The Open University, Milton Keynes, U.K.

H880: Technology-Enhanced Learning: Foundations and Futures

EMA End of Module Assessment: MOOC design

The Citizen Science Educator

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Part 1.1 *(1056 words)*

Title

The Citizen Science Educator

Description

Learn the basics about citizen science, explore where this technology-enhanced learning (TEL) is headed and develop the knowledge necessary to move citizen science into the future.

Goals of the course

- Broaden the awareness of citizen science among primary and middle school professionals with an interest in using technology to enhance learning
- Guide the learners in engaging in and constructing citizen science learning experiences
- Enable the students to create their own open educational resources (OERs)
- Provide insights about the future of citizen science accessibility and ways to include future technologies
- Support the United Nations Sustainable Development Goal (SDG) targets 4.3.1 and 4.4.1 (UNESCO, 2018) related concepts of quality education.
- Successful completion provides contributions to learners' certified membership (CMALT) with the Association for Learning Technology (ALT)

Target audience

The Citizen Science Educator is for educational professionals interested or currently working in (but not limited to) primary and middle schools, who know of or have already discovered citizen science and would like to use technology to enhance learning.

Table 1: Learner persona 1.

	**Name:** Duckcat **Gender:** Male **Age:** 32 **Lives in:** Papeete, Tahiti

Education and experience	Prior to his career in education, he was a basketball player and real estate agent. Worked in seven different countries and knows what it means to be an immigrant professional. He has International Baccalaureate, inquiry-based curricula experience.
Role and responsibilities	Primary school teacher in Tahiti.
Technical skills	Familiar with a wide range of ICT devices; more Apple-oriented rather than Windows or Android.
Subject domain skills and knowledge	Holds a M.Ed and thrives in team sports and educational working environments.
Motivation and desires	Always keen to learn more. He wants to make use of ICT and learning that can engage his somewhat isolated students with the rest of the world.
Goals and expectations	He wants to find out how he can improve his ICT use in his inquiry-based teaching.
Obstacles to academic success	He can be lazy. He could be better organised and dislikes individual work. He is in an isolated context.
Unique assets	He knows what it takes to be part of a successful team; creative and imaginative.

Table 2. Learner persona 2.

 *"WONKA" by Gwen Brydson is licensed under CC BY-NC-ND 4.0*	**Name:** Charlie **Gender:** Male **Age:** 40 **Lives in:** Lake Como, Italy
Education and experience	Holds a B.Ed and is an experienced Middle School Principal. Previously a middle school science teacher.
Role and responsibilities	Principal of a medium-sized international school.
Technical skills	Managing teams, creating policies, knowledgeable about science and the scientific inquiry method.
Subject domain skills and knowledge	Science and educational leadership.
Motivation and desires	Is unhappy with the depth and breadth of teaching and learning at his current school and wants to make the most of the new iPads he just purchased for the

	entire school.
Goals and expectations	To make the most of the new iPads at the school.
Obstacles to their success	Hearing issues; a little hesitant to use social media (other than LinkedIn) due to his current position as Principal.
Unique assets	Witty, confident, fun and happy.

FutureLearn (2019i)

Learning outcomes

LO1: week 1

The learner should be able to describe and identify the conventions of citizen science.

LO2: week 2

The learner should be able to appraise principles and generalisations and experiment with citizen science.

LO3: week 2

The learner should be able to analyse and formulate opinions about citizen science trends and theories.

LO4: week 3

The learner should be able to synthesise and evaluate the accessibility and scope of citizen science for the future.

LO5: week 3

The learner should be able to create and share citizen science learning experiences, assessment and resources online, inclusive of future technologies.

Assessment

LO1: assessed by a collaborative voting poll and contributions in the discussion forum conceptualised from the learners' engagement with the OERs used during week 1.

LO2: assessed in connection with the summative and formative assessments in modules 2.3b and 3.2, including students' communication with others in the forums and activities allowing learners to experiment with citizen science.

LO3: assessed through discussions that demonstrate metacognition in collaborative activities, as seen in activities 2.1b and all end-of-week reflections.

LO4: assessed by learners providing justified changes and recommendations that consider the future of citizen science regarding accessibility issues, as well as summarising their own ideas for possible citizen science projects in modules 2.3b, 3.1a, 3.1b, 3.2, end-of-module multiple-choice questionnaires (MCQs) and end-of-week reflections in week 2 and 3.

LO5: assessed in both summative assessments, in modules 2.3a, 3.3a, 3.4a and 3.4b, MCQs, student reflection and action online by developing a community of practice beyond the MOOC, to consolidate their learning about the future of citizen science.

Pedagogic approach

This citizen science MOOC is designed to encompass a socio-constructivist approach (Vygotsky, 1979, in FutureLearn, 2019m) and open pedagogy (Hegarty, 2015, in FutureLearn, 2019l). The course aims to facilitate personal inquiry (Anastopoulou et al., 2012) to enhance assessment and develop a community of practice (Wenger-Trayner and Wenger-Trayner, 2015). The activities are designed according to the seven characteristics of learning tasks identified in FutureLearn (2019d):

- Assimilative
- Finding and handling information
- Communicative
- Productive
- Experiential
- Interactive
- Assessment

During week 1, the focus on the learning tasks will be assimilative and communicative. In week 2, the learning will continue with communicative tasks in order to find and handle information, experiment and interact with content and others. In week 3, students apply their knowledge creatively producing online citizen science content and engage in formative and summative assessments at the end of the course.

Accessibility and inclusion

Since the MOOC will be provided through the FutureLearn (2019) platform, its assistive technologies will be included in the course design (e.g., video captions and transcripts, colours with adequate contrast, layout and design, notifications and large buttons and controls).

When signing up for the course, learners will be invited to confidentially share aspects of their social conditions and context as well as learning needs and abilities. This will allow the tutors and FutureLearn technical staff to make any required adjustments in the platform for the user.

In the collaborations throughout the course, learners will also share their online persona. This will allow the tutors to consider intersectionality within the learning design, identifying the 'intersecting factors that can raise barriers to equitable participation' (FutureLearn, 2019a) by facilitating an icebreaker activity and supportive communication.

Part 1.2 MOOC summary *(1099 words)*

Week 1

1.1 Welcome

A text-based introduction to FutureLearn (2019) and the course, with information on how to navigate through the MOOC platform and obtain support and assistance.

1.1a Greetings!

The tutors provide a welcome message in a Second Life (Linden Research Inc., 2019) virtual reality (VR) video about the citizen science course description, goals and learning outcomes, highlighting the importance of being part of the online community. Learners begin communicating in the forum.

1.1b Icebreaker activity

In a hand-shaped KWL chart (Teachervision, 2019), learners write five things (one per finger) that they think describe citizen science; inside the palm of the hand, they outline their initial thoughts about the future of citizen science (see Appendix A).

