

Opening up Smart Learning Cities - building knowledge, interactions and communities for lifelong learning and urban belonging

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Abstract. This paper revisits issues arising from prior research carried out by the author examining citizen informal learning through interactions with the real world via augmented reality interfaces triggering place based knowledge. Topics discussed in this paper were not part of the research yet deserve further discussion in that context. Two areas are of particular interest: place based digital knowledge content delivery and user generated content related to place. In other words, how users might freely and easily access knowledge content that relates to features and places they pass through or live in, and how they might digitally interact with their local environment to contribute to a community of memory associated with place [39 30, 29]. This compiling of the knowledge archive of place, both expert and citizen generated, might be described as the reading and writing of the city, somewhat like [26] or [19], reflecting ideas going back to the Berkeley Community Memory bulletin-boards of the 1970s [7]. Discussion includes the concept of community mapping, briefly examining examples from literature and a prototype, the ‘Learner Feedback Map’, developed by the author but not used in the final research. The challenges of finding and delivering knowledge content, and of uploading and hosting user-generated content are briefly considered in the context of decentralised networks and the Fediverse.

Keywords: Fediverse, OER, Linked Open Data, Community Mapping, UGC, User-Generated Content

1 Introduction

This paper has been written as a deeper critical reflection on recent research concerning citizen informal learning through interactions with the real world via augmented reality interfaces triggering place based knowledge. Noting issues that were raised during the research deserving further discussion and investigation, two areas of perhaps most significance are discussed, of access to and generation of knowledge related content. These issues were not directly part of the research, but were noted as a consequence of it. In the context of this introduction, it is important to state that the research did not benefit from external funding sources and therefore selected to make use of free smartphone apps and digital platforms that were currently available at the time to support the technological aspects of the activities and interactions being inves-

tigated. This meant that the researched learning experiences represented what might be achieved by anyone facilitating such activities in real-world scenarios who had low or no funding. In the view of this author (the researcher) this is important, as it took an approach of authentic research of this kind, of real-world augmented reality activity design and implementation without extra funding or bespoke mobile apps, and the challenges that this approach subsequently highlighted.

A brief summary of the research is provided to facilitate the context of discussion, and to support the reader in understanding what happens when a user accesses or creates knowledge about a location or object in a (usually urban) place. What users think, feel or want to say or do during that process impacts areas of discussion in terms of how expert knowledge might be further explored by users, either on locale or beyond, and of methods for capturing user contributions to place based knowledge in an archive of community memory. This engagement and interaction reflects what is referred to here as the ‘reading and writing of the city’ that forms the core cultural basis of an urban environment [26].

1.1 Accessing and creating knowledge

Discussion is comprised of two related areas: how users access knowledge, either via digitally augmented reality triggering or other geo-coded methods of smarter content delivery, and how users generate knowledge that might be added to community archives, to then potentially (ideally) be maintained as urban collective knowledge memory, e.g. [52]. These two areas are related by means of how knowledge is defined, accessed and delivered, of the ownership of that (digitised) knowledge, and of the intertwined relationship between expert and community generated knowledge. We might describe this relationship as the reading and writing of the smart city, somewhat after [26] or [19].

Practical and technical considerations are part of the debate of this paper, within the two areas of concern. Provision for enabling user generated content (UGC) focuses on community knowledge mapping, an initiative that has seen consistent uptake and implementation for a number of years, further discussed below and later. For more streamlined and effective delivery of knowledge, focus is placed in a number of related debates. Smarter delivery and findability (41, 15); discourses around quality and purpose of effective metadata and the role of Linked Open Data, e.g. [6, 52, 15], and the potential of the ActivityPub¹ protocol to share knowledge efficiently in a civic federated archive (48, 13, 11).

To further reflect on mechanisms by which users may contribute their own memories, knowledge, experiences and media content, the paper discusses the concept of the user feedback map. Several examples from past initiatives found in the literature are provided that demonstrate how users have contributed to knowledge banks of a

¹ <https://activitypub.rocks/>

local area through creation of local community maps of places, features or events added by user citizens who live or work there (Mapping for Change Community Maps², MapLocal³, Culture Map Malta⁴, and many others⁵). These initiatives have much in common, utilising simple digital functionality (usually a website and a Google or Open Maps feature) that permit anyone with an Internet connection to contribute their own information and content. As part of the authors own research, a ‘Learner Feedback Map’ was developed as a prototype to show the feasibility of a simple web form user interface with interaction functionality to upload geocoded content for building knowledge maps of user generated contributions viewable to others.

2 Context of prior research

The prior research that forms the basis for the topics of debate in this paper concerned citizen informal learning in real-world locations using augmented reality (AR) triggering that provided multimedia content and optional tasks. Two urban locations were used to situate these AR based activities, London UK and Valletta, Malta, each being designed as a ‘smart learning journey’ comprised of several related locations along a route that could be undertaken as a whole (of walk-able distance) or as stand alone points of interest. Each featured location had an AR trigger using image recognition, which on being triggered offered the user an interface of icons linking to various content choices - videos, images or written content in webpages. Some location trigger points also offered suggested tasks in the form of question prompts, to provide ideas for how to engage in the given location. The HP Reveal free smartphone app (formerly known as Aurasma) was used to facilitate these AR triggers, with the interface being designed and built using the HP Reveal Studio web application. The interface of content choices was very similar for both journey activities, though the journeys themselves had different themes: creative writing and English literature heritage (London), and Maltese democracy (Valletta). Participants were drawn from various undergraduate and postgraduate students cohorts, and took part voluntarily. Figure 1 (left) shows the London UK medieval St Olave’s church noticeboard augmented by the icon interface triggers and (right) shows the Valletta Malta Parliament Building entrance with its augmented reality interface being triggered through the HP Reveal camera image recognition.

² <https://mappingforchange.org.uk>; e.g.

