Fostering young smart citizens through personal learning environments for urban inquiries

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Abstract. The aim of this qualitative study is to investigate how young citizens engage with urban inquiries activities on Personal Learning Environments (PLEs). This work analyses how educators can design and assess short inquiry activities as well as how students use a PLE to interact and collaborate for creating scientific questions. Participants of this qualitative study were 5 researchers from Higher Education, 2 science teachers and a class with 26 teenagers of a secondary school in the UK. The outcomes indicate the most popular pedagogical tools used by teachers and researchers, the most used co-inquiry components by learners, difficulties and recommendations for implementing urban inquiries through two open platforms: weSPOT and nQuire.

Keywords: co-inquiry, smart city, scientific questioning, problematisation, human data interaction, data-driven inquiry, data literacy, weSPOT, nQuire

1 Introduction

The urban inquiries project aims to equip students to be able to identify and describe problems or questions scientifically, with a focus on the students' own physical locality, mediated by social and Personal Learning Environments (PLEs). PLEs facilitate users to access, aggregate, configure and manipulate digital artefacts of their ongoing learning experience. This study argues that PLEs might help learners engage with problematisation related to current issues to be addressed or opportunities for future improvements in their city, which might be interesting for them and relevant for their communities. It focuses on smart cities learning, which offer new opportunities for co-inquiry by engaging participants to discuss and support urban developments propitiated by technology. Smart cities mean intelligent places for generating innovation, large data sets, real time information-response and empowering citizens [1]. The concept of smart cities learning [2] in this study refers to young citizen engagement through participatory learning with the aim to investigate and understand key issues related to urban centers for transforming them into smart cities.

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Various initiatives on collective investigations, problem-based projects and collaborative inquiry-based learning ("co-inquiry") have been emerging in Secondary and Higher Education funded by local governments and the European Commission. Inquiry-based learning (IBL) is a constructivist approach that supports a learner in active experimentation [3]. An inquiry-based task generally follows a cycle of 1.questioning, 2.hypothesis, 3.evidence collection, 4.analysis, 5.question answering and 6.reflection. Co-inquiry based learning has been taking place in informal ways mainly among users who master technologies in the context of open platforms, resources and Social Networks [4]. It refers to a cooperative process, where students raise important questions with experts or specialists, integrating relevant information and generating acceptable lines of thought based on scientific assumptions and knowledge areas. However, one of the big challenges for educators is to integrate these approaches into the curriculum because it requires time, and the outcomes might be unclear or unexpected. The literature indicates that most teachers prefer to focus on content for preparing students for their exams instead of applying various lessons for inquiry-based learning projects [5]. This work investigates technologies and pedagogical approaches that might be useful for designing short inquiry activities integrated into the school's curriculum. Our research question centres on how students interact as co-investigators through online co-inquiry environments during four lessons. Which components do learner's groups use to achieve their learning outcomes?

2 Co-inquiry platforms: weSPOT and nQuire-it

Urban inquiries were based on 2 platforms: weSPOT with access to nQuire.

weSPOT enables its users to create mashups of their preferred inquiry components, assign them to phases of an investigation, share them with other inquiry members and interact to carry out a collaborative research. When creating a new inquiry, the admin is provided with a set of recommended components for six phases (6 separate screens). The admin (e.g. teacher) can select all or a few phases and its components organising desired sequence in the PLE, e.g. questions, hypothesis, mind maps (Figure 1). Students can then access any component or phase whenever they want in a different order.

The nQuire-it platform offers three types of investigation, with different methods of data collection and forum to discuss content (e.g. questions photos and comments):

- Spot-it missions use uploaded pictures for the data collection.
- Sense-it missions provide data by unlocking the sensors of mobile devices.
- Win-it missions have a research question that requires text as an answer.