1.2 TEL and citizen science

1.2a What is TEL?

Students read the article on TEL by Kirkwood and Price (2014) and engage in the discussion forum after watching What is an inquiry classroom? mp4 (2015).

1.2b What is citizen science?

Citizen science is introduced through The Awesome Power of Citizen Science (2016) video. The Scistarter.org (2019) platform is introduced, and learners watch a video from H880 FutureLearn (2019c) 'Why are we here? ERA' project which highlights access and inclusion. Learners discuss their observations in the forum.

1.3 Openness

1.3a Pedagogy, collaboration and communication

Learners are provided with a historical overview of pedagogy from Crompton's (2013) article (see Appendix G) and watch Connectivism (2016) and Overview of connectivism (2014).

Learners read a summary of the Open University (2017) journal (Ferguson et al., 2017) section 'Learners making science'. An activity engages them in a project on a citizen science platform of their choice. Learners identify pedagogical practices they experienced in the discussion forum.

1.3b Open educational resources and social media

In a real-world video, the tutors introduce OERs such as Flickr (2019), Creative Commons (2019) and open access journals, as well as a general summary about OERs and open educational practices with Cronin's (2017) article and Martin Weller's (2014) book *The Battle for Open*. Teachers and learners will also create a personal learning network (PLN) (Oddone, 2018). Learners are provided links to these resources and are asked to mind map their current PLN.

The Open University's Innovating Pedagogy (2012) seamless learning chapter (Sharples et al., 2012) is deconstructed by playing an online game developed by the tutors through a game creation toolkit by FlowLab (2019). Learners search the Internet to explore a range of OERs and OER databases and discuss ways in which social media and OERs can be integrated into citizen science.

1.4 What do we know now?

Students reflect on activity 1.1b and refine their definition of citizen science, sharing and discussing in the forum.

Learners engage in a peer-constructive voting poll (Draper, 2009) and a consolidating reflection in the discussion forum about the main concepts covered during the week.

Week 2

2.1 The future of citizen science

2.1a SDG 4 and citizen science

Introduces the United Nations SDG 4 about quality education by indicating how modules 1.2 and 1.3 support particular SDG 4 global indicators. Learners are invited to think critically about quality and the impact this has on citizen science.

2.1b Citizen science and mobile learning

Learners reflect on the limitations identified in the ERA project (module 1.2) and m-learning advances mentioned in the Open University (2019) journal. The transformative potential of m-learning in citizen science leads the students to consider access and inclusion in relation to technological advances.

2.1c Enhancing technologies with citizen science and m-learning

Learners investigate further into m-learning and the importance of technological innovations to support the future of citizen science. The students summarise Bela et al. (2016) and formulate opinions on m-learning technologies that can contribute to citizen science.

2.2 Gamification

Learners are provided with an introduction into gamification with summaries of various open online journals (Thiel et al., 2016; Faiella and Ricciardi, 2015). Their engagement in a game and subsequent reflection will highlight concerns about reward-based gamification and its alignment to behaviourism, as opposed to socio-constructivism.

2.3 Integrating the future

2.3a AR and VR, are we there yet?

Some forms of educational AR and VR mobile applications that could be used in citizen science are introduced. Learners construct a summative inquiry-based lesson plan assessment for a citizen science project that integrates exemplified technologies, with a critique of other learners' planning.

2.3b Future predictions

Learners are introduced to continuity of change predictors relating to Wi-Fi, mixed reality of practices and accessibility guidelines. The Gartner Hype Cycle (FutureLearn 2019n) is used to reflect on course material. Learners self-assess as types of innovators according to Rogers (1995, in FutureLearn, 2019n).

2.4 Voting poll and reflection

Learners complete a peer-constructive interaction voting poll (Draper, 2009) and complete end-of-week reflections.

Week 3

3.1 Accessibility and inclusion in citizen science

3.1a What do accessibility and inclusion mean in citizen science?

Students learn about various projects and initiatives, such as One Laptop Per Child (OLPC) OLPC Mission, Part 1: Principles and Child Empowerment (2008) and the Fraunhofer-Institut für Digitale Medientechnologie IDMT (2018) article about hearables. Other forms of access and inclusive technologies are covered (e.g., widgets, avatars and voice recognition).

3.1b Barriers and exclusion – what is the future of accessibility and inclusion?

Learners analyse the OLPC project further, watching OLPC (2017) and reading the Vox Media (2019) article regarding barriers and exclusions.

After learning that the project lost momentum, struggling to reach its goals, the students evaluate various citizen science projects to identify and discuss how accessibility and inclusion can be improved in the future.

3.2 How is citizen science assessed in the future?

Learners read about Technology-Enhanced Assessment (TEA) from the University of Reading (2019) website and explore the links within. The Zooniverse (2019) website is introduced. Learners share how and what they would do as formative and summative assessment in a citizen science project of their choice.

3.3 Conceptualising your understanding

Learners create a Coggle (2019) mind map revising their PLN (as a teacher) or construct a student PLN (Oddone, 2018). Learners gain input from others on how to make their PLN more open and identify opportunities for assessment.

3.4 Consolidate your understanding and reflection

3.4a Consolidate your understanding

Learners engage in an MCQ formative assessment in a confidence-based marking framework (Draper, 2009; Jordan, 2013).

3.4b Reflection

Learners reflect and are given positive praise with GIFs embedded into the webpage. The MOOC Twitter (2019) @citscieducator and relevant hashtags (#citscifuture and #citscieducator) are shared. Learners are encouraged to follow and share their learning to develop a community of practice.

3.4c Congratulations!

Learners are advised of how and where their learning contributes towards an Association for Learning Technology (2019) certified membership.

Part 1.3 Week 2 full text *(2927 words: 2584 excluding references)*

Welcome to the second week of the Citizen Science Educator MOOC!

Well done everyone for making it this far! You have done an excellent job getting to know more about citizen science as a form of technology-enhanced learning (TEL).

In week 2, we will look at the United Nations 2030 Sustainable Development Goal 4 (Quality Education), the future of citizen science with mobile learning, gamification and future predictions.

2.1 The future of citizen science

2.1a SDG 4 and citizen science

In module 1.3b, we looked at open educational resources. Openness with resources is especially beneficial for developing countries.

We begin week 2 by taking a look at the Sustainable Development Goals (SDGs) by the United Nations Development Programme (2019) and, in particular, SDG 4 'quality education'. Click on the link here to access the website. The SDGs are a set of universal goals to be achieved by 2030. These goals are broken down into goal descriptors (you can access them here). However, the focus seems to target developing countries.

So, what constitutes quality?

