" (Thompson, 2012, p. 160) compiles to manifest the learner in the smart learning environment. These relationships will be explored further in an additional paper by the author in contexts of smart learning environments and related discourses (e.g. Allen & Marshall, 2019; Gourlay & Oliver, 2018; Jones, 2018).

In considering these citizens in a situated hyperlocality it is pertinent to describe the term hyperlocal as a way of thinking about a local area defined by closely related places or specific communities. Coined in the 1980s as a term to describe local television content, by the 2000s 'hyperlocal media' described the rise of online alternative local news

websites and bloggers (Van Kerkhoven & Bakker, 2014). In recent years terms such as hyperlocal delivery or hyperlocal marketing have become popular. Along with Carroll et al.'s work (Carroll et al., 2017, various), others have used this term in relation to learning situated in a close area of locality (e.g. Martin, Dikkers, Squire, & Gagnon, 2014).

Activities supporting twenty-first century skills and literacies

In planning for digital urban activities, the purpose, aim and success criteria of the activity may not always include learning as a specified goal. However, opportunity and mechanisms for learning are manifold: explicit topic learning goals, creative contributions, participatory interaction rewards, challenges for critical thinking and analysis skills development, or simply to take part in an activity and then discussing it reflectively afterwards with other participants, for example using action learning approaches (Lin, Galloway, & Lee, 2011). This concept was employed by the author (Lister, 2022) with University of Malta postgraduate Education students who took part in a smart learning journey in Valletta, Malta as part of their module syllabus. During a subsequent classroom open and emergent discussion, exploratory student reflections uncovered how a learning activity such as they had participated in might be utilised for various learning goals as well as the challenges they had faced. This brought to life the practical aspects of designing for a smart learning journey and related epistemological context in an applied setting.

Additionally, it may be increasingly important to support and develop digital skills and literacy amongst citizen populations. As is made clear by other work (e.g. in Bailey, Perks, & Winter, 2018; Hernandez & Roberts, 2018) there is a growing need in society to support those who may be less comfortable or experienced with digital platforms and technology, or who may simply not have enough access to digital tools and devices to enable them to develop their skills and confidence in digitised environments. Smart urban citizen activities can provide opportunities for such support, even as additional 'covert' learning (Lister, 2020), to enhance digital interaction provision and support participants who may be less digitally literate. Vosloo (2018) outlines a variety of case studies that demonstrate how an activity can be designed to mitigate lower digital literacy, working in conjunction with the DigComp 2.1, the 'Digital Competence Framework for Citizens' (Carretero, Vuorikari, & Punie, 2017). Quality and access to lifelong learning as part of Unesco Sustainable Development Goal 4[4] can be enhanced by smart learning activities at all levels. A culture of lifelong learning might be fostered at informal level amongst citizens to become engaged in their surroundings for a variety of reasons (for example Angelidou & Stylianidis, 2020; Carroll et al., 2017). This might form part of the solution to encourage further learning at more formal levels.

Next I briefly acknowledge possible conceptual hinterland for pedagogy in contexts of skills and literacies within socio-cultural and political settings, before then beginning to unpack the process of scoping, planning and developing smart learning activities.

Pedagogy and context

Pedagogical considerations for smart learning may not always begin with the learning itself. Schreiber-Barsch (2017) warns about the notion of inclusivity in learning where an opposing exclusivity is implied, and that the (overarching) aim and normative nature

[4]Unesco SDG 4: https://sdgs.un.org/goals/goal4

of citizen participation frameworks is to encourage and sustain societal political compliance (Williamson, 2015). The socio-political examination of access to lifelong learning is described as "not merely a pedagogical issue, but in essence a negotiation of citizenship and politics" (Schreiber-Barsch, 2017, p. 67). For purposes of discussion in this paper this might be considered as the socio-cultural-historical contextual relevance of place or additional factors such as digital skill and literacy efficacy. Sultana (2018) argues that digital literacy and skills are socio-cultural interpretations of different societal political models with different goals. Contrasting a "'technocratic' or 'social efficiency' approach, (where) the main concern is to ensure a smoother relationship between supply and demand of skills for the benefit of the economy", with a 'developmentalist' approach, focused on "personal growth and fulfilment [...] to facilitate self-exploration and self-construction" (p. 64) he further acknowledges an 'emancipatory approach' that seeks to build "to develop the knowledge that leads to freedom" (p. 65). These latter approaches echo the effective learning principles described in Liu, Huang & Wosinski (2017, p. 209), developing digital skills, literacies and critical awareness for learning to learn, to do and for self realisation in citizen smart learning activities.

Culturally diverse first-language differences may potentially negatively impact learning participation, as "...feelings of mistrust, dislike and resentment stem from variance across values and that communication barriers result from divergences in language and communication" (Stahl, Miska, Lee, & de Luque, 2017). A peer-learning approach, making "positive use of differences between pupils, turning them into learning opportunities" (Topping, Buchs, Duran, & Van Keer, 2017) may actively support learning. In the research discussed in this paper, first-language difference and cultural diversity between groups of learners emerged as fostering value for learners. In addition to language used in learning content, a fully inclusive learning activity experience needs to have considered relevant usability and accessibility (e.g. Bevan, 2008) for a diverse body of participants in relation to the nature of the activity being developed.

This socio-political contextual hinterland serves to flag up some of the challenging factors relating to activity purpose, setting, location and digital tool selections for any intended interaction mediation in smart learning activities and environments. Pedagogical considerations therefore fold into practical considerations, and vice versa.

Considerations for scoping, planning and designing smart learning

Indications are that smart urban activities are engaging and useful, contributing to cultural heritage and quality of life (Afonso & Fatah gen Schieck, 2019; Angelidou & Stylianidis, 2020; Hannewijk et al., 2020). It may be probable to assume (though may deserve further research) that stakeholders who are not educators involved in implementations of smart urban citizen activity provision are unaware of considerations for learning in relation to designing and developing any potential for learning in their activity. If learner-experience centred pedagogical considerations that support smart learning are to be included as part of an activity strategy, then pedagogical approaches need to be framed as practical design considerations that offer added value for both participant and provider. This may assist in overcoming discipline specific terminology that might otherwise be problematic and off-putting for those who are not part of the educational fraternity. One of the aims of the PECSL is to be understandable and practical, complementing related learning frameworks such as the previously mentioned

DigComp 2.1, cognitive domain measurement using Bloom's Revised taxonomy (Anderson & Krathwohl, 2001) and perhaps more familiar user-centred design processes. This notwithstanding that the deepest level of epistemological considerations remain specialist in articulating theoretical and philosophical reflections on learning in complex human-technology intra- and inter- action terrains.