<https://communitymaps.org.uk/project/archway?center=51.5657:-0.1337:14>

³ <https://chrisspeed.net/?p=1303>

⁴ Now defunct, however available via the Internet Archive Wayback Machine, e.g.:

<https://web.archive.org/web/20161203012651/https://www.culturemapmalta.com/#/> or

<https://web.archive.org/web/20180920013724/https://www.culturemapmalta.com/#/>

⁵ Oxford Bibliographies for Community Mapping

<https://doi.org/10.1093/OBO/9780199874002-0184> & Cultural Mapping

<https://doi.org/10.1093/OBO/9780199756841-0249>

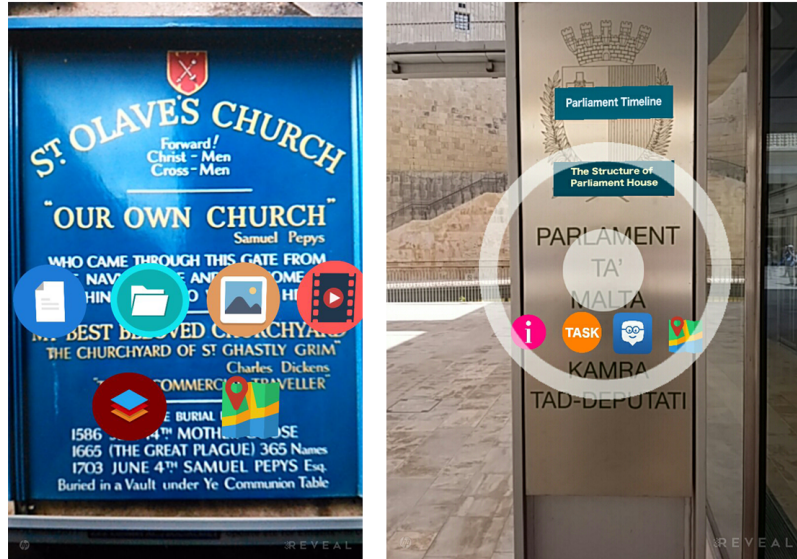


Fig. 1. (L) London UK St Olave's noticeboard with AR icon interface; (R) Valletta Malta Parliament Building entrance viewed through HP Reveal camera triggering the AR interface

The project itself was investigating development of pedagogical concepts arising from participant experience using the methodology of phenomenography, which examines the focal awareness and derived meaning for a user [34]. However, other issues were apparent in the transcripts that merit further discussion outside of the phenomenographic research approach, or of any potential pedagogical design considerations. These are the later observations made by the researcher when reflecting on the transcript themes, and relate to technological and digital content related aspects. The two related areas nominated at the beginning of this paper - accessing and creating knowledge content - involve both technological and practical considerations. Key technical problems are effectiveness of metadata and content delivery mechanisms, ownership of data and content, and intellectual property concerns. Key practical issues are provision for users to upload and share content, and how preservation of this archive of citizen memory of place might be achieved. To glimpse what citizens experience in terms of accessing and creating knowledge content, we can reflect on what participants in the research said. Table 1 includes interview transcript extracts talking about provided content and making choices about that content. Table 2 includes transcript extracts talking about creating and uploading multimedia content in various contexts.

Table 1 Showing actions and contexts of consuming provided knowledge content

Summary of interest	Quote	Pn
Information provision: useful/ too	<i>" ... it's nice to be able to use your smart phone ... in terms of the information itself ... because there was so</i>	P1

much; Discussing is useful Googling is useful	<i>many links for each kind of sort that we eventually stopped looking at the information... and then kind of just discussing the places ourselves or even Googling things ourselves because we found that was a little bit easier for us to do ...</i>	
What is memorable about place is the knowledge associated with it	<i>“ ... I think initially you’re approaching place but then what kind of seems to stick (is) what author was attributed to that place. So for example ... there is the Charles Dickens right next to the George and Vulture, ... it seems to be the kind of literary figure that resonates after having seen a place...”</i>	P4
Googling own information may be more important than providing any	<i>“ ... We walk around (and) use the app where you move your phone over it and it gives you information. It’s kinda like I can get that information if I just Google it and searched a few things couldn’t I?”</i>	P6
Provided content about place: more real, engaging, relating to creating own content, making content choices	<i>“ ... if we look at the monument, a video for example of the great siege, it would’ve been more interactive, real, you’re seeing it, it’s relevant... you’re not seeing it as a waste of time ... ” “... you’re just going to have bits and pieces there distributed according to where you are ... some videos for you to see and maybe watch them later but at the moment ... you’re being engaged into seeing what you have to do, take pictures and do the task at that time ... ”</i>	P7

Table 2 Showing experiences of creating and uploading own content

Summary of interest	Quote	Pn
Contributing content that is more personal, perhaps more original	<i>I wanted to try and contribute something personal... something bit more individual, for the sake of sharing and learning, I would personally prefer to see ten different poses in front of a statue or ten different corners of the building rather than ten very similar photos of the front face of the building just because its more interesting to look at ... ”</i>	P21
Problems with uploading video content Interest in the cultural mix of the present day location	<i>“ ... I did try to take some videos of like the first one at the gate and there was like a musician playing it was kind of cool like Bob Dylan-esque music, and there was like a group of Chinese tourists and like the big screen like the big gate so it was kind of like lovely mix but I couldn’t get my video to upload...”</i>	P22
Observations about socio-temporality contrasting ideas and habits of the ‘exact’ location through time	<i>“ ... cos there was like, like this video of like a chariot (horse drawn carriage) going by, and then in real life we’re taking a video of ... this guy playing guitar, and singing. And ... people walking through, and baby strollers, and stuff, so its just like that picture and like the</i>	P23

video that we took are, like what we are really seeing are very different but its ... the same exact place you know, its been there for hundreds of years and I love that. ... ”

These short excerpt examples from participant transcripts provide various perspectives about interactions with content - amount and choice; ability to ‘Google’ search; evocation of deeper reflections about the socio-temporality of the city; evocation of cultural knowledge related to place forming deeper place-based memory attribution; situated content being ‘real’ and adding engagement value, and so on. These pose the issues that are the basis for the discussion in this paper.

3 Reading and writing the city

Reading and writing the city is a way of describing the process by which citizens read and contribute knowledge content related to urban places. For example, reading expert science, literature, art or cultural heritage, and then contributing to a community archive of citizen memoir and lived experience about those places (to also be able to read what others say).

Discussion here is scoped in terms of UGC that includes casual social media comments and content sharing to more complex creative work, for example photography, street art or situated creative writing such as poetry or story telling via digital means (e.g. ambient literature, [49]). UGC is considered as contributions to community content archives that build the city as digital/real-world memory in parallel to the expert knowledge attached digitally to place by geocoding and accessed via smart technologies. The methods by which expert knowledge content might be provided or sourced (discovered) by users, and how they might add to their community archive are part of considerations. Discussion is positioned in the context of the open, interactive city [38], and a “frictionless learning environment ... (of) ... space, time, resources and community interaction” for individual or group learning needs [40]. This means open data, the open knowledge commons, and the increasing relevance of this being hosted on open distributed networks, sometimes referred to as the Fediverse⁶.