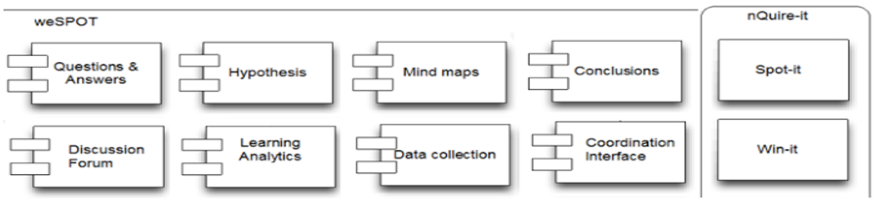

Figure 1: co-inquiry components used in Urban Inquiries PLE.

3 Pedagogical Principles from ENGAGE and MK:Smart

Innovations from science and technology are vital to Europe's future. To ensure that the process and outcomes of research are acceptable to society, these endeavours now fall under the framework of 'Responsible Research and Innovation' (RRI), which sets out 6 keys for how all societal networked actors should work together: Science Education, Public Engagement, Open Access, Ethics, Gender and Governance. For smart citizens to participate in the processes of RRI, they will need to be sufficiently literate about how science works, and understand among other things, the benefits and risks of technology, and ethical thinking, in order to participate in debates, make informed choices and co-learning together. Urban inquiries pedagogical tools are based on two projects: ENGAGE and MK:Smart.

ENGAGE (engagingscience.eu) includes 14 Institutions in 13 countries. Its purpose is to increase awareness of RRI through IBL by reaching 12.000 teachers in Europe and 360.000 students. It targets three components: students' interest, science knowledge and co-inquiry skills. ENGAGE OER embed science concepts within the context of its implications to society and future scenarios that make the pros and cons of technology more concrete for helping students think through the current and emerging issues in more depth. Two ENGAGE tools were applied in this study:

- **Scientific Dilemma** in Science education refers to controversial socio-scientific issues related to applications and implications of Science [5]. It propitiates a productive learning context to facilitate co-learners' construction of science understanding and strengthen decision making and problem solving skills.
- **Group Discussion** for Science Education aims to help students share their understanding about a scientific phenomenon and developing key scientific skills, such as arguing and reasoning [5].

MK:Smart (www.mksmart.org), partly funded by HEFCE, is currently collecting and aggregating a vast number of open and proprietary data sets related to Milton Keynes into a data hub, to support smart city technologies in the areas of energy, water and transport. Of particular interest to the project is how to support citizens to be bottom-up innovators of smart city technologies. The educational focus of MK:Smart is in bringing smart city data literacy into the classroom for analysing and interpreting across large urban data sets and improving data literacy amongst future generations, with particular regard to formulating and answering questions from data, in real-life contexts[6]. The MK:smart tools applied in this study are:

- **Data Inquiry:** Tasks are designed to teach skills in a practical context of addressing a particular urban challenge around energy, water or transport. The overall approach is designed so that students first undertake a data inquiry, using available data and visualisations as evidence to answer questions.
- **Storytelling:** Students are supported to tell stories from data.
- **Contextualisation**: Students contextualise a larger data set by doing their own personal data collection and analysis.

4 Qualitative Study – Urban Inquiries PLE

Participants of this initial study consisted of four researchers from Higher Education from different faculties, two science teachers and a classroom of secondary school students with twenty six participants (13-15 years old). Initially, researchers explored together various components in the weSPOT and nQuire platforms and pedagogical approaches during 4 weeks (February 2014). They designed 3 short urban inquiry activities about relevant topics related to smart cities: Energy (*How do people influence energy consumption?*), Microclimates (*Are there any microclimatic design in my town?*) and Electric-Cars (*Is an electric car worth buying?*). Then they set up three PLEs for co-inquiry projects using different components and pedagogical tools. The common components for all co-inquiries were weSPOT questioning and nQuire spot-it to discuss photos. Both PLEs - energy and microclimate - included the 6 co-inquiry phases with all components, while the electric cars PLE included only 1 phase (problematisation). Regarding the pedagogical tools, the electric cars PLE was based on dilemma, data inquiry and discussion. The microclimate PLE focused on data inquiry, while the energy PLE focused on data inquiry, contextualisation and storytelling.