To assist discussion, the process of designing and developing a smart activity with potential for learning can be conceptualised as two areas of scope and strategy, the practical and the pedagogical, as intertwined and not distinctly separate parts of the whole. Areas intertwine in a variety of contexts: for example in notions of value, both for learning and for purpose of activity that may not be learning; for issues relating to location and environment that pose challenges either pedagogically or for pragmatic concerns; or that environment or nature of activity may raise socio-cultural related concerns for participants in terms of relevance, interest, cultural meaning, value or place-related affective factors (for example place and associated fear, in Buell, 2005, p. 63; Jayanandhan, 2009, p. 107). All of these factors form a fluid set of both general and specific aspects of an activity influencing design and participation, additionally demonstrating how epistemological considerations and awareness might provide pragmatic contribution to improved learning potential for smarter learning. Subsequent sections draw out how these areas might inform each other over iterative design and development stages to enable the optimisation of learning opportunity for participants, either in implicit ways, explicit learning goals or covert learning aims (Lister, 2020). A simple grouping of these concepts is provided in Table 1.

Practical considerations

Practical considerations revolve around participants, place and location, and the purposes of activity, with the additional planning consideration for multiple kinds of interactivity. The type and locations of activity might be early primary influencers of how decisions are made and choices are defined. Just as when a digital application (for example a smartphone app or more complex website) is developed, the initial strategy and scope are key to understanding what is being made, and what is *not* being made (Garrett, 2010, p. 60). Additional to participant considerations, understanding the requirements of the client or other commissioning stakeholders may dictate the approach

Table 1 Conceptualised areas of scope and strategy for a smart learning activity

Practical
- Purposes, aims and goals of the activity
- Places - locations and environments
- Participants
- Multi-layered interactions
Pedagogical
- General factors for learning - planning, scope, outcomes
- Experience Relevance - variation and complexity
- Related practical pedagogies
- Pedagogical Relevance - value, motivation and autonomy
- Epistemology for smarter learning

taken, and likewise, budget constraints or other permission requirements may also define the scope of the activity for levels of complexity, interactivity, safety, privacy, autonomy or other factors, even including location selections. Participant groups are impacted by similar constraints in addition to core anticipated levels of digital literacy, confidence and skills. The PECSL acknowledges this complexity, and positions discussion in a context of pragmatic considerations and their impact for potential learning.

Purposes, aims and goals of the activity

The beginning of an urban digital citizen hyperlocal activity might often start with ideation - what do we want to happen? How and where do we want it to happen? Who is our target participant? What is the point of this activity? Ideation may define an activity in a context of purpose, budget and potential locations. Ideation may emerge from a variety of core requirements such as training support, community event planning, environmental initiatives or urban redevelopment scenarios. Use digital technologies in order to take part may also inform ideation, or for enhanced value and enriched experience. For example, user generated content may contribute to the purpose of the activity, not only for meaningful and valuable engagement, but as opportunities to facilitate digital literacy development, agency and empowerment.

Places - locations and environments

The environment of an activity, its general location, hyperlocal places of interest, and implications for citizen engagement both in 'being there' and in digital interaction configuration. This means scoping locations and features for purpose, value, engagement, safety, cultural context, and how technology may be used to augment the environment with digital interactions.

Participants

Participant group demographic and literacy factors relevant to activity are essential aspects to plan for and are generally part of any activity design and planning. Aspects of surrounding activity context such as reasons and purpose of activity, how participants are invited to take part, any reward or value being explicitly articulated and any implicit motivation already present may impact potential for learning in negative and positive ways.

Multi-layered interactions

Potentials for interacting with an activity encompasses multiple layers and types of interactions: human to human, human to digital, and digital to human being those that participants might directly control or be consciously aware of. Digital to digital may offer further advantages and considerations for learning, such as smarter delivery of content (Lister, 2018), or content interactions and choices potentially impacting further content selections being available. Technologies and places work together to augment the environment with learning opportunity, social connections and digital interactions. This is the human-digital actant terrain described by Thompson as folding into each other (Thompson, 2012, p. 60), meshing together to "design environments in which motivated learners can acquire what they need" (Siemens, 2006, p. 119). Pedagogical

considerations of interactions work in relation to practical concerns of digital interaction provision, and all aspects of interactions have potential for learning.

Pedagogical considerations

At its core, the PECSL absorbs practical into pedagogical considerations, placing learner experience at the foundation of the model. The aim and scope of the activity define potential pedagogical considerations, with key questions that frame the significance and impact of learning. Questions can be defined according to aim, scope and intended participants. It may be useful to develop a list of relevant questions to help scope the activity for potential learning:

- What benefit is gained from participating in this activity?
- How can development of skill or knowledge benefit potential participants?
- Is learning a desirable benefit return for provider and/or participant in this activity?
- Is this activity predominantly about learning? If so, what is the topic and level of learning and who is it aimed at? If not, can (should) learning be an additional benefit?

General factors for learning: planning, scope, outcomes

Learning outcomes can be implicit and may not be measured in assessed ways (e.g. Harrington, 2008, p. 131, in Lister: Measuring learning that is hard to measure: using the PECSL model to assess implicit learning, in preparation). Significance of reflection and relevance positioning may alert participants to their own learning either as it happens or after participation, during individual or group reflection and discussion sessions (e.g. Lin et al., 2011; Lister, 2022). Interactions might be planned in the context of pedagogical usefulness. For example, to encourage dialogic space expansion (Wegerif, 2013) through reflection by sharing participant comments about the activity in digital channels, or by requesting content to be made and shared, such as video and photographs. By additionally employing mapping technologies (e.g. What3Words[5] or smart learning feedback maps[6]) to pin feedback into hyperlocal features (e.g. Carroll et al., 2017; Jones, Layard, Speed, Lorne, & Blunt, 2013), a citizen memory bank (Gorry, 2016) can be developed that shares prior participant feedback and content. This might act as further encouragement for others to take part.