Some people in higher education have thought about this question and have conceptualised the definition of quality into four broad categories:

1. **Purposeful**: quality as fulfilling predetermined specifications, requirements or standards.
2. **Exceptional**: quality as something distinctive, exclusive and excellent.
3. **Transformative**: quality as effecting positive change in students' learning in the affective, cognitive and psychomotor domains, as well as personal and professional potential.
4. **Accountable**: quality as accountability to stakeholders, for the optimal use of resources and the delivery of educational products and services with zero defects.

(Schindler et al., 2015, p. 5, in FutureLearn, 2019f)

Your quality is not necessarily *my* quality. Context is fundamental. For some students, learning mathematics by counting rocks under a safe tree with a teacher instead of counting the dead bones of their family in a catastrophic environment is considered quality.

Socio-constructivism and connectivism can be the most resourceful means to constitute quality according to Schindler et al.'s. (2015, in FutureLearn, 2019f) list above.

Activity 1

[30 minutes]

1. Search the SDG 4 web page and look through some of the 'Goals in Action'. Are there any examples that reflect citizen science?
2. Choose one example from this 'Goals in Action' list and consider how you would enhance that action with citizen science. Share this in the discussion forum.
3. What SDG 4 goal descriptors can be addressed through citizen science?
4. Comment on another student's post addressing these points:
    a. What SDG 4 descriptors would their citizen science enhancement be able to define as quality according to Schindler et al.'s (2019f) list?
    b. How can OERs and social media be integrated into delivering SDG 4?

2.1b Citizen science and mobile learning

You can see by just remixing some of those 'Goals in Action' from 2.1a that technology can enhance learning in many ways, especially through citizen science!

The video about accessibility with the ERA project in Ireland we encountered in module 1.2 is a good example of a citizen science project that is specialised for one particular group and purpose. In comparison to Thailand, the authoritarian regime has tightened its grip on cyberspace, ramping up attempts to control the internet (Carnegie Endowment for International Peace, 2019). The complexities of politics could hinder the future of citizen science and TEL in developing countries.

The article by Faraon (p. 23, 2018) discusses democratic engagement and the concept of 'co-creative media', which 'aims to support the democratic engagement of citizens by facilitating participatory and co-creative processes'. The article highlights multilingualism, third-party adoptability of digital technology, open sources and the integration of online content as major contributors in the strength of digital technology:

> 'Digital technology has strengthened the voice of citizens within democratic processes, enabled the creation of virtual spaces and opportunities for activism, and promoted government accountability (Zanello & Maassen, 2011). Building on digital technology, several social media platforms, such as Facebook and Twitter, have emerged where citizens can connect, communicate, and collaborate with each other.' (Faraon, p. 24, 2018).

Faraon's words reflect the strengths and connections that citizen science has with OERs and m-learning. The Innovating Pedagogy 2019 report (Ferguson et al., 2019) illustrates technological advances, such as the virtual studio on pages 30-32, which look towards the future with more access to physically restrictive environments, highlighting the importance of the learner's context.

When advances in technology such as Second Life (Linden Research Inc., 2019), augmented reality (AR) and virtual reality join forces with citizen science, the process of data collection becomes easier and fun. In our welcome video at the start of this MOOC, we presented ourselves in a Second Life virtual world. An appropriate example for primary and middle school settings to engage students in inquiry-based learning with AR is the NearPod (2019) platform. Although this is not directly a citizen science-based platform, it exemplifies the changing landscape of lesson planning, pedagogy and enhancing technology in teaching and learning. For instance, it allows you to visit the pyramids of Egypt by moving around your classroom.

Activity 2

[20 minutes]

Do a quick Internet search for two different definitions of 'm-learning' or 'mobile learning'. Then, provide your own definition of m-learning and describe the reasoning behind how you formulated it in the discussion forum. Include the links to the websites you got your information from.

2.1c Enhancing technologies with citizen science and m-learning

The definition of m-learning in Wikipedia (2019) reads: 'learning across multiple contexts, through social and content interactions, using personal electronic devices'. This sounds a lot like citizen science!

In the case study by Reyna and Simoes (2016), open sources of citizen science rely on technological innovations to support their methodology:

> 'Fortunately, most modern mobile devices include a sensor (e.g.: GPS) that helps positioning the information. By combining the location stamp with the information provided by the surveyor, we are able to develop strategies to establish a degree of confidence in the reliability of the contributed data. We can compare this data with nearby data participants that have been collected by other

> participants in a similar time frame. Should data from different sources confirm these observations, the level of confidence automatically increases.' (p. 2, 2016).

If the students in the geology ERA project covered in module 1.2 had had this kind of technological capability, they might have been able to enhance mobility, productivity and validity, allowing for a broader scope of enhanced inquiry and learning to occur. Maybe it depended on whether they had a first-generation iPad from 2010, as compared to an iPad pro from 2017. There is a big difference in mobile device capabilities between the two!

Mobile learning is increasingly intertwined with citizen science, and one type of technology can be quickly replaced by another. The future of citizen science then relies on how it can be designed taking into account the constant advancements in technology.

Read the 'abstract' on page 1 and the 'discussion' on pages 8 and 9 of the article by Bela et al. (2016) about learning and the transformative potential of citizen science.

Activity 3

[30 minutes]

1. What technologies around you could enhance citizen science in the future?
2. After reading the sections of Bela et al. (2016), evaluate one type of mobile device or application (other than a citizen science platform) that you could integrate into citizen science.

2.2 Gamification

Can we all just play games and learn? Quite possibly!

Gamification is a relatively new concept that was coined in 2002 and appeared in educational technology literature in 2008 (Faiella and Ricciardi, 2015). It is described in Wikipedia (2019a) as 'the application of game-design elements and game principles in non-game contexts'. It can formulate a process to problem-solve through a set of activities within game-like elements. Gamification attempts to improve engagement, organisational productivity and, most of all, entertainment!

Apostel et al. (2013, in Faiella and Ricciardi, 2015) identify eight elements of games that are used for the gamification of learning:

- Rules

- Goals and outcomes
- Feedback and rewards
- Problem-solving
- Story
- Player(s)
- Safe environment
- Sense of mastery

However, many game features are still being debated when it comes to learning. There is little research regarding gamification in education, but there is evidence of the correlation between motivation and gamification (Faiella and Ricciardi, 2015).

It is not all fun and games, yet.

Hanus and Fox (2015, in Faiella and Ricciardi, 2015) tested two classes within the same curriculum by introducing gamified elements to only one of them. Their results showed that the students of the gamified class had lower levels of motivation and test scores on a final exam. The researchers identified that this was due to a negative effect on intrinsic motivation due to gamification. This study aligned with other academic literature which also identified negative effects of reward on motivation. The gamified conditions (such as badges, coins, competition and social comparison) harm motivation. The findings highlighted that social elements are crucial in creating motivating gamified learning.