3.1 Finding and delivering expert knowledge

Considerable research exists relating to methods by which information can be delivered in smarter ways, e.g. [15, 53]. I have previously argued that the knowledge commons⁷ might make use of simple metadata properties from the Open Graph⁸ [35], with perhaps only one or two additional useful pedagogical properties being added to those already existing, similar to [1]. This topic can be contentious amongst research-

⁶ <https://axbom.com/fediverse/>

⁷ Knowledge Commons definition: https://en.wikipedia.org/wiki/Knowledge_commons

⁸ The Open Graph protocol <https://ogp.me>

ers, with different groups researching different methods, chief among these and potentially most popular with educators are the Open Educational Resources Schema⁹, based on Google Schema¹⁰ or the Learning Resource Metadata Initiative¹¹, based on the Dublin Core¹² metadata system. The key challenge with these or other systems are that they are only partially interoperable, and are often not actually used by those who publish knowledge content [44]. This remains an on-going issue for those who aim to connect the Internet of Things (IoT) and place to the connected knowledge seeker, with no end in sight. Hillerbrand [20] summarises this with: “(t)hese wild debates occur primarily within the technical community. The result is an echo-chamber debate that bears little connection to the nontechnical problems faced by businesses, especially consumer-facing businesses” (2016, p. 214). Replace ‘businesses’ and ‘consumer facing business’ with ‘educators and ‘citizen-facing educators’ or similar, and the issue is the same.

More and better Metadata

Current work highlighted here focuses on increasing interest in the literature on metadata for open knowledge and open educational resources, as well as noting an increase in training academic or information science staff to understand and implement metadata, e.g. [27]. Practical examples are seen in staff portal support pages at Macquarie University, Australia¹³, or Imperial College, London, UK¹⁴, showing the need to add good search and social metadata, using Dublin Core, Open Graph or Twitter Cards. This would have been highly unusual even only a few years ago. The conversation amongst practitioners themselves therefore (not just technologists) has turned toward metadata, perhaps regarded as the best solution for content management and findability [17, 46, 27]. Contexts range between cultural heritage, tourism, open educational resources and others, with varying approaches to utilising smarter technologies and IoT infrastructure for better providing knowledge content to smartphone or desktop, just-in-time queries [21, 27, 51]. How we resolve the issue of a more fluid and standardised connectivity between knowledge, experts and citizens remains a significant challenge [37, 48).

Multiple issues arise in the searching and retrieving of content, both in access and selection choices and in the connected relationships of searchable databases, or the possibility of search serendipity [16, 31]. In the case of the urban real-world just-in-time Google searching described by P1 (Table 1), serendipity may be relevant when P1 says it was ‘easier’ to ‘just Google things’ than go through the provided content

⁹ Open Educational Resources Schema <http://oerschema.org/docs/>

¹⁰ Schema.org <http://schema.org/docs/about.html>

¹¹ LRMI https://www.dublincore.org/specifications/lrmi/lrmi_1/

¹² Dublin Core <https://www.dublincore.org/>

¹³ <https://staff.mq.edu.au/support/marketing-and-communications/website-guides-and-resources/squiz-newsletter/news/news/how-to-write-good-metadata>

¹⁴ <https://www.imperial.ac.uk/staff/tools-and-reference/web-guide/t4-site-manager/content-types/social-metadata/>

choices. Perhaps the act of discovering content is as much part of interaction and engagement reward as the quality of the content itself. Not defining search results or provided content too rigidly might foster new ideas, though this can also be a problem of too little information to make informed choices. For example, Google Lens¹⁵ smart search results remain simplistic and lack means by which a user can determine what is relevant to them at that time. As I have argued elsewhere [35, 33], perhaps a more streamlined connectivity to Google Lens via configurable (ideally open) API¹⁶, with refined displays of results may be the way to integrate both expert or user-generated geospatially related knowledge in any connected urban environment.

The role(s) of UGC in metadata

User generated content can form a valuable and engaging aspect of cultural knowledge and experience in public spaces [42], and additionally UGC content or metadata may be used to establish further information about user-participant experience of events or places [18, 14]. While UGC offers usefulness for other users and for civic event organisers or similar, some potential problems arise when UGC forms part of re-usable knowledge repositories. Issues such as copyrighted content that may form all or part of a UGC upload [28] or maintaining the integrity of UGC within a more formal information management system delivery [23] are two examples.

4 Community Archives

If we are to foster inclusive smart cities that are truly built around the people who live in them (past, present and future) then we must consider how to effectively capture the meaning and lived experience of those lives. Citizen experiences may be formed as part of interactions with expert knowledge, or consist of more informal experiences of everyday life, and together they form an archive separate from any expert knowledge, arguably distinct from any social media platform or proprietary technological implementation (and subsequent ownership by private enterprise). These are the urban archives of citizens, the memory of the city [47, 19, 36, 2] and need to be preserved for posterity, as the city is the physical embodiment of the history of the people who live in it ([9] in [26]). Two issues are therefore pertinent: how users upload to the civic archive, and who owns the archive and the data within it. These issues are discussed in following sections.

4.1 Community Mapping

Community mapping is interpreted here as the ability and affordance for communities to map points of interest in their local area and add textual or rich media content for others to find. This can be for a wide range of purposes, for example events, facilities, work opportunities, arts and creativity, conservation or urban planning feedback could

¹⁵ <https://lens.google/>

¹⁶ <https://en.wikipedia.org/wiki/API>

all be part of a mapped network of citizen activity and daily life. Cultural mapping is defined in Oxford Bibliographies [12] as:

“Cultural mapping ... aims to make visible the ways local stories, practices, relationships, memories, and rituals constitute places as meaningful locations ... cultural mapping has generally evolved along two main branches: The first begins with cultural assets, seeking to identify and document tangible and intangible assets of a place to ultimately develop a cultural resource or asset mapping. The second branch begins with a culturally sensitive humanistic approach, seeking to articulate a “sense of place,” people-place meanings, and distinctive elements...”