Experience relevance: variation and complexity

Experience relevance is a concept that may help to indicate the type and complexity of experience variation that could be anticipated to be encountered by a participant when they take part in an activity. Primary research findings from an investigation into experiencing a smart learning journey (Lister, 2021a, 2021b) demonstrate possible categories of commonality, variation and complexity of experience, analysed as phenomenographic structure of awareness (Cope, 2002, 2004). Summarised findings and the basis of the pedagogical model discussed in this paper are outlined in more depth in following sections. Consideration of anticipated experience awareness

[5] https://what3words.com
[6] http://smartlearning.netfarms.eu/scl-learner-feedback-map/

complexity may assist in supporting a learner for multiple inter- and intra-contextual (Marton & Pong, 2005), intersubjective (Suthers, 2006) awarenesses (McKenna, 2016), and mitigate towards potentially transformative, integrative, reconstitutive learning (Baillie, Bowden, & Meyer, 2013).

Related pedagogies

Related pedagogies that may be appropriately considered in light of the scope and aims of the activity are subsequently further discussed. These pedagogies can be utilised in appropriate ways, complementing and informing anticipated experience relevance variation, and wider epistemological contextual interpretations.

Pedagogical relevance: value, motivation and autonomy

The relevance of an activity expressed in explicit terms, and any additional implicit terms that a participant might interpret as of relevance to them personally. Relevance may often be situated in wider contexts and related past or current experiences, and may be impacted significantly by anticipated value, implicit motivation, cultural context or social interpretations, that is, how other people might see or interpret things.

Epistemology for smarter learning

Epistemological considerations for smarter learning can be particularly relevant when considering the connective sociomaterial contexts of a smart learning activity. These are more complex considerations, yet may impact the 'success' of participating in the activity in very direct ways. Reflecting on the activity in contexts of socio-cultural historical activity theory (e.g. Roth & Lee, 2007) and Actor Network Theory (e.g. Fenwick & Edwards, 2010), and core learning theories of social constructivism (Vygotsky, 1978), constructionism (e.g. Patten, Sánchez, & Tangney, 2006) and connectivism (Siemens, 2006) can all shed light in pragmatic ways to enhance the activity experience as a whole.

Next I outline the research that underpins the pedagogical model discussed in this paper, to offer background for methodology, analysis and findings that led to the PECS L model being formulated.

The research

The pedagogical considerations discussed in this paper are founded in participant experience gathered from primary research into smart learning journeys (Lister, 2021a, 2021b). Some texts referred to here provide context and episteme for the methodological approach in this study. Using the methodology of phenomenography (Marton, 1981), emergent semi-structured interviews were conducted with 24 voluntary participants to elicit their perceived experiences of taking part in a smart learning journey in London, UK or Valletta, Malta. Interviews were analysed collectively, though individual context is retained, analysis process utilising a framework of a Structure of Awareness (after Gurwitsch, 1964, 2010, in Cope, 2002, 2004). This approach permits variation and commonality of experience to emerge from the data and form a phenomenographic 'outcome space' of the phenomenon being researched, comprising of categories of description experience variation (Marton & Pong, 2005). The research discovered

four categories of description with four layers of complexity in each, see Table 2, 'The experience complexity of a smart learning journey' (Lister, 2021a). These were Tasks and Obligations, Discussing, Being There and Knowledge & Place as Value. Each category described four levels of complexity, showing an expanding structure of awareness, from simple direct relevance extending toward complex reflections and relevance in wider aspects of work, life or other objects of vital interest (Greeno & Engeström, 2014).

Descriptive guidelines outlining each category and level of experience complexity were formed during the analysis process. In turn these guidelines for relevance structures of experience formed the foundation of the PECSL, permitting a direct relationship between pedagogical layers of considerations and the participant experiences that had naturally emerged.

Phenomenographic analysis takes what is known as a second order perspective (Marton, 1981, p. 2), where experience is analysed from the perspective of the participants themselves, contrasting with a first order perspective taken by methodologies such as grounded theory (Kaapu, Saarenpää, Tiainen, & Paakki, 2006). In a first order perspective, the researcher observes and analyses the researched, interpreting the data by placing the participant as the object of research, but in phenomenography the researcher attempts to 'become the researched', and experience the world through their eyes (Marton, 1996, p. 185). The significance of a phenomenographic structure of awareness analysis therefore allows understanding of experience from the perspective of those who experience it, as much as is possible within the limitations of descriptive language and interview conversations (Kvale, 1996, p. 297; Säljö, 1997, p. 178). Care is taken to bracket the researcher's own assumptions and preconceptions (e.g. Kvale, 1996, p. 54), permitting meaning to emerge from the utterances of the participants. Analysis and interpretation of the focus of awareness and perceptual boundary (e.g. Bruce, Pham, & Stoodley, 2004) of interview quotes leads to understanding of how a structure of

Table 2 Experience complexity of a smart learning journey

	Category A **Doing the tasks**	**Category B** **Discussing**	**Category C** **Being there**	**Category D** **Knowledge and place as value**
Level 4	Research tasks and topic beforehand, take time doing and reflecting on tasks	Share tasks and content, do additional learning, discuss related experience and knowledge	Live it, being in the picture, live the atmosphere, take more time, seeing the whole and related parts	Knowing and seeing knowledge and place as valuable, personal experience, deeper engagement and 'possibilities'
Level 3	Tasks indirectly related to coursework or assessment	Discuss tasks and topic in relation to time and place	Experience in the place relating to other people, aspects and memories. Make connections between places and knowledge	Engage further with knowledge in topics, create upload content for tasks and at locations
Level 2	Do the tasks of interest, directly related to coursework or assessment	Discuss the tasks, help each other with tasks and tech	Locations are of some interest, potential for learning, creativity or inspiration	Click a few content links, save links 'for later', make screenshots of augmentations or tasks
Level 1	Do the tasks, go home	Discuss who does the tasks, how technology works	Go to locations, do tasks, go home	No engagement with content or knowledge, don't create or upload content

awareness is formed, varying throughout an interview and across interviews, between focus and boundaries. Over repeated reflections and examination of interview data across all interviews, categories of experience variation emerge.