Gamified learning relates to an educational theorist called B.F. Skinner (Wikipedia, 2019b), who theorised the concept of behaviourism. You might have already heard of Skinner, as his work is seen as an extension of the famous concept of Pavlov's Dog (Psychologist World, 2019). Pretty much the opposite of what socio-constructivism and connectivism are all about.

Thiel et al. (2016) recognised a need for collaboration and communication in gamification by applying strategies added to game elements in e-participation platforms to evoke interest, introduce additional motivations and increase engagement. They also recognised that one size does not fit all when it comes to gamification. Again, many gamification approaches rely on reward-based aspects of learning, which runs the risk of extrinsic motivation overriding intrinsic motivation (Thiel et al., 2016).

During module 1.3b, you got to play a game created by the tutors on the Flowlab (2019) platform, which gamified your learning about a chapter in the Innovating Pedagogy 2012 journal. What was this experience like for you?

Activity 4

[15 minutes]

1. How did you think you were learning when playing the game?
2. What did you learn from playing the game?
3. How were you motivated?
4. How inclusive or accessible was this resource for you?
5. Share your answers and discuss in the forum.

2.3 Integrating the future

2.3a AR and VR, are we there yet?

As you saw with gamification, it seems not all technological advances can contribute to the future of citizen science – or is it just that we are not at that point of being able to do so yet?

As educators, you are probably already trying to manage the pedagogical challenges of 1:1 iPads and other technological devices. Thinking of ways to incorporate these new technologies into your teaching and learning can be tricky. So, how could you incorporate new technologies into your citizen science teaching and learning?

What are AR and VR

We already see AR and VR infiltrating teaching and learning in such applications as Nearpod (2019), Interactive Anatomy 4D (4D Interactive Anatomy Zrt, 2019), Ocean Rift (Facebook Technologies LLC, 2019) and Jigspace (2019). Nearpod allows a teacher to facilitate a variety of pedagogical approaches, designing them with the inclusion of inquiry with multimedia and AR and VR capabilities. Jigspace uses AR as a deconstructing engineering tool to inquire into and use as a resource to discover how things are built, made and operated.

In nursing education, VR technology has entered the field at a fast pace, opening the door to VR having the potential to significantly improve student performance (Park, 2018):

> ‘VR can be useful, for example, when it enables scholars to attend an international conference without traveling to the physical convention center. VR provides the ability to speak, listen, and discuss in real time. Those using VR can choose to view a featured or real-time image of the other participants as if they were actually at the conference. Further, remote participants can feel touch through electronic sensors attached to their body. How amazing!’
> (Park, 2018)

Activity 5

[1 hour 30 minutes]

1. Read the article by Virtual Multimodal Museum (2019) about AR audio.
2. Do an Internet search into types of VR or AR applications currently available.
3. Using Kath Murdoch's inquiry cycle (2019), create a series of learning experiences/lessons that incorporate a citizen science project with hearables, AR or VR technology (or maybe a combination if you are feeling confident and creative!).
4. Share this in the discussion forum and comment on one other student's lesson plan.

2.3b Future predictions

It is difficult to predict the future in this technological world we live in. In Luc Besson's film *Valerian and the City of a Thousand Planets* (2017), there is an extravagant VR marketplace world where the characters engage in a full-body shopping-focused reality. This is not too far from where some businesses are headed already, with large commercial companies investing in such VR worlds (Kim, 2017, in Park, 2018). If immersive technologies are changing to such capacity, then so must do our approaches to teaching and learning. Citizen science can be seen as an investment in the future and a bridge between what we are currently capable of and what may be in the future.

It is easy to overestimate the future and all this hype around technology. It takes time for new and future technology to become mainstream and most effective in education. One way to look at it is by assessing the state of technologies according to the Gartner Hype Cycle. In 2018, the Open University started a campaign about the possible futures of education. Three main themes were identified:

1. Students can personalise their learning material.
2. Artificial intelligence (AI) can be used to help students succeed.
3. A move into micro-accreditation could take place in ways that the user gains credit for their interaction (FutureLearn, 2019e).

That third point sounds like gamification, doesn't it? This modern age of learning has enabled teachers and students to increase their use of technologies like AI, with m-learning allowing for more collaboration, communication and action to occur (Horizon Report Preview: 2019, p. 8).

In the Horizon Report Review (Adams Becker et al., 2017), the idea of mixed reality (MR), which is a blend of the physical world with digital spaces, reinforces the importance of citizen science in teaching and learning. The report also suggests that MR will be increasingly present in the next two to three years. In five years or so, we may see cryptocurrencies and virtual assistants entering our online world (Adams Becker et al., 2017).

Edward Cornish (2004, in FutureLearn, 2019i) identified four predictors that can be used to help with forecasting the future in education:

Continuity of existence: some things will probably stay the same.

Continuity of change: some things have predictable change.

Continuity of pattern: conformity to a pattern which can repeat itself.

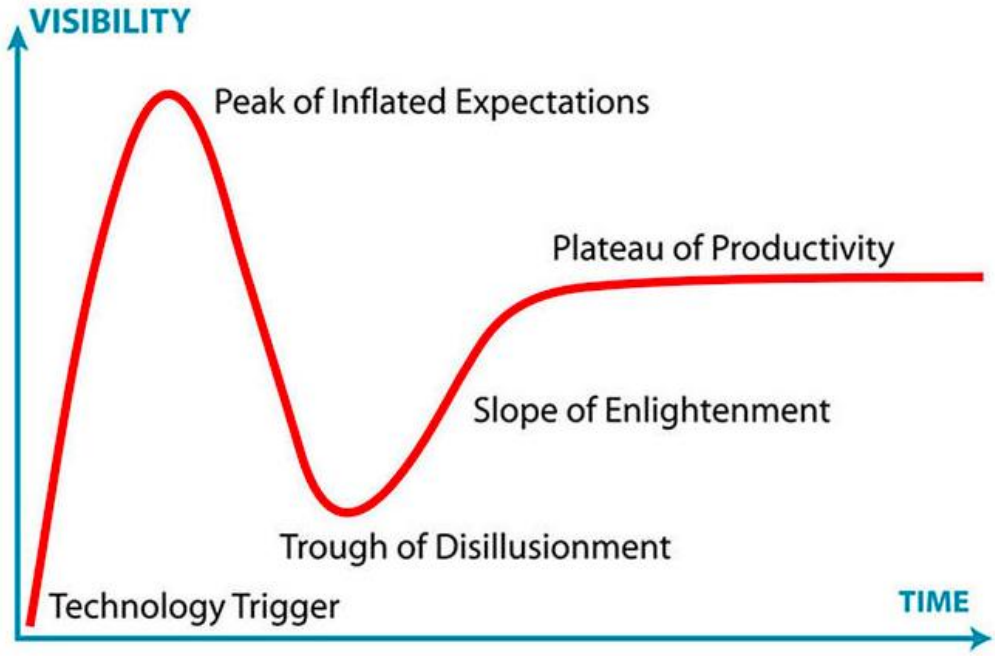
Continuity of casuality: some consequences are inescapable.