Community mapping merits it’s own page in the Oxford Bibliographies record [43], and offers the following definition:

“Community mapping is best characterized as a collaborative mapping exercise, in which local voices are articulated, as against standardized modes of mapping, which have historically frequently reflected more top-down or expert forms of knowledge. As such it is in theory participatory, inclusive, and appropriate to local needs, interests, and goals.”

Community maps can sometimes be more overtly political, known as ‘counter-mapping’ (e.g. [10]), where local communities may challenge an ‘official’ map of an area by creating their own alternative version for political or citizen activism purposes. I would suggest that the difference between community and counter-mapping can be a moot point, depending on the purpose of any community mapping project. Community or cultural mapping has been a popular method by which citizens are empowered to create a record of their own locality, and has ‘a long trajectory’ [43], with plentiful literature documenting initiatives of this kind. Next, three examples of community mapping are highlighted for purposes of bringing to life what community mapping is and why it might be used within contexts similar to the research informing this paper.

MapLocal (Speed, 2013) was an Android smartphone app developed as part of a research project ‘Localism and Connected Community Planning’, to ‘unlock the creativity of communities by gathering materials to inform neighbourhood planning’. While a MapLocal webpage exists¹⁷, as well as the original project guide [25] and academic publication [24], the content and the app are defunct, and no longer able to be seen or contribute to further initiatives or knowledge banks in the area. The University College London Mapping For Change¹⁸ project worked with “groups and organisations who want to understand, improve and produce information about the places that matter to them” (from their website), with UK based initiatives mainly in the London area. Their Community Maps are grouped into themes of Sustainability,

¹⁷ See footnote 3

¹⁸ <https://mappingforchange.org.uk/>

Health and Wellbeing, People and Society and Planning and Urban Design, with various local mapping projects listed in each. Most projects appear to be seven or eight years old, and it is difficult to establish whether they are still used, though maps are intact and fully interactive. The Culture Map Malta project was somewhat similar to Mapping for Change, though was part of the Valletta European City of Culture 2018 events and activities and therefore had a different purpose. With an emphasis on civic heritage, it documented historic and community places of interest in the Valletta and beyond in Malta. Using similar web-based technology to Mapping for Change, citizens were invited to add their contributions so that visitors to the city might find places of interest when they came for a holiday or as part of a cultural event. Sadly this project is now completely defunct, and can only be found via the Internet Wayback machine¹⁹. All three examples demonstrate the value and usefulness of community mapping and the range of purposes for which it can be adapted, as well as the unfortunate fact that none of the knowledge content survives either at all or in any usable format. Arguably, these projects would benefit from being included in established civic digital archives and retained for posterity as records of community, content and life being lived at that time in those places.

The Learner Feedback Map, a practical example of a community user-feedback map developed by the author is described in the following section, and highlights the challenges and reasons for subsequent abandonment of this tool as part of the technological solutions used in the research informing this paper.

4.2 The ‘Learner Feedback Map’

The practical example of a user-learner feedback map described in this section was developed by the author as a simple and workable solution to the issue of how participant learners might be able to upload comments, photos or videos pinned to a specific location by using an online form. This would have solved the issues that P22 describes, provided in transcript excerpt Table 2.

Technology used was a combination of ‘off-the-shelf’ readily available apps and services, additionally utilising open source JavaScript libraries, Google Sheets scripts and free web services. These are listed in Table 3 with short commentary about each.

Table 3 Technologies used to build the Learner Feedback Map

Technology	Short Description	Further comments
Jotform	Free online form service that included location finder	<i>Jotform²⁰ offered functions that at the time were not available elsewhere: upload video, audio, record video, GPS location co-ords submission. Easy to implement, choice of internal hosting or exporting data submissions</i>

¹⁹ Culture Map Malta in 2018

<https://web.archive.org/web/20180614133520/https://www.culturemapmalta.com/#/>

²⁰ <https://www.jotform.com/>

Google Sheets	Using Google drive hosted data from Jotform responses	<i>University of Malta Google Drive was a more secure option to host data (research ethics/privacy); also running Google sheet scripts to configure co-ords data output.</i>
Zapier	A connectivity actions service similar to 'If This Then That'	<i>Zapier²¹ is a versatile connective functions platform, connecting one online service with another, with particular actions executed on specified event. Used to add Jotform submissions to Gsheet rows. Also used to publish to social media (Facebook or Twitter) when form events executed.</i>
Sheetsee.js	A JavaScript library allowing Gsheets information to be visualised on a map	<i>Sheetsee was an Open Source JavaScript library authored by Jessica Lord²² that visualises data from Google Sheets into html tables, diagrams or maps. Functioning in updated version until 2021, defunct as of 2022 due to Tabletop.js dependency no longer supported by Google. Needs geo-coordinates delivered in specific way, connects to Google Sheets via G-sheet key.</i>
JSON/ CSS	Code that permits visual styling of data	<i>JSON/CSS configuration permits design flexibility for displaying data cards on map pins in webpages. I displayed journey name, text comments and uploaded image in each map pin card. Username was not displayed.</i>
Open-StreetMap	Mapping	<i>OpenStreetMap²³ is open source mapping that can be customised using tiles. Sheetsee.js had its own tile set but this could be configured if further desired.</i>
WordPress website	Webpage to host & display the interactive maps	<i>The final link in the chain was displaying the Learner Feedback Map, I used a self-hosted WordPress website at smartlearning.netfarms.eu²⁴ to do this.</i>

A learner feedback map was created for both smart learning journey activities being investigated and it worked very well in testing scenarios, with the maps displaying user feedback in an accurate, appealing and interactive way. Maps were demonstrated to other academics, some asking which app I had used to make it as they wished to make one too. I displayed the code and the technology chain listed in Table 3, and explained that there was no single 'app', there was only web developer technology and ad-hoc solutions. Indeed, I had tested other apps that might achieve what was needed, especially alert apps (ThunderMaps²⁵, which would have been costly for multiple user accounts) or older location-based learning apps (7Scenes²⁶, which was rather limited visually, though had excellent journey planner designs). These or other apps were not suitable for what I needed, which was to permit participants of the researched smart learning journey activities a way to easily upload their own contributions to the journeys themselves, attached to a geocoded pin. These could then create activity feedback maps of user experience to be accessed by others and developed over time. Figure 2 (left) shows the Malta Learner Feedback Map, with an example of

²¹ <https://zapier.com/>

²² jlord Github <https://github.com/jlord>

²³ <https://www.openstreetmap.org/>

²⁴ <http://smartlearning.netfarms.eu/scl-learner-feedback-map/> (archived)

²⁵ <https://web.archive.org/web/20160125154905/https://learn.thundermaps.com/>

²⁶ <https://web.archive.org/web/20160311151804/http://7scenes.com/>

a possible tourism training activity and photo of the Auberge de Castille, Office of the Prime Minister, and (right) shows the London Learner Feedback Map, with comments about the Literary London journey activity and including a screen capture of the HP Reveal activity channel.