Experience variation as a foundation for smart pedagogy

Founding a pedagogical model in experience variation seeks to offer a participant-centred approach to design and development of smart learning activities, acknowledging the participant (learner) as a complex human agent entity in a shifting territory of re-constitutive experience. This attempts to add further understanding or overcome potential limitations arising from concepts of learner ontologies (Rezgui, Mhiri, & Ghédira, 2014), learner personas (GhasemAghaei, Biddle, & Arya, 2015), learner profiles (Omarali, 2016) or learning styles (e.g. Schunk, 2012, pp. 478–482). While these may all have been employed to various effect in learning designs and pedagogical models, in smart learning activities the considerations of learning can be particularly challenging. It may therefore be useful to embellish these concepts with inter- and intra-contextual (Marton & Pong, 2005) understanding for the fluid multi-level complexity of experiencing a smart learning activity manifested outside in the real world, offering more flexibility and less dependence on explicit instructional design approaches or data-driven 'smart' learner ontologies.

Within smart citizen digital urban activities the hybrid and flexible nature of activity types and participant groups requires approaches that strive to reflect this flexibility to support design and scope. The PECSL is one such attempt, acknowledging the many and varied digital activities, learners and citizens groups, and placing focus on activity and participant relationships rather than personalised digital interactions and types of learner. Figure 1 visualises the relationships of the PECSL model of considerations, from the central experience variation categories, their related pedagogies, subsequent further pedagogical relevances and epistemological contexts.

Learner-centred experience considerations as a design process for smart learning

The experience variation categories of description arising from phenomenographic investigation of smart learning activities (Lister, 2021a) can inform pedagogical understanding and potentially directly impact learning design approach of activities at all stages of design and development. From the early scoping and ideation of an activity, the aims and desired outcomes through to the detail of participant tasks, goals and interactions at different locations, consideration of experience variation may offer clues to enable a wider range of opportunity for participant engagement, meaning-making and enjoyment.

The challenge in urbanised digital smart activities is in their very versatility, and that participants may be drawn from a wide variety of demographic backgrounds and digital literacy skill sets to participate in the same activity. These challenges can sometimes mean that activities might only be suitable for some participants, and while that may still apply, awareness of experience variation may act to mitigate participant differences in some contexts. Discussion in this paper is motivated by these ideas, and seeks to reflect on where experience variation relevance, related pedagogies with further arising

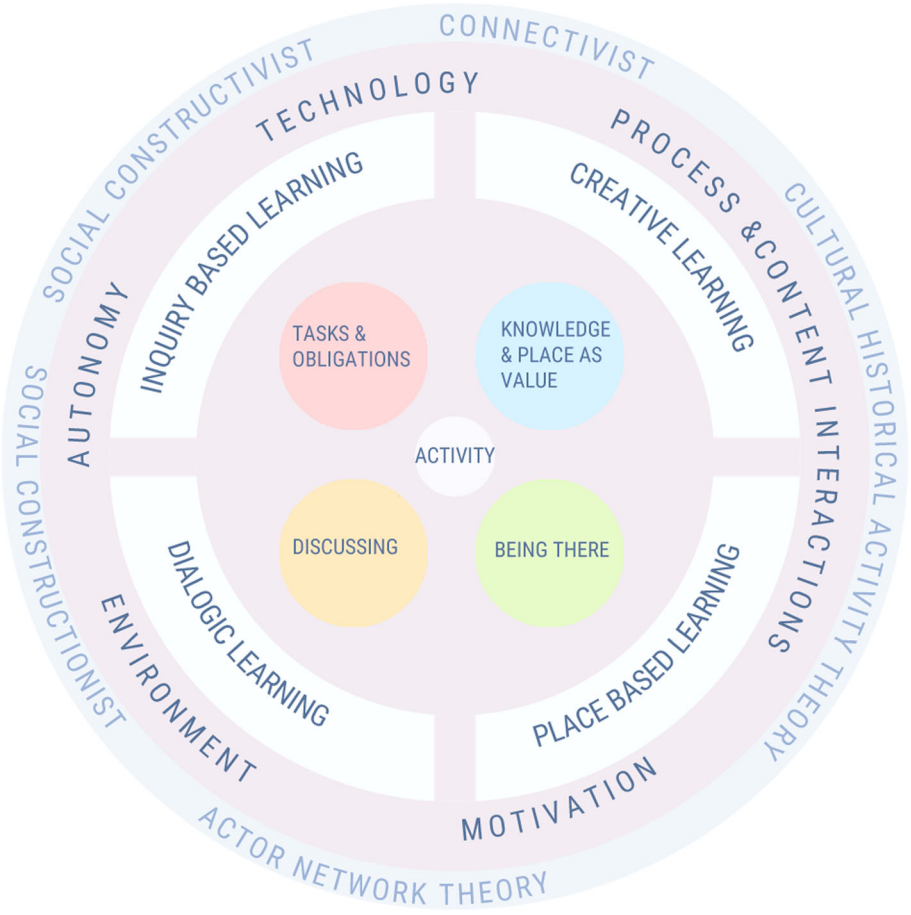

Fig. 1 Visualisation of the Pedagogy of Experience Complexity for Smart Learning (PECSL) model

relevance structures and the epistemological considerations stemming from these might assist in formation of more robust and flexible activity design and development.

Iterating the considerations process

Taking inspiration from Design 101 (Gibbons, 2016) and the approach of key User-centred Design (UCD) texts (Garrett, 2010; Saffer, 2010), design and development of a smart learning activity can adopt an iterative process of continuous re-evaluation throughout activity realisation. By re-examining considerations of the activity in iterative cycles, the activity can benefit from more accurate decisions being made relating to aspects such as interaction design, overall learning potential and anticipated cultural perceptions and contexts. Anticipating the experience of the participant for type and complexity in relation to different groups of participants may assist in further enrichment and value of the activity overall.

Referring to Fig. 2, a generic iterative process is shown with possible stages of iteration and reflection considerations. These or similar processes might be planned during the strategy and scope stages (Garrett, 2010) of a UCD process, as additional factors of consideration for potential learning.