Some of the main concerns with new technology are related to how accessibility changes with it. In October 2019, the Wi-Fi Alliance (2019) announced the release of the new 802.11ax Wi-Fi 6 edition, with the development of Wi-Fi 7 already in construction (Seeker, 2019). Wi-Fi 6 implemented remarkable improvements which could be considered as a continuity of change. However, the access to these improvements is only going to be as fast as what your Internet service provider will allow you. This kind of change would resemble a continuity of casuality. This could impact the progress of more advanced, real-time and big-data-driven citizen science projects in the future.

The Web Content Accessibility Guidelines (WCAG) have been a driving force around the world in assessing and encouraging improvements in accessibility. These provide the foundations for knowing and delivering support and assistance to achieve online access and inclusion. The Guidelines are always developing and changing with technology. They currently include a set of standards that cover web and mobile access. You can see the story of WCAG's evolution from their open textbook here with this hyperlink. These standards allow learning designers and technologists to maintain equity and inclusion when providing access to technology.

One way to look at the future is by assessing the state of technologies according to the Gartner Hype Cycle (FutureLearn, 2019n) (see image 1).

Image 1. Gartner Hype Cycle (FutureLearn, 2019n).



Activity 6

[20 minutes]

1. Reflecting on the OLPC initiative, where would you place it on the diagram?
2. Reflecting on the Nearpod application, where would you place it on the diagram?
3. Reflecting on your chosen citizen science platform, where would you place it on the diagram?
4. Reflecting on gamification, where would you place it on the diagram?
5. Share your reflections in the discussion forum and comment on one other student's entry.

2.4 Voting poll and reflection

Now that you have gained a lot of valuable knowledge about the future of citizen science, how would you rate yourself according to Rogers' (1995, in FutureLearn, 2019n) types of innovator? You can choose from the following:

Innovators: people who are risk-takers and like to try new things and new ideas.
Early adopters: people with opinions and who adopt innovations early to maintain their reputation and build their abilities to be ahead of the pack.
Early majority: people who adopt innovations for practical benefits.

Late majority: people who are interested in the practical benefits but need more support before taking that next step.

Laggards: resistant to change and only adopt innovations when required.

Activity 7

[5 minutes]

So which one are you?

Activity 8

[20 minutes]

Learners individually reflect on what happened, what is new and what next, Learners choose to share in the discussion forum.

Part 2

(1610 words)

Title and description

The title ‘The Citizen Science Educator’ was chosen so that this short course could be considered an extension of ‘The Online Educator’ MOOC (FutureLearn, 2019) aimed to support further learning related specifically to the future of citizen science. I would imagine that there could be additional MOOCs that feed from The Online Educator, such as m-learning, learning at scale and open learning MOOCs. With the description, I wanted to ensure that prospective learners could easily understand what the MOOC was about and what they would gain from it.

Goals and target audience

The goals draw from Conole’s 7Cs of learning design (FutureLearn, 2019b), as well as the mapping of a MOOC design pattern as according to Warburton and Mor (2015). The goals are reflected in the learning outcomes and aim to develop an open online community of practice (Wenger-Trayner and Wenger-Trayner, 2015) about citizen science. LO5 in particular relates to an increase in open digital practices (FutureLearn, 2019k), while LO2, 3 and 4 target the community indicators framework according to Galley et al. (2014, in FutureLearn, 2019j) (see Appendix B).

One of my main concerns was that a short three-week MOOC might not provide enough evidence or opportunity to encompass an emerging leadership hierarchy and build a shared vocabulary. Some of the reflective activities I included are designed to allow learners to collaborate and agree on shared definitions of the concepts investigated (e.g., module 2.1b, definition of m-learning), which contributes to the creation of a shared vocabulary and an emerging leadership hierarchy.

The target audience was defined based on my own strengths and experiences in a pedagogical approach related to citizen science. Since a MOOC has a large, diverse audience, I had to provide some pedagogical foundations prior to investigating into the future of citizen science.

Personas

Both Charlie and Duckcat are an exaggerated version of myself. I wanted to include one persona with teaching experience and one in educational leadership. They were devised according to the Open University's persona card template (2019) provided through my H880 studies.

The characteristics of these personas, including learning style and physical and social contexts, were taken into account in the learning design, especially during week 1, reflecting the importance of personal traits and experiences, types of social resources and appropriateness to the learner (Luckin, 2018, in FutureLearn, 2019o; Sharples, 2015, in FutureLearn, 2019p).

Learning outcomes

When outlining the learning outcomes, I ensured they would deliver the goals set for this MOOC. LO 1 and 2 give the learner an understanding of citizen science pedagogy, which could then lead them into a critical engagement about citizen science with LO 3 and 4, extending into and revisiting creative and online creation in LO 5. Learners experimented with LO5 in week 1 so that tutors could understand their online creative capabilities.

I have indicated in Appendix I where the learning outcomes should be identifiable. I considered the Sheffield Hallam University (Winwood and Purvis, 2015) guidelines on constructing learning outcomes along with the 7Cs of learning design (FutureLearn, 2019b). Each learning outcome integrates vocabulary related to these concepts while considering the pedagogical practices of inquiry and socio-constructivism replicated in the MOOC content.

What I realised is that how I design the learning outcomes impacts how learners can demonstrate them. These outcomes were designed to address the Hegarty's (2015, in FutureLearn, 2019l) concept of open pedagogy, as well as methods for assessment (Appendix C).

Approach to assessment

While designing the MOOC, I made a conscious effort to both include and distinguish between shallow and deep learning in the collaboration and communication of the learners. Shallow learners, as termed by Draper (2009, p. 287), 'are mainly storing information as separate items, while deep learners are trying to make connections between items'. This balance could easily affect the motivation and engagement of learners. I therefore implemented MOOC activities and volume of tutor input according to Salmon (2019) (see Appendix H); activities and discussions in weeks 1 and 2 are heavily focused on peer interaction because this 'enhances learning by both stimulating the production of reasons and by metacognition' (Draper, 2009, p. 289).

To promote deep learning, the communal voting polls (CVP) and MCQ included in the MOOC would have to blend selected-response and constructed-response questions as mentioned in the article by Jordan (2013) regarding computer-marked assessment. The results would then offer both authentic and pre-determined answers, providing a balance of what the student knows and what they think they know. Confidence-based marking, seen as a positive inclusion by Draper (2009) and Jordan (2013), would be incorporated into the CVP design so that a process of negative marking could take place with care on the FutureLearn platform. These methods of assessment could be seen as technology-enhanced assessments that promote deep learning, peer interaction and great pedagogical power (Draper, 2009).