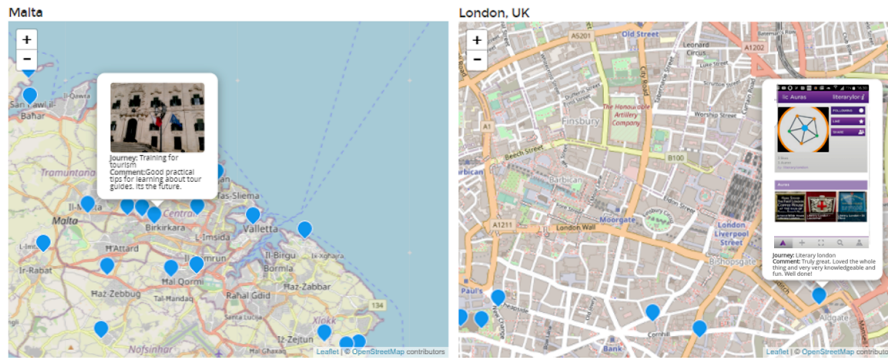


Fig. 2 (L) the Malta Learner Feedback Map, with example of tourism training activity; (R) the London Learner Feedback Map, showing the Literary London journey activity with screen capture of HP Reveal activity channel

I took the decision to not use the feedback maps in the live research because of script conflict with other apps, and the reliability of the technologies due to multiple dependencies and related risk. The form worked well in a stand-alone capacity but when embedded in the HP Reveal app browser window the location submission would not work, encountering JavaScript conflicts. This was frustrating, as otherwise it would have worked nicely. I could have shared the form via other means, but felt I was overloading participants with too many apps. Soon after, the scripts used to visualise the data into maps became obsolete (both Sheetsee.js configuration and then the Tabletop.js library itself). The data from tests is intact, but not publicly viewable. The risks of using proprietary apps or script libraries are commonplace, as these might (quickly, or unpredictably) become dysfunctional or obsolete. This has happened to ThunderMaps, 7Scenes and HP Reveal itself, as well as to the Edmodo mobile learning app [22] that was also used in the project. This highlights in stark practical terms the challenges for low or no cost smart city activities, where citizens themselves are creating engaging initiatives using the technology they find around them, only for that technology to break or suddenly be withdrawn, and all UGC is lost.

5 The decentralised future of the Knowledge Web

Within the scope of discussion in this paper, there are two ‘halves’ to the problem of hosting and delivery of digital knowledge content to users as and when they require it in urban connected environments. Expert knowledge has a range of problems perhaps mainly relating to intellectual property licensing and subsequent ease of access, reuse and sharing by the public. User knowledge content has its own problems relating to

uploading, hosting and subsequent access and delivery. The debate in this section refers both to the digital infrastructure of efficient knowledge content delivery (expert or UGC), and to the ownership of the servers and apps in which that data sits, the latter issue being perhaps more significant than is initially apparent.

Increasingly, debate in academic circles and elsewhere within digital development communities has turned towards the future of Internet platforms and services, particularly in light of the risks of proprietary ownership of data [48, 32] as well as the extractive nature of ‘informational capitalism’ [48]. This debate is complex and this paper can only provide some overview of the possible solutions being discussed that may support free access to expert knowledge delivery and how to potentially capture and store UGC in publicly owned civic archives. Current debates have progressed from the Internet of Things Linked Open Data (LOD)/Linked Open Services concepts [15] towards divergent ideas that encompass LOD, interoperable metadata and embracing the promise of decentralised (federated) networks. This challenges the centralised dependency on (usually) private monopoly platforms, e.g. [50, 48] and the walled gardens of non-reliable, non-portable content and communication they create [4, 32]. Conversely, the decentralised server model of microblogging communication app Mastodon, and the ActivityPub protocol demonstrate potential for a federated universe of agnostic data sharing and notifications across apps, platforms and servers. This ad-hoc connected collection of servers and users of apps that communicate is generally known as ‘the Fediverse’²⁷. In a Mastodon²⁸ post, Idehen²⁹ (2023) provides a succinct and easy to understand explanation: “The Fediverse is a Federation of loosely coupled systems that perform CRUD³⁰ operations (ActivityStreams³¹) using a common protocol (ActivityPub³²)”.

So, why is the Fediverse important to our discussion about smarter (more efficient, better) delivery and creation of knowledge content in the smart learning city? For user citizens of the smart learning city, this essentially means that provision of open content from experts residing in multiple source databases (e.g. Open Access published work, preprints or open educational resources) can then be shared and subsequently *backtracked*³³ for where it is shared to, or accessed in an open landscape of apps and communities. These ActivityStream operations and ActivityPub protocols together

²⁷ <https://en.wikipedia.org/wiki/Fediverse>

²⁸ <https://joinmastodon.org/>

²⁹ @kidahen@mastodon.social (thread: <https://mastodon.social/@kidehen/109684267932110804>)

³⁰ CRUD is ‘Create, read, update and delete’;

https://en.wikipedia.org/wiki/Create,_read,_update_and_delete

³¹ [https://en.wikipedia.org/wiki/Activity_Streams_\(format\)](https://en.wikipedia.org/wiki/Activity_Streams_(format))