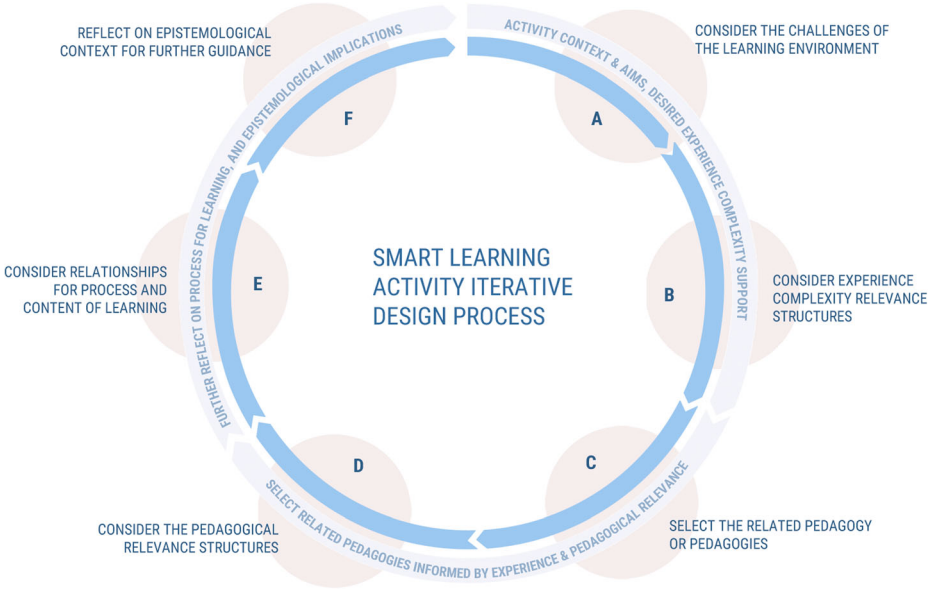

Fig. 2 Interpretation of the PECSL design iterative process, after Design 101 (Gibbons, 2016)

Consider of the environment

In order to "design environments in which motivated learners can acquire what they need" (Siemens, 2006, p. 119), key aspects of the complexity of the smart learning environment should be considered. A useful summary from Goodyear & Cavalho consists of a three-layer architecture: the physical of tools and (digital and other) material world resources, the social of interpersonal relationships and the epistemic of knowledge and ways of knowing (Goodyear & Carvalho, 2012, pp. 49–60). Noting that smartness emerges as a result of structure and interactions in a fluid sociomaterial assemblage (Bhatt & de Roock, 2013), whether or not mediated or enacted through digital technologies (Dron, 2018, pp. 2, 3). Thompson's deft description that "technologies and people fold into each other. Human and non-human actants are in a co-constitutive relationship" (Thompson, 2012, p. 160) sums up the merging of digital and real life perceived experience and acted upon terrain.

Plan for experience complexity

Experience complexity is present, continuously re-interpreted relating to environment, social and digital mediation. Being able to plan beforehand for the kinds of experience that may be possible, desirable or indeed problematic can aid the overall integrated structure and interaction of the activity. Technology is only a part of this consideration, perhaps impact of activity relevance, tasks, topic, social, cultural or environmental considerations being equally significant. Activity type, location and other environmental factors will mitigate expected or desired experience and designing for learning affordances related to these.

Consider the choice of related pedagogy

Depending on the nature of the activity, the choice of related pedagogy will determine the type of relevance that the learner perceives. This needs appropriate framing,

particularly anticipating experience variation and relevance. Core related pedagogies nominated in the research were inquiry-based learning (e.g. Chiang, Yang, & Hwang, 2014), dialogic learning (e.g. Wegerif, 2013), place-based learning (e.g. Taylor, 2017) and creative learning (e.g. Cremin, 2015). These were selected according to the categories of description for experiencing the smart learning journey, and related to participant interview utterances, interpreted as structures of awareness demonstrating experience variation and complexity.

Plan for the pedagogical relevance of motivation

Consider the 'global aspects of learning' and 'hidden agendas' (Marton & Booth, 1997, p. 141) that may be present (as perceived by the participant), and how these impact the activity for motivation (Ryan & Deci, 2000) and engagement (Lister, 2021c). The wider situated-ness of the activity is as much part of how it is experienced as the activity itself.

Plan for process and content integration

Consider the significance of how process for learning in the activity interrelates with the knowledge content provided, or created by participants. These are two sides of the same coin, a symbiotic intertwined relationship that can work effectively together to enable deeper and richer experience complexity for the participant. Over instruction of process (the act of learning) may result in 'technification' and a surface level of learning (Marton & Booth, 1997, p. 169), and an erosion of intrinsic motivation that might have been present in the participant (Dron, 2018; Lister, 2021c).

Reflect on epistemology

Reflect on roles for individual and social construction of meaning, the continual reconstituting of the person-world relationship (Prosser & Trigwell, 1999, p. 13, 139; Wright & Osman, 2018). Consider how connections in digital networks might impact access to knowledge and therefore meaning making with both human and non-human agents. Consider the cultural context, rules, division of labour and other aspects of sociocultural activity, that situated place is as much cultural as task or topic, that expectations or assumptions of activity purpose can be impacted and informed by epistemological contexts.

This is an iterative, circular, learner-centred design process, where stages can be revisited and reimagined in any order as the design of the activity progresses. This permits flexibility, adapting to any type of activity, refining design as considerations might indicate.

Conclusions

This paper has sought to describe in broad terms the concept and generic application of the Pedagogy of Experience Complexity for Smart Learning, a model of four layers of considerations arising from research into experiencing the smart learning journey (Lister, 2021b). The PECSL is particularly suited and envisaged for smart learning activities set in real world hyperlocal locations, aimed at urban citizen learners for all types of learning opportunity. This pedagogical model attempts to offer a pragmatic and

flexible group of considerations based in authentic participant experience of smart learning that may be applied alongside user-centred design principles for iterative design and development of smart learning activities. The overview of A-F procedural stages (Lister, 2021b) outline how stages of pedagogical consideration can evolve iteratively as the activity design and development progresses. Considerations can be modified to encompass direct relevance to the specifics of activity requirement or relevance, but are here described as a 'draft blueprint' approach that might be utilised in part or whole to assist in supporting the planning and design for potential learning in urban smart digital citizen activities.

Abbreviations

PECSL: Pedagogy of Experience Complexity for Smart Learning; UCD: User centred design

Acknowledgements

I acknowledge the University of Malta Faculty of Education and my principal supervisor Dr. P. Bonanno in their generous support of my PhD.

Author's contributions

This is a single author work. The author(s) read and approved the final manuscript.