Pedagogic approach

The learning outcomes and assessment practices were constructed considering the pedagogical frameworks of socio-constructivism, inquiry and openness for an educational audience. The open pedagogy framework by Hegarty (2015, in FutureLearn, 2019l) was used as a foundation to incorporate the personal inquiry cycle of Anastopoulou et al. (2012) and the socio-constructivist pedagogy of Vygotsky (1979, in FutureLearn, 2019m).

Critiquing my application of open pedagogy for this MOOC, I have determined using Hegarty's (FutureLearn, 2019l) framework that there are a few areas of development to

consider (Appendix C). Possibly due to the short duration of the course, trust, confidence and openness could be better developed. Even though I do have some small opportunities for peer assessment and critique in the learning activities, maybe I could have had more group-oriented activities to further support trust, openness and confidence with others.

Being critical of how open my pedagogic approach is relies on how open my digital practices are, as defined by Cronin (FutureLearn, 2019k) and in Appendix D. I allow for social media inclusion when concluding the MOOC, and I provide a limited scope of online creative resources (e.g., Coggle). This was done intentionally to avoid overloading learners with too many expectations, so that motivation and engagement were sustained throughout the MOOC.

Even though I encouraged learners to connect with the MOOC's Twitter and use hashtags, I feel that not enough social media was included in the modules. Revising this (e.g., including the MOOC's Twitter as an online resource) could support more open digital practices, strengthening my community of practice. I also feel that even though inquiry is evident, as indicated in Appendix E, I did not allow time for personal inquiry questioning and responding in the modules or activities.

From an online pedagogic approach, I ensured that I incorporated MOOC design patterns reflecting Salmon (2019) and Warburton and Mor (2015), as shown in Appendices H and F. This shaped the pedagogical approach in how tutors could moderate and acknowledge learning outcomes. I feel that I may have overloaded my MOOC with design patterns, aiming for quantity instead of quality. This may impact the proposed timing of each stage of the weekly learning, as I had estimated one hour for each step in one week would be sufficient. Thinking about week 3 in particular, more time might be needed to complete the final step for both summative and formative assessments. Student feedback about their MOOC experience would be crucial.

Accessibility and inclusion

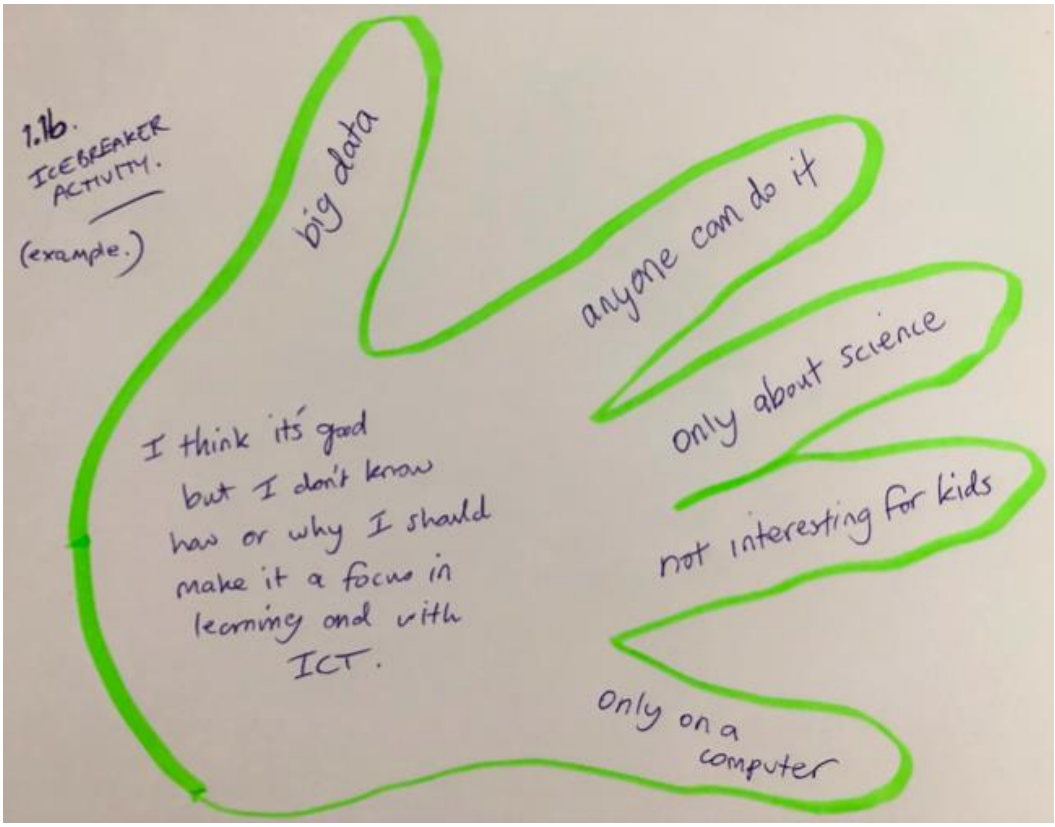
Both personas have some challenges. In my MOOC, I take considerable advantage of the current accessibility and inclusion features that the FutureLearn platform already provides. I feel that the emphasis on communication and collaboration at the beginning of the MOOC reflects a supportive environment for learners to stay motivated and less anxious. However, not all learners will be as easy to manage as Charlie and Duckcat. The idea of embodiment and academic research into virtual worlds such as Second Life suggests that 'giving people a

virtual body can improve cognitive abilities and enhance their interest in a particular subject or reduce racial bias and domestic violence' (FutureLearn, 2019g). In some of my more challenging activities, there are alternate methods for learners to complete the tasks and achieve the learning outcomes, but I do not allow for much individual creativity such as Second Life opportunities to develop.