³² ActivityPub / Social Working Group <https://www.w3.org/TR/activitypub/>

³³ I use this expression as it harks back to the common method that bloggers used to be notified of who was sharing their posts, where and in what context. (WordPress still offers this feature in their post admin interface)

can ‘talk’ with any federated server and user on it using any application that adopts the protocol. Two things are therefore accomplished, an open ownership culture, and a common communication method. Saunders [48] outlines a conceptual model envisaging a peer-to-peer led, sharing, decentralised network for open science, that we should design multiple protocols “with extensibility in mind” that are interoperable and added to as they become re-used and adapted. Going on to discuss instances (servers) within the federated universe that “... are hosted independently and can choose to federate with other instances to enable communication between them” (2022, p. 94). Further suggesting we “decouple interfaces from the underlying data so that we have a continuous communication (and) different interfaces are just views on the data” (p. 95) fits well with the concept of multiple ad-hoc low or no cost apps and ‘smart enough’ [3] functionality, e.g. geocode + image triggering, working with open protocols to see the same data through different interfaces that could be envisaged as a future of the smart enough smart learning city. Linked Data Notifications (LDN) [5] for knowledge availability or other information may be significant in delivery within smart urban (learning) content findability and access. Platform interoperable content sharing and semantic web techniques of pingback (see related prior mention of trackback) are configured into the LDN protocol, to support decentralisation, that is, “data and applications that are loosely coupled, and users are empowered to choose where their data is stored or held” [5, p. 539]. Amongst other technical specification discussion, Restful API³⁴ is acknowledged for its suitability to persistent notification support, resource organisation, discovery and description, and for ‘CRUD’ (create, read, update, and delete) operations (p. 541), somewhat as indicated earlier in [15].

Related intellectual property discussion in Saunders [48] regarding the problematic walled gardens of academic publishing models certainly imply that for expert knowledge to be openly accessible and easily deliverable on demand means it has to be open knowledge, open data, open access or open educational resources. If protocols were able to find relevantly tagged content from these sources there would be few other barriers to delivering it. Still relevant concerns about UGC and remixed copyrighted works [28] require intelligent metadata analysis, e.g. [17] to assist in moderating any copyright infringement from UGC remixed and shared works. This may indeed also be somewhat part of the related concerns for the role of the user and UGC to contribute to cultural archives, where studies such as the European project SPICE [8] researched methodologies for “producing, collecting, interpreting, and archiving people’s responses to cultural objects, with the aim of favouring the emergence of multiple, sometimes conflicting viewpoints, and motivating the users and memory institutions to reflect upon them”. This perhaps highlights not only the roles for user experience and user contribution to archived ‘memory’ content, but also perhaps the roles of those who moderate and curate such content [23]. It is clear from cursory examination of Facebook social media groups such as British Social History, Vintage News or (many) others that citizen memories and experience of place are not always associated with specific heritage or cultural features, but rather may be associ-

³⁴ <https://restfulapi.net/>

ated with places that seem quite arbitrary and indistinct, such as local bus stations, shops or office buildings. This is evident from multiple posts in those groups. Surely this citizen memory of place deserves some preserving for posterity beyond the ‘memory institutions’ referred to in [8] and might be better served to be held in publicly owned (federated) servers, that could be ‘loosely connected’ with any number of institutions and applications through open protocols such as ActivityPub, and Linked Data Notifications via open APIs.

The risks of proprietary service and repository ownership

When proprietary platforms, apps and technologies are used and content is uploaded to those databases, the content and personal data of those author users (expert or citizen) is then owned by the private company. Proprietary ownership of knowledge, whether expert or user generated, becomes a disconnected set of walled gardens, where data (knowledge content) cannot be accessed unless a dedicated proprietary app or service is used. The knowledge content is therefore corralled into private collections, and risks not being accessible, personal data being utilised (or sold) for other non-agreed purposes, or content may be lost altogether due to private companies being sold, liquidating or otherwise closed down. As noted in the prior examples of community mapping and the specific case of the learner feedback map, if the technologies being utilised are withdrawn, the content itself does not usually survive.

6 Limitations of this paper and scope for further research

Discussion in this paper has endeavoured to provide a brief outline of some of the challenges and possible solutions for a truly open smart learning city - the frictionless environments of casual learning and cultural interactions described in [40]. This author has offered a layperson’s interpretation of some of the technological issues at hand, placed in a context of how real people interact with their digitally connected world as either citizen users or facilitators of activities supporting urban culture and daily life. The scope of this paper invites further research into reading and writing the smart enough [3] city, perhaps using a variety of design approaches and participant users. Focus might be on smart digitally enhanced creative activities using ad-hoc apps and technological solutions to *discover, read and write the belonging of the city*. At time of writing, potential concepts and approaches perhaps based in multiple cities, countries and universities are being further investigated.

7 Conclusions

The accrued knowledge of the smart city, both derived from sciences or humanities experts as well as citizen communities has over time become a challenge for how to manage it, own it, maintain it and offer equitable access to it. But concepts of smart cities have become much more people orientated, and as Boy [3] argues, “(u)rban space is not just a container for social relations, but a product of social relations”.

How we achieve in practical terms a technologically infused urban connected environment without compromising the privacy and freedom of the individuals who live in it remains to be seen. Certainly, these issues are surfacing as high profile concerns; Tim Berners-Lee recently reiterating this growing problem [45].

The aim of this paper has been to acknowledge the interplay between citizen and place, for both expert knowledge and UGC. This author cannot claim knowledge beyond a general grasp of the technical implications involved, however has offered a layperson's overview of potential issues and possible solutions for an open knowledge web. Data and content needs to be decoupled from platforms and apps, thereby empowering users (expert and citizen) to move between platforms, viewing and sharing the same (open) data sources, and that archived content is owned and maintained in civic federated archives for the benefit of all.