Authors' information

I confirm that this manuscript has not been published elsewhere and is not under consideration by another journal.
Penelope J Lister. MA, MSc, MBCS, FHEA. PhD Candidate (awaiting viva, Feb 2021).
University of Malta, Faculty of Education, Department of Leadership for Learning and Innovation. Associate Lecturer at London Metropolitan University, UK.
Email: pen.lister@penworks.net
I lecture in multimedia and digital media from foundation to post-graduate level at London Metropolitan University, UK, recent focus is in digital media practice, user-centred design and user experience. Additionally I have recently taken lecture sessions in smart learning with undergraduate and postgraduate education students at University of Malta. My knowledge areas are user experience, usability, user evaluations, website development, digital media best practice. I also work in continuing professional development for academics, lecturing and supporting use and best practice for technology in learning and teaching content and process.
My PhD title is "Experiencing the Smart Learning Journey: A pedagogical Inquiry". I am awaiting viva.

Funding

The author receives no additional external funding.

Availability of data and materials

Not applicable.

Declarations

Competing interests

The author declares no competing interests.

Received: 24 February 2021 Accepted: 6 May 2021
Published online: 26 May 2021

References

Afonso, A., & Fatah gen Schieck, A. (2019). Play in the smart city context: Exploring interactional, bodily, social and spatial aspects of situated media interfaces. *Behaviour & Information Technology*, *39*(6), 656–680. https://doi.org/10.1080/0144929X.2019.1693630.

Allen, S., & Marshall, J. (2019). What could happen when action research meets ideas of sociomateriality? *International Journal of Action Research*, *2-2019*(2-2019), 99–112. https://doi.org/10.3224/ijar.v15i2.02.

Anderson, L. W., & Krathwohl, D. R. (Eds.) (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Addison Wesley Longman.

Angelidou, M., & Stylianidis, E. (2020). Cultural heritage in smart city environments: The update. In *Proceedings of the ISPRS annals of the photogrammetry, remote sensing and spatial information sciences*, (vol. 2, pp. 957–964). https://doi.org/10.5194/isprs-annals-V-2-2020-957-2020.

Bailey, D., Perks, M., & Winter, C. (2018). Supporting the digitally left behind. *Ingenia Online*, (76) https://www.ingenia.org.uk/Ingenia/Articles/930f81f3-4d8a-4e76-b926-1a450d5e7d8f.

Baillie, C., Bowden, J. A., & Meyer, J. H. F. (2013). Threshold capabilities: Threshold concepts and knowledge capability linked through variation theory. *High Education*, *65*(2), 227–246. https://doi.org/10.1007/s10734-012-9540-5.

Bevan, N. (2008). Classifying and selecting UX and usability measures. In *Proceedings of Meaningful Measures: Valid Useful User Experience Measurement (VUUM)*. 5th COST294-MAUSE Open Workshop.

Bhatt, I., & de Roock, R. (2013). Capturing the sociomateriality of digital literacy events. *Research in Learning Technology*, *21*. https://doi.org/10.3402/rlt.v21.21281.

Bruce, C., Pham, B., & Stoodley, I. (2004). Constituting the significance and value of research: Views from information technology academics and industry professionals. *Studies in Higher Education*, *29*(2), 219–238. https://doi.org/10.1080/03075070420001908 04.

Buell, L. (2005). Space, place, and imagination from local to global. In L. Buell (Ed.), *The future of environmental criticism: Environmental crisis and literary imagination*, (pp. 62–96). Blackwell.

Carretero, S., Vuorikari, R., & Punie, Y. (2017). *DigComp 2.1: The digital competence framework for citizens with eight proficiency levels and examples of use*. European Commission. Publications Office of the European Union. https://doi.org/10.2760/38842.

Carroll, J. M., Shih, P. C., Kropczynski, J., Cai, G., Rosson, M. B., & Han, K. (2017). The internet of places at community-scale: Design scenarios for hyperlocal neighborhood. In S. Konomi, & G. Roussos (Eds.), *Enriching urban spaces with ambient computing, the internet of things, and smart city design*, (pp. 1–24). IGI Global. https://doi.org/10.4018/978-1-5225-0827-4.ch001.

Chiang, T., Yang, S., & Hwang, G. (2014). Students' online interactive patterns in augmented reality-based inquiry activities. *Computers & Education*, *78*, 97–108. https://doi.org/10.1016/j.compedu.2014.05.006.

Cope, C. (2004). Ensuring validity and reliability in phenomenographic research using the analytical framework of a structure of awareness. *Qualitative Research Journal*, *4*(2), 5–18 http://search.informit.com.au/documentSummary;dn=133094720910488;res=IELHSS.

Cope, C. J. (2002). Educationally critical aspects of the concept of an information system. *Informing Science*, *5*(2), 67–78. https://doi.org/10.28945/538.

Cremin, T. (2015). Editorial: Perspectives on creative pedagogy: Exploring challenges, possibilities and potential. *Education 3-13*, *43*(4), 353–359. https://doi.org/10.1080/03004279.2015.1020632.

Dron, J. (2018). Smart learning environments, and not so smart learning environments: A systems view. *Smart Learning Environments*, *5*(1), 25. Springer Open. https://doi.org/10.1186/s40561-018-0075-9.

Fenwick, T., & Edwards, R. (2010). *Actor Network Theory in Education*. Routledge. https://doi.org/10.4324/9780203849088

Garrett, J. J. (2010). *The elements of user experience: User-centered design for the web and beyond*, (2nd ed.,). New Riders Press https://dl.acm.org/doi/book/10.5555/1965524.

GhasemAghaei, R., Biddle, R., & Arya, A. (2015). Multimodal software for affective education: UI design. In *Proceedings of EdMedia: World conference on educational media and technology, AACE, 2015*.

Gibbons, S. (2016). *Design thinking 101*. Nielsen Norman Group https://www.nngroup.com/articles/design-thinking/.

Goodyear, P., & Carvalho, L. (2012). The analysis of complex learning. In H. Beetham, & R. Sharpe (Eds.), *Rethinking pedagogy for a digital age: Designing for 21st century learning*, (2nd ed., pp. 49–63). Routledge.

Gorry, G. A. (2016). Memory machines and the future of knowledge management. *Knowledge Management Research & Practice*, *14*(1), 55–59. https://doi.org/10.1057/kmrp.2014.19.