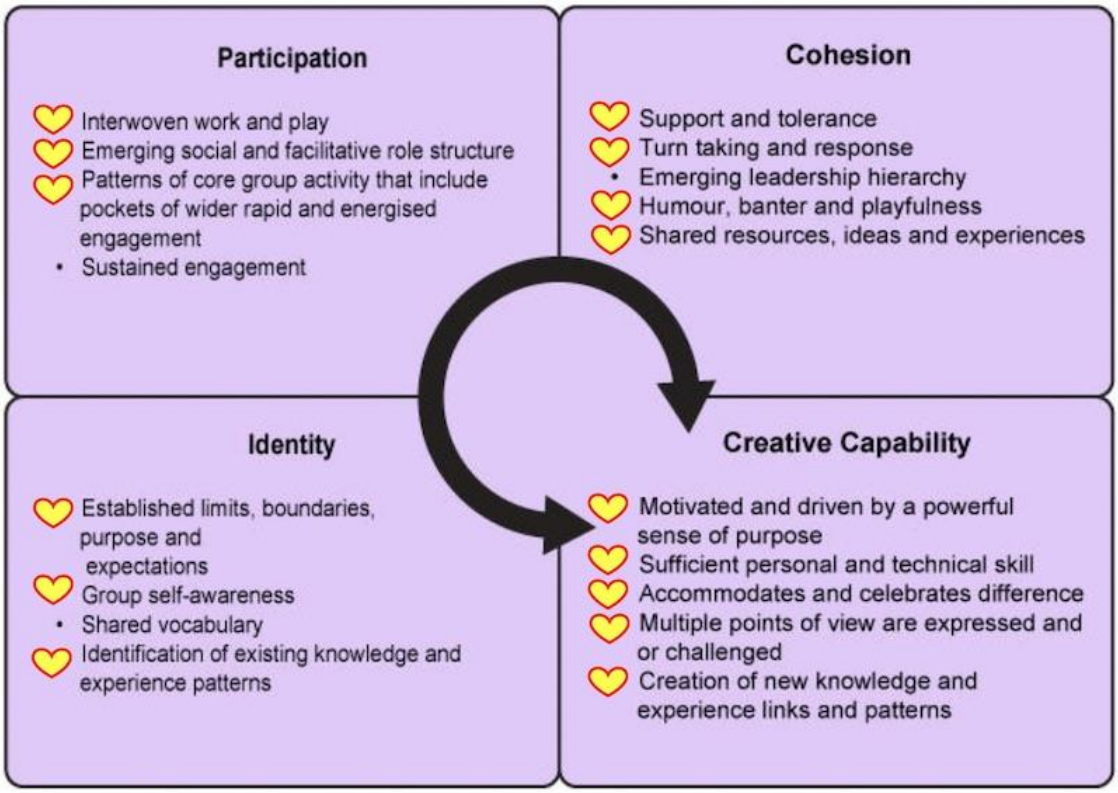
For my MOOC to support these two potential learners, it is crucial that this kind of contextual information is gained at the beginning of the course, as mentioned during admission and week 1. According to the IMS Global Learning Consortium Standards (FutureLearn, 2019h), my MOOC would support some flexibility and adjustments for learner needs and abilities to complete tasks and demonstrate learning outcomes. Even though I have included in week 1 an awareness of support for learners, I think that I should include access to and promote learner awareness about assistive technologies outside the FutureLearn platform. In addition, tutors should be knowledgeable of online resources and be provided professional development that can support their own ability to include equity in learning. Course tutors could include various resources such as W3C Web Accessibility Initiative (WAI) (2019) or Digital A11y (2019), which offers a wide scope of resources and experiences about web accessibility. Knowing that these exist would support learners and enable them to incorporate adaptive digital assistance, but it would also be interesting to trial the MOOC and see what diversity of learners it attracts so that the MOOC could be continually evolving and improving.

Appendices

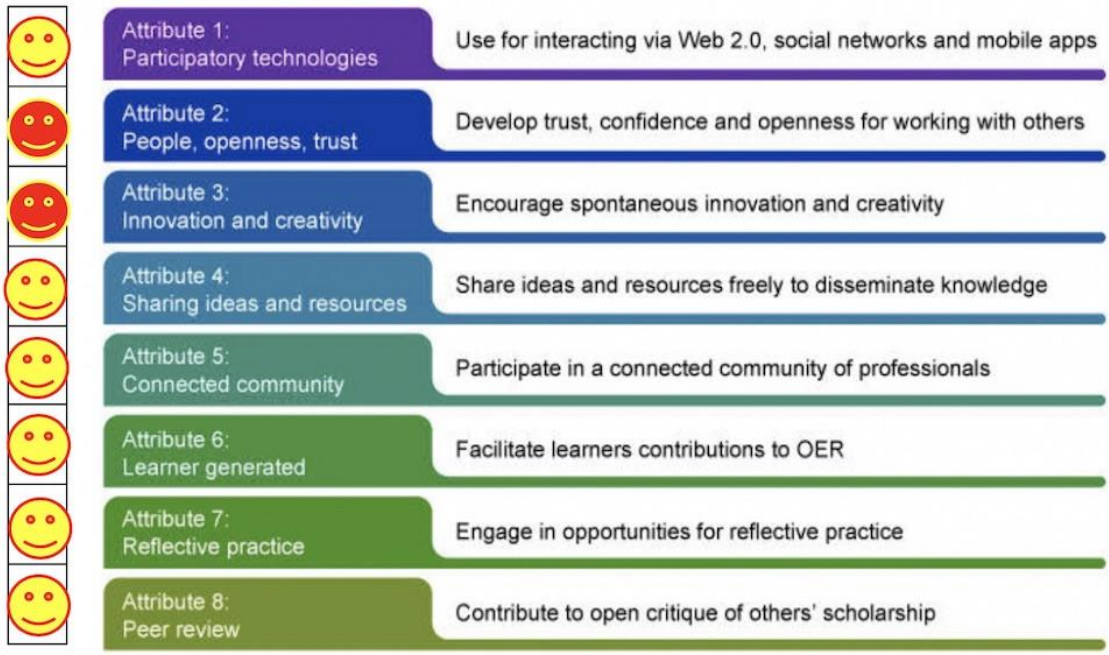
Appendix A. Icebreaker activity (module 1.1b): what do I already know about citizen science?