References

1. Badita, F.: Changing the world of Publishing - Creating an Open Graph Standard. Medium (2016, November 28). <https://medium.com/@baditaflorin/changing-the-world-of-publishing-creating-a-open-graph-standard-7fd3191038c6>.
2. Bergum, S.: This City Is An Archive: Squatting History and Urban Authority. *Journal of Urban History* 2022, Vol. 48(3), 504–522 (2022). <https://doi.org/10.1177/0096144220955165>
3. Boy, J.: Smart Enough or Too Smart? Territorial Platforms, Social Reproduction, and the Limits to Digital Circuits of Dispossession. *Limits 22, Eighth Workshop on Computing within Limits* (2022). <https://computingwithinlimits.org/2022/papers/limits22-final-Boy.pdf>
4. Capadisli, S.: *Linked Research on the Decentralised Web*. Doctoral Dissertation. University of Bonn, Germany (2020). <https://hdl.handle.net/20.500.11811/8352>
5. Capadisli, S., Guy, A., Lange, C., Auer, S., Samba, A., Berners-Lee, T.: Linked Data Notifications: A Resource-Centric Communication Protocol. In Blomqvist, E., Maynard, D., Gangemi, A., Hoekstra, R., Hitzler, P., Hartig, O. (eds.), *The Semantic Web, ESWC 2017*. LNCS, vol 10249. Springer, Cham, (2017). https://doi.org/10.1007/978-3-319-58068-5_33
6. Carpenter, T.: Article Sharing Framework: Facilitating Scholarly Sharing Through Metadata. *The Scholarly Kitchen*, (2021, May 17). <https://scholarlykitchen.sspnet.org/2021/05/17/stm-article-sharing-framework/>
7. Carroll, J. M., Shih, P. C., Kropczynski, J., Cai, G., Rosson, M. B., & Han, K.: The Internet of Places at Community-Scale: Design Scenarios for Hyper-local Neighborhood. In Konomi, S., & Roussos, G. (eds.), *Enriching Urban Spaces with Ambient Computing, the Internet of Things, and Smart City Design*, pp. 1-24. IGI Global, (2017). <https://doi.org/10.4018/978-1-5225-0827-4.ch001>

8. Daga, E., Asprino, L., Damiano, R., Daquino, M., Agudo, B.D., Gangemi, A., Kuflik, T., Lieto, A., Maguire, M., Marras, A.M., Pandiani, D.M., Muhlolland, P., Peroni, S., Pescarin, S., & Wecker, A.: Integrating Citizen Experiences in Cultural Heritage Archives: Requirements, State of the Art, and Challenges. *Journal on Computing and Cultural Heritage*, 15(1), 1–35 (2022). <https://dl.acm.org/doi/10.1145/3477599>
9. de Certeau, M.: *The Practice of Everyday Life*. University of California Press (1984).
10. Dinler, M.: Counter-Mapping through Digital Tools as an Approach to Urban History: Investigating the Spatial Condition of Activism. *Sustainability* 2021, 13(16), 8904 (2021). <https://doi.org/10.3390/su13168904>
11. Dulong de Rosnay, M., & Musiani, F.: Alternatives for the Internet: A Journey into Decentralised Network Architectures and Information Commons. *TripleC: Communication, Capitalism & Critique*, 2020, 18 (2), 622-629 (2020). <https://shs.hal.science/halshs-02917474>
12. Duxbury, N., & Redaelli, E.: *Cultural Mapping*. Oxford Bibliographies. (2020, August 26). <https://doi.org/0.1093/OBO/9780199756841-0249>
13. Findlay, C.: Participatory cultures, trust technologies and decentralisation: innovation opportunities for recordkeeping. *Archives and Manuscripts* 45(3) (2017). <https://doi.org/10.1080/01576895.2017.1366864>
14. Girardin, F., Blat, J., Calabrese, F., Dal Fiore, F., & Ratti, C.: Digital Footprinting: Uncovering Tourists with User-Generated Content. *Pervasive Computing* 7(4), 36-43, (2008).
15. Gyrard, A., Patel, P., Sheth, A. P., & Serrano, M.: Building the web of knowledge with smart IoT applications. *IEEE Intelligent Systems* 31(5), 83–88 (2016). <https://corescholar.libraries.wright.edu/knoesis/1123>
16. Haklay, M.: *Beyond Quantification, We Need a Meaningful Smart City*. Urban Pamphleteer. University College London, UK, (2013). <https://www.ucl.ac.uk/urban-lab/sites/urban-lab/files/UrbanPamphleteer1.pdf>
17. Hart, L., & Bardoli, J.: How automated content tagging improves Findability. *Techtarget*, (2020, October 19). <https://techtargget.com/searchcontentmanagement/tip/AI-in-content-management-supports-tagging-search>
18. Hauthal, E., & Burghardt, D.: Mapping Space-Related Emotions out of User-Generated Photo Metadata Considering Grammatical Issues. *The Cartographic Journal* 53(1) 78-90 (2016). <https://doi.org/10.1179/1743277414Y.0000000094>
19. Hetherington, K. (2013). Rhythm and noise: the city, memory and the archive. *The Sociological Review*, 61(1), 17–33. <https://doi.org/10.1111/1467-954X.12051>
20. Hillerbrand, E.: Semantic web and business: Reaching a tipping point? In: Workman, M. (ed.), *Semantic Web, Implications for Technologies and Business Practices*, 213-229, Springer, Cham (2016). https://doi.org/10.1007/978-3-319-16658-2_11

21. Hu, X., Ng, J. and Xia, S.: User-Centered evaluation of metadata schema for non-movable cultural heritage: murals and stone cave temples. *Journal of the Association for Information Science and Technology* 69(12), 1476-1487 (2018). <https://doi.org/10.1002/asi.24065>
22. IBL News.: Edmodo.com Will Shut Down Its Platform and Service on September 22. IBL News (2022, August 24). <https://iblnews.org/edmodo-com-will-shut-its-platform-and-service-on-september-22/>
23. Jansson., I-M.: Organization of User-generated Information in Image Collections and the Impact of Rhetorical Mechanisms. *Knowledge Organization* 44(7) (2017). <https://doi.org/10.5771/0943-7444-2017-7-515>
24. Jones, P., Layard, A., Lorne, C. & Speed, C.: Localism, neighbourhood planning and community control: the MapLocal pilot. In: O'Brien, D. and Matthews, P. (eds.), *After Urban Regeneration: Communities, Policy and Place*. Policy Press, Bristol, UK, pp. 165–179 (2015). <http://oro.open.ac.uk/69275/1/Maplocal.pdf>
25. Jones, P., Layard, A., Speed, C., & Lorne, C.: *MapLocal Project Guide*, (2013). <https://chrisspeed.net/wp-content/uploads/2013/10/MapLocal-Small.pdf>
26. Jordan, S.: Writing the Smart City: “Relational Space” and the Concept of “Belonging”. *Writing in Practice: Journal of Creative Writing Research*, 1 (1) (2015). <https://www.nawe.co.uk/DB/wip-editions/articles/writing-the-smart-city-relational-space-and-the-concept-of-belonging.html>
27. Keck, H., & Heck, T.: Improving tagging literacy to enhance metadata and retrieval for open educational resources. In: *Proceedings of the Conference on Learning Information Literacy across the Globe*, Frankfurt am Main, Germany (2019). <https://doi.org/10.25657/02:17763>
28. Kim, H., Breslin, J., & Hwa Choi, J.: Semantic representation for copyright metadata of user-generated content in folksonomies. *Online Information Review* 34(4), 626-641 (2010). <https://doi.org/10.1108/14684521011073025>
29. Kinsley, S.: Memory programmes: The industrial retention of collective life. *Cultural Geographies* 22 (1), 155–75 (2015). <https://www.jstor.org/stable/26168631>
30. Kitchin, R.: The Timescape of Smart Cities. *Annals of the American Association of Geographers*, 109(3), 775-790 (2019). <https://doi.org/10.1080/24694452.2018.1497475>
31. Kop, R.: The Unexpected Connection: Serendipity and Human Mediation in Networked Learning. *Educational Technology & Society*, 15 (2), 2–11 (2012). <https://www.jstor.org/stable/jeductechsoci.15.2.2>
32. Lelešius, G.: *Improving Resilience of ActivityPub Services*. Undergraduate Dissertation, Computer Science Tripos – Part II, University of Cambridge, UK, (2022).
33. Lister, P.: Ways of Experiencing Technology in a Smart Learning Environment. In: Streitz, N.A., Konomi, S. (eds.), *Distributed, Ambient and Pervasive Interactions. Smart Living, Learning, Well-being and Health, Art and*