Gourlay, L., & Oliver, M. (2018). *Student engagement in the digital university: Sociomaterial assemblages*. Taylor & Francis. https://doi.org/10.4324/9781315647524.

Green, B. (2019). *The smart enough city, putting technology in its place to reclaim our urban future. Strong ideas*. MIT Press. Available from https://mitpress.mit.edu/books/smart-enough-city. https://doi.org/10.7551/mitpress/11555.001.0001.

Greeno, J. G., & Engeström, Y. (2014). Learning in activity. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences*, (2nd ed., pp. 128–147). Cambridge University Press. https://doi.org/10.1017/CBO9781139519526.009.

Gurwitsch, A. (1964). *The field of consciousness*. Duquesne University Press.

Gurwitsch, A. (2010). In R. Zaner (Ed.), *The collected works of Aron Gurwitsch (1901-1973). Volume III, The field of consciousness: theme, thematic field, and margin*. Springer. https://doi.org/10.1007/978-90-481-2942-3.

Hannewijk, B., Vinella, F. L., Khan, V.-J., Lykourentzou, I., Papangelis, K., & Masthoff, J. (2020). Capturing the city's heritage on-the-go: Design requirements for mobile crowdsourced cultural heritage. *Sustainability*, *2020*(12), 2429.

Harrington, M. (2008). *Simulated ecological environments for education: A tripartite model framework of HCI design parameters for situational learning in virtual environments*. Doctoral Dissertation, University of Pittburgh D-Scholarship@Pitt. http://d-scholarship.pitt.edu/8971/.

Hernandez, K., & Roberts, T. (2018). *K4D emerging issues report 10: Leaving no one behind in a digital world*. Institute of Development Studies https://www.ids.ac.uk/publications/leaving-no-one-behind-in-a-digital-world/.

Horn, S. (2018). Signs of the city: Metropolis speaking. In S. Nichols, & S. Dobson (Eds.), *Learning cities. Cultural studies and transdisciplinarity in education*, (vol. 8, pp. 77–94). Springer. https://doi.org/10.1007/978-981-10-8100-2_6.

Jayanandhan, S. R. (2009). John Dewey and a pedagogy of place. *Philosophical Studies In Education*, *40*, 104–112 Ohio Valley Philosophy of Education Society. http://files.eric.ed.gov/fulltext/EJ864314.pdf.

Jones, C. (2018). Experience and networked learning. In D. N. Bonderup, S. Cranmer, J. A. Sime, M. de Laat, & T. Ryberg (Eds.), *Networked learning. Research in networked learning*, (pp. 39–55). Springer. https://doi.org/10.1007/978-3-319-74857-3_3.

Jones, P., Layard, A., Speed, C., Lorne, C., & Blunt, C. (2013). MapLocal. Arts and Humanities Research Council as part of the Connected Communities programme. https://chrisspeed.net/wp-content/uploads/2013/10/MapLocal-Small.pdf.

Kaapu, T., Saarenpää, T., Tiainen, T., & Paakki, M. (2006). The truth is out there - Phenomenography in information systems research. In *Proceedings of the 29th information systems research seminar in Scandinavia, Helsingör, Denmark*.

Kvale, S. (1996). *Interviews. An introduction to qualitative research interviewing*. Sage Publications.

Lin, T. C. Y. W., Galloway, D., & Lee, W. O. (2011). The effectiveness of action learning in the teaching of citizenship education: A Hong Kong case study. In K. J. Kennedy, W. O. Lee, & D. L. Grossman (Eds.), *Citizenship pedagogies in Asia and the Pacific, CERC studies in comparative education*, (pp. 53–80). Springer. https://doi.org/10.1007/978-94-007-0744-3_4.

Lister, P. (2018). A smarter knowledge commons for smart learning. *Smart Learning Environments 5* (8). Springer Open. https://doi.org/10.1186/s40561-018-0056-z

Lister, P. (2020). Smart learning in the community: Supporting citizen digital skills and literacies. In N. Streitz, & S. Konomi (Eds.), *Distributed, ambient and pervasive interactions. HCII 2020. Lecture notes in computer science*, (pp. 533–547). Springer. https://doi.org/10.1007/978-3-030-50344-4_38.

Lister, P. (2021a). Understanding experience complexity in a smart learning journey. *SN Social Sciences*, *1*(1), 42. Springer Nature. https://doi.org/10.1007/s43545-020-00055-9.

Lister, P. (2021b). *Experiencing the smart learning journey: A pedagogical inquiry*. [Unpublished doctoral dissertation, University of Malta]. University of Malta.

Lister, P. (2021c). What are we supposed to be learning? Motivation and Autonomy in smart learning environments. In Streitz, N., & Konomi, S. (Eds.), *Distributed, Ambient and Pervasive Interactions. HCII 2021*. Lecture Notes in Computer Science 12782, (pp. 1–15). Springer. In press. https://doi.org/10.1007/978-3-030-77015-0_17.

Lister, P. (2022). Future-present learning and teaching: A case study in smart learning. In E. Sengupta, & P. Blessinger (Eds.), *Changing the conventional classroom, innovations in higher education teaching and learning (IHETL)*. Emerald Publishing In press.

Liu D., Huang, R., & Wosinski, M. (2017). Future Trends in Smart Learning: Chinese Perspective. In: *Smart Learning in Smart Cities*. Lecture Notes in Educational Technology (pp. 185-215). Springer. https://doi.org/10.1007/978-981-10-4343-7_8

MacGregor, D. (2018). Learning in/from 'disadvantaged' communities: Connecting people and sites of learning. In S. Nichols, & S. Dobson (Eds.), *Learning cities, multimodal explorations and placed pedagogies*, (pp. 203–217). Springer. https://doi.org/10.1007/978-981-10-8100-2_13.

Martin, J., Dikkers, S., Squire, K., & Gagnon, D. (2014). Participatory scaling through augmented reality learning through local games. *TechTrends*, *58*(1), 35–41. https://doi.org/10.1007/s11528-013-0718-1.

Marton, F. (1981). Phenomenography - describing conceptions of the world around us. *Instructional Science*, *10*(2), 177–200. https://doi.org/10.1007/BF00132516.

Marton, F. (1996). Cognoso ergo sum – Reflections on reflections. In G. Dall'Alba, & B. Hasselgren (Eds.), *Reflections on phenomenography: Toward a methodology?* (pp. 163–187). Acta Universitatis Gothoburgensis.