The team of researchers and educators guided students to register in both platforms, and then invited them to select one of the 3 themes based on their own interests. In total, 6 learners chose the Energy group, 7 chose to work on Microclimate and 13 students selected Electric-cars. Co-inquiry sessions were planned as follows:

•**Preparation:** Signing up in weSPOT and nQuire-it, selecting a topic and questions.
•**First lesson:** Join their PLE, add questions using hands on activities about urban data
•**Second lesson**: Explaining best scientific question and collect more data
•**Conclusion:** Elaborating a poster about urban inquiry problematisation and reviews.

The data for qualitative analysis comprised 161 messages in 3 PLEs, two sets of semi-structured surveys (pre and post) and video feedback from learners and educators.

5 Urban Inquiry – Lessons and findings

The electric-cars group in "weSPOT questions" created first 16 questions, which were grouped in a mind map in weSPOT by their group facilitator: "*What are their pros and cons?*" "*How do they work?",* etc. Second, they used "weSPOT comments" to specify scientific questions after reflecting on methods that might be useful to obtain answers (e.g. interview, statistics). They listed 14 issues, then rated the best questions in their group based on relevance, and attributed stars based on their interests. They then added more specific questions in "nQuire spot-it" based on various pictures, graphs and science news, e.g. *How green are electric cars? How is the electricity which powers them generated?* Participants also uploaded new images from the web and used their mobile phones to take photos of parking areas in weSPOT. After visualising a geolocation map about electric car parking in Milton Keynes (MK) through "the weSPOT MICI" they noticed that the number of empty parking areas was high. They also used audio and video data collection to interview electric car owners. They selected parents and drivers in the popular areas in MK. They shared 103 messages including data, 81 ratings. Approximately 65% of students were very active as collaborators.

The Microclimate group shared initially five questions also based on curiosity in weSPOT question: *Is there any solar panels in our town or city? How do you know if your solar panels are efficient?* Next, students interpreted data visualisations in order to answer some initial issues. To help interpretation of graphs, students were encouraged to first tell stories about what was happening in individual graphs, and offer explanations for what they observed from data. They created more interesting questions: *"At night, will we still have electricity?" How much energy could we save if all houses in MK had Solar Panels?"* Their selected question was "*what are the advantages and disadvantages of solar panels*?". They then listed more issues for data collection: *What are the best areas for solar panels? How efficient are solar panels?* They shared 32 messages, 23 ratings, but only 30% of students were very active.

The Energy group created only three questions initially based on their curiosity: *"How do people waste energy in the school?" "Do you think people should have a limit of electricity in a day?"* "*In the future do you think electricity should be free?"* Then, students interpreted a graph of daily energy consumption and created a short story of how electricity use increases rapidly between 7pm and 9pm and is lowest overnight. A few of them wrote the explanation that people in the house are out during the day, then in the evening they consume more energy. They did not collect data about appliances at home, apart from one student who uploaded various photos of types of equipment to illustrate energy consumption in the school. They add 26 messages, 14 ratings and only 10% of students were very active as collaborators.

Science teacher and researchers observed that 50% of students were not focused on the technology. They were able to complete some activities faster using the paper-based materials, especially where technical problems were encountered. All participants knew that weSPOT was in development, so they collaborated by listening 30 technical comments and suggestions related to weSPOT and 4 for nQuire.

Educators used weSPOT analytics dashboard (Fig.2) to observe participation and provide feedback during a face-to-face session. Groups used different devices: computers, laptops, iOS/Android phones and tablets. They listed various benefits of PLEs: 1. Peers interactions with ratings and comments supporting reflection (Question), 2. Learn from each other with data collection and discussion (nQuire-it). 3. Visualising "pros and cons" on controversial issues (mind maps). 4. Forming opinions (Report).
Educators used the weSPOT analytics dashboard to observe participation and provide feedback during the face-to-face session (Fig. 2). Groups used desktop computers, laptops, iOS phones/tablets and Android phones and tablets during their lesson.