- Creativity. HCII 2022. LNCS, vol 13326. Springer, Cham (2022). https://doi.org/10.1007/978-3-031-05431-0_11
34. Lister, P.: The pedagogy of experience complexity for smart learning: considerations for designing urban digital citizen learning activities. *Smart Learn. Environ.* 8(1), 1–18 (2021). <https://doi.org/10.1186/s40561-021-00154-x>
 35. Lister, P.J.: A smarter knowledge commons for smart learning. *Smart Learn. Environ.* 5, 8 (2018). <https://doi.org/10.1186/s40561-018-0056-z>
 36. Lundemo, T.: Mapping the World: Les Archives de la Planète and the Mobilization of Memory. In: Blom, I., Lundemo, T., & Røssaak, E. (eds.), *Memory in Motion Archives, Technology, and the Social*. Amsterdam University Press (2017). <https://doi.org/10.5117/9789462982147>
 37. Martin, P., Magagna, B., Liao, X., Zhao, Z.: Semantic Linking of Research Infrastructure Metadata. In: Zhao, Z., Hellström, M. (eds.), *Towards Interoperable Research Infrastructures for Environmental and Earth Sciences. Lecture Notes in Computer Science()*, vol 12003. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-52829-4_13
 38. McKenna, H. P.: Rethinking Learning in the Smart City: Innovating Through Involvement, Inclusivity, and Interactivities with Emerging Technologies. In: Gil-Garcia, J., Pardo, T., Nam, T. (eds.), *Smarter as the New Urban Agenda. Public Administration and Information Technology*, vol 11. Springer, Cham (2016). https://doi.org/10.1007/978-3-319-17620-8_5
 39. McKenna, H. P.: Human-Smart Environment Interactions in Smart Cities: Exploring Dimensionalities of Smartness. *Future Internet* 12, 79 (2019). <https://doi.org/10.3390/fi12050079>
 40. McKenna, H. P., & Chauncey, S.: Taking learning to the city: An exploration of the frictionless learning environment innovation. In: *Proceedings of EDULEARN14 Conference, Barcelona, Spain (2014)*.
 41. Morville, P.: *Ambient Findability*. USA. O'Reilly Media (2005).
 42. Palmer, J.M.: The Resonances of Public Art: Thoughts on the Notion of Co-Productive Acts and Public Art. *Urban Public Art: Geographies of Co-Production: City & Society*, 30,(1), 68-88 (2018).
 43. Perkins, C.: *Community Mapping*. Oxford Bibliographies (2018, February 22). <https://doi.org/10.1093/OBO/9780199874002-0184>
 44. Pospelova, P.: Schema markup in university websites. *Deleted Agency* (2014, June 14). <http://www.deleteagency.com/news/schema-markup-in-university-websites>
 45. Renjifo, D.: Inventor of the world wide web wants us to reclaim our data from tech giants. *CNN* (2023, January 6). <https://edition.cnn.com/2022/12/16/tech/tim-berners-lee-inrupt-spc-intl/index.html>
 46. Rězník T., Raes, L., Stott, A., De Lathouwer, B., Perego, A., Charvát, K., & Kafka, S.: Improving the documentation and findability of data services and repositories: A review of (meta)data management approaches. *Computers &*

- Geosciences 169, 105194 (2022).
<https://doi.org/10.1016/j.cageo.2022.105194>
47. Roberts, L.: Navigating the ‘archive city’: Digital spatial humanities and archival film practice. *Convergence: The International Journal of Research into New Media Technologies* 21(1), 100–115 (2015).
<https://doi.org/10.1177/1354856514560310>
 48. Saunders, J. L.: Decentralized Infrastructure for (Neuro) science (2022). arXiv preprint arXiv:2209.07493.
 49. Spencer, A.: What in the world is ambient literature? *The Writing Platform* (2017, Aug 10). <http://thewritingplatform.com/2017/08/world-ambient-literature/>
 50. Srnicek, N.: *Platform Capitalism*. Polity, Malden, MA, USA & Cambridge UK (2017).
 51. Tlili, A., Zhang, J., Papamitsiou, Z., Manske, S., Huang, R., Kinshuk & Hoppe, H.U.: Towards utilising emerging technologies to address the challenges of using Open Educational Resources: a vision of the future. *Educational Technology Research and Development* 69, 515–532 (2021).
<https://doi.org/10.1007/s11423-021-09993-4>
 52. Van Hooland, S., Méndez Rodríguez, E. & Boydens, I.: Between Commodification and Engagement: On the Double-Edged Impact of User-Generated Metadata within the Cultural Heritage Sector. *Library Trends*, 59 (4), 707-720 (2011). <https://doi.org/10.1353/lib.2011.0011>
 53. Zouaq, A., Jovanović, J., Joksimović, S., & Gašević, D.: Linked data for learning analytics: Potentials and challenges. In Lang, C., Siemens, G., Wise, A., & Gašević, D. (Eds), *Handbook of Learning Analytics*. 1st edn, pp. 347-355. Society for Learning Analytics Research (SoLAR) (2017).