Marton, F., & Booth, S. (1997). *Learning and awareness*. Lawrence Erlbaum Associates.

Marton, F., & Pong, W. P. (2005). On the unit of description in phenomenography. *Higher Education Research & Development*, *24*(4), 335–348. https://doi.org/10.1080/07294360500284706.

McKenna, H. P. (2016). Is it all about awareness?: People, smart cities 3.0, and evolving spaces for IT. In *Proceedings of the 2016 ACM SIGMIS Conference on Computers and People Research (SIGMIS-CPR '16)*, (pp. 47–56). ACM. https://doi.org/10.1145/2890602.2890612.

Omarali, P. S. (2016). Investigating the effectiveness of the 'online learner profiling questionnaire' in generating a profile of learners based on learner dispositions: A pilot study. In A. Volungeviciene, A. Szűcs, & I. Mázár (Eds.), *Forging new pathways of research and innovation in open and distance learning: Reaching from the roots, European Distance and E-Learning Network, Germany 2016*, (pp. 99–108).

Patten, B., Sánchez, I. A., & Tangney, B. (2006). Designing collaborative, constructionist and contextual applications for handheld devices. *Computers & Education*, *46*(3), 294–308. https://doi.org/10.1016/j.compedu.2005.11.011.

Prosser, M., & Trigwell, K. (1999). *Understanding learning and teaching: The experience in higher education*. Open University Press.

Rezgui, K., Mhiri, H., & Ghédira, K. (2014). An ontology-based profile for learner representation in learning networks. *International Journal of Emerging Technologies in Learning (iJET)*, *9*(3). https://doi.org/10.3991/ijet.v9i3.3305.

Roth, W., & Lee, Y. (2007). 'Vygotsky's Neglected Legacy': Cultural-Historical Activity Theory. *Review of Educational Research, 77*(2), 186-232. https://doi.org/10.3102/0034654306298273.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68.

Saffer, D. (2010). *Designing for interaction, second edition: Creating innovative applications and devices*. New Riders.

Säljö, R. (1997). Talk as data and practice - A critical look at phenomenographic inquiry and the appeal to experience. *Higher Education Research & Development*, *16*(2), 173–190. https://doi.org/10.1080/0729436970160205.

Sandberg, J. (2005). How do we justify knowledge produced within interpretive approaches? *Organizational Research Methods*, *8*(1), 41–68. https://doi.org/10.1177/1094428104272000.

Schreiber-Barsch, S. (2017). Space is more than place: The urban context as contested terrain of inclusive learning settings for adults and arena of political subjectivation. In H. Sacré, & S. De Visscher (Eds.), *Learning the city, cultural approaches to civic learning in urban spaces*, (pp. 67–81). Springer. https://doi.org/10.1007/978-3-319-46230-1_5.

Schunk, D. H. (2012). *Learning theories: An educational perspective*, (6th ed.,). Pearson Education.

Siemens, G. (2006). *Knowing knowledge*. KnowingKnowledge.com Internet Archive. Retrieved September 15, 2020, from https://web.archive.org/web/20061206214545/http://www.knowingknowledge.com/book.php.

Stahl, G. K., Miska, C., Lee, H.-J., & de Luque, M. S. (2017). The upside of cultural differences: Towards a more balanced treatment of culture in cross-cultural management research. *Cross Cultural & Strategic Management*, *24*(1), 2–12. https://doi.org/10.1108/CCSM-11-2016-0191.

Sultana, R. (2018). Precarity, austerity and the social contract in a liquid world: Career guidance mediating the citizen and the state. In T. Hooley, R. Sultana, & R. Thomsen (Eds.), *Career guidance for social justice*, (pp. 63–76). Routledge. https://doi.org/10.4324/9781315110516-4.

Suthers, D. D. (2006). Technology affordances for intersubjective meaning making: A research agenda for CSCL. *Computer Supported Learning*, *1*(3), 315–337. https://doi.org/10.1007/s11412-006-9660-y.

Taylor, K. H. (2017). Learning along lines: Locative literacies for Reading and writing the City. *Journal of the Learning Sciences*, *26*(4), 533–574. https://doi.org/10.1080/10508406.2017.1307198.

Thompson, T. L. (2012). Who's taming who? Tensions between people and technologies in cyberspace communities. In L. Dirckinck-Holmfeld, V. Hodgson, & D. McConnell (Eds.), *Exploring the theory, pedagogy and practice of networked learning*, (pp. 157–172). Springer. https://doi.org/10.1007/978-1-4614-0496-5_9.

Topping, K. J., Buchs, C., Duran, D., & Van Keer, H. (2017). *Effective peer learning: From principles to practical implementation*. Routledge. https://doi.org/10.4324/9781315695471.

Tristán-López, A., & Ylizaliturri-Salcedo, M. A. (2014). Evaluation of ICT competencies. In J. Spector, M. Merrill, J. Elen, & M. Bishop (Eds.), *Handbook of research on educational communications and technology*. Springer. https://doi.org/10.1007/978-1-4614-3185-5_26.

Van Kerkhoven, M., & Bakker, P. (2014). The hyperlocal in practice. *Digital Journalism*, *2*(3), 296–309. https://doi.org/10.1080/21670811.2014.900236.

Vosloo, S. (2018). *Guidelines: Designing inclusive digital solutions and developing digital skills*. United Nations Educational, Scientific and Cultural Organization https://unesdoc.unesco.org/ark:/48223/pf0000265537.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press. http://ouleft.org/wp-content/uploads/Vygotsky-Mind-in-Society.pdf.

Wegerif, R. (2013). *Dialogic: Education for the internet age*. Routledge. http://www.rupertwegerif.name/uploads/4/3/2/7/43271253/deiaproofs24thoct12.pdf. https://doi.org/10.4324/9780203111222.

Williamson, B. (2015). Educating the smart city: Schooling smart citizens through computational urbanism. *Big Data and Society*, *2*(2), 1–13. https://doi.org/10.1177/2053951715617783.

Wright, E., & Osman, R. (2018). What is critical for transforming higher education? The transformative potential of pedagogical framework of phenomenography and variation theory of learning for higher education. *Journal of Human Behavior in the Social Environment*, *28*(3), 257–270. https://doi.org/10.1080/10911359.2017.1419898.

Publisher's Note