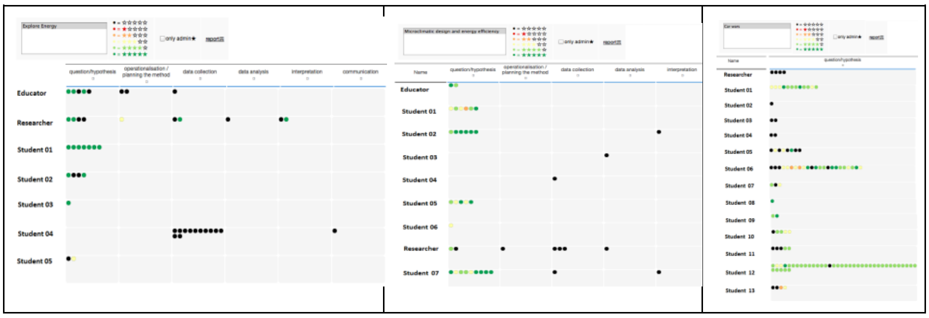

Figure 2 weSPOT learning analytics dashboard for the three groups.

6 Discussion and Conclusions

This work represents the first in a series of studies to engage with Milton Keynes schools to undertake urban inquiries. Findings indicate that the most used co-inquiry components were weSPOT questions and nQuire spot-it. The interfaces used by PLE community for co-evaluation were rating, voting, commenting, and analytics dashboard by teacher. Teachers and researchers provided various feedbacks also during face-to-face sessions particularly for the energy and microclimate groups, while feedback was lower for the electric car team as it was not required. The analytics dashboard indicates that the most active group was Electric-Cars. They interacted more autonomously in the PLE, which was simple with only 1 phase for accessing all components on the same screen. This might facilitate students' collaboration. The pedagogical tools dilemma, data inquiry and discussion facilitated students to achieve learning outcomes without direct supervision. Learners engaged as co-investigators with all tasks by sharing and discussing questions, data, comments and ratings, searching for more information and contacting experts when necessary. This study indicates clear evidence on students' progress on creating questions mediated by social PLE based on key factors that support it are: easy-to-use PLE design, pedagogical tools that promotes students' interest, knowledge skills and interactive group work.

Keys amongst some areas for improvement are to reduce some of the technical difficulties and distractions [7] during the use of technologies that at times detracted from full participation in the activities. The second is to ensure that sessions are planned with more details together with the Science Teacher so that tasks, which require thought that is independent from technology, could be conducted in a separate area to avoid distractions, such as framing initial questions, or undertaking the data analysis activities. On the other hand, tasks focused on sharing, rating and debating should be implemented by learners in their PLE and using mobile devices anywhere.

This study indicated evidence on co-inquiry based learning focused on the collaborative construction of scientific questions. It showed how PLE supported young smart learners to develop collective inquiry and share outcomes. Students co-authored 3 videos, 3 posters and 1 conference presentation through urban inquiries.

References

[1] N Komninos, M Pallot, H Schaffers (2013). Special issue on smart cities and the future internet in Europe. Journal of the Knowledge Economy.

[2] Buchem, I.; Pérez-Sanagustín, M.(2013). Personal Learning Environments in Smart Cities: Current Approaches and Future Scenarios. eLearning Papers, Open Education Europa (35)1.

[3] A J. Dewey (1933). How we think: a restatement of the relation of reflective thinking to the educative process. Heath: Boston, MA.

[4] Okada,A.; Serra,A; Ribeiro, S; Pinto. S. (2015). Key skills for co-learning and co-inquiry in two open platforms: a massive portal (EDUCARED) and a personal environment (weSPOT) Open Praxis (4)1.

[5] Okada A.; Young G.; Sherborne T. (2015). Innovative teaching of Responsible Research and Innovation in Science Education. eLearning Papers, Open Education Europa 44(1).

[6] Vahey, P., Yarnall, L., Patton, C., Zalles, D., & Swan, K.(2006). Mathematizing middle school: Results from a cross-disciplinary study of data literacy." *American Educators Research Association Annual Conference*.

[7] Kinshuk, R. (2014). Ubiquitous Learning Environments and Technologies. Springer.