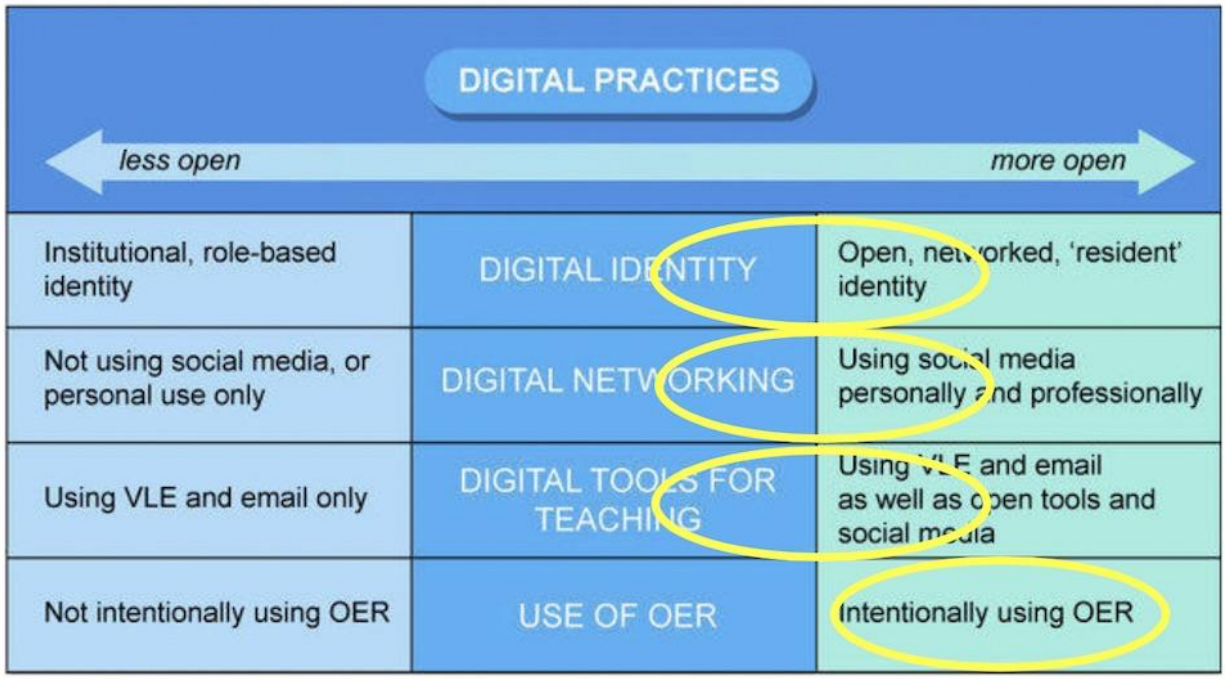
Appendix B. Community indicators identified in my MOOC (Galley et al., 2014, in FutureLearn, 2019j).



Appendix C. Evaluation of open pedagogy of my MOOC (Hegarty, 2015, in FutureLearn, 2019l).



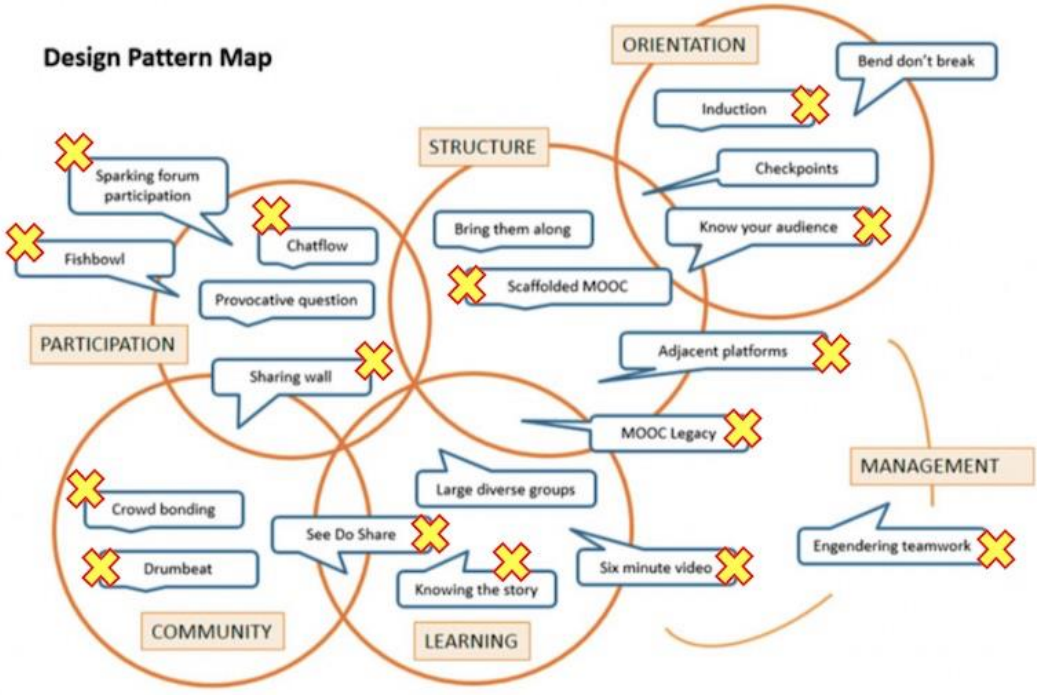
Appendix D. Evaluation of digital practices in my MOOC (FutureLearn, 2019k).



Catherine Cronin's matrix of digital practices

Appendix E. Evaluation of inquiry for learners in my MOOC (Anastopoulou et al., 2012).

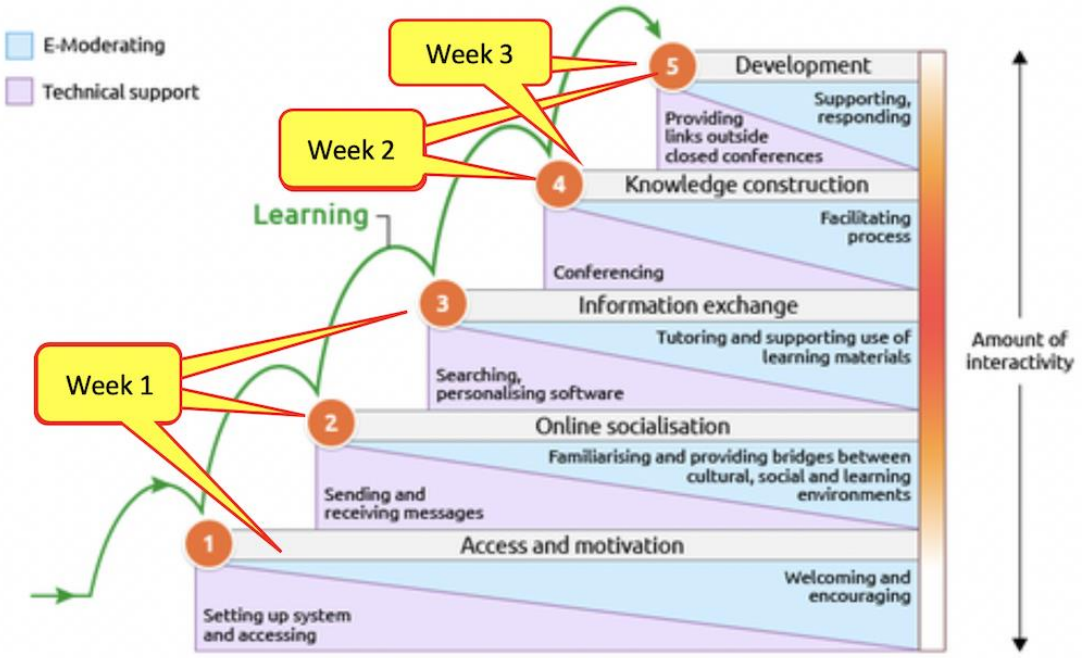
Appendix F. Evaluation of MOOC design principles in my MOOC (Warburton and Mor, 2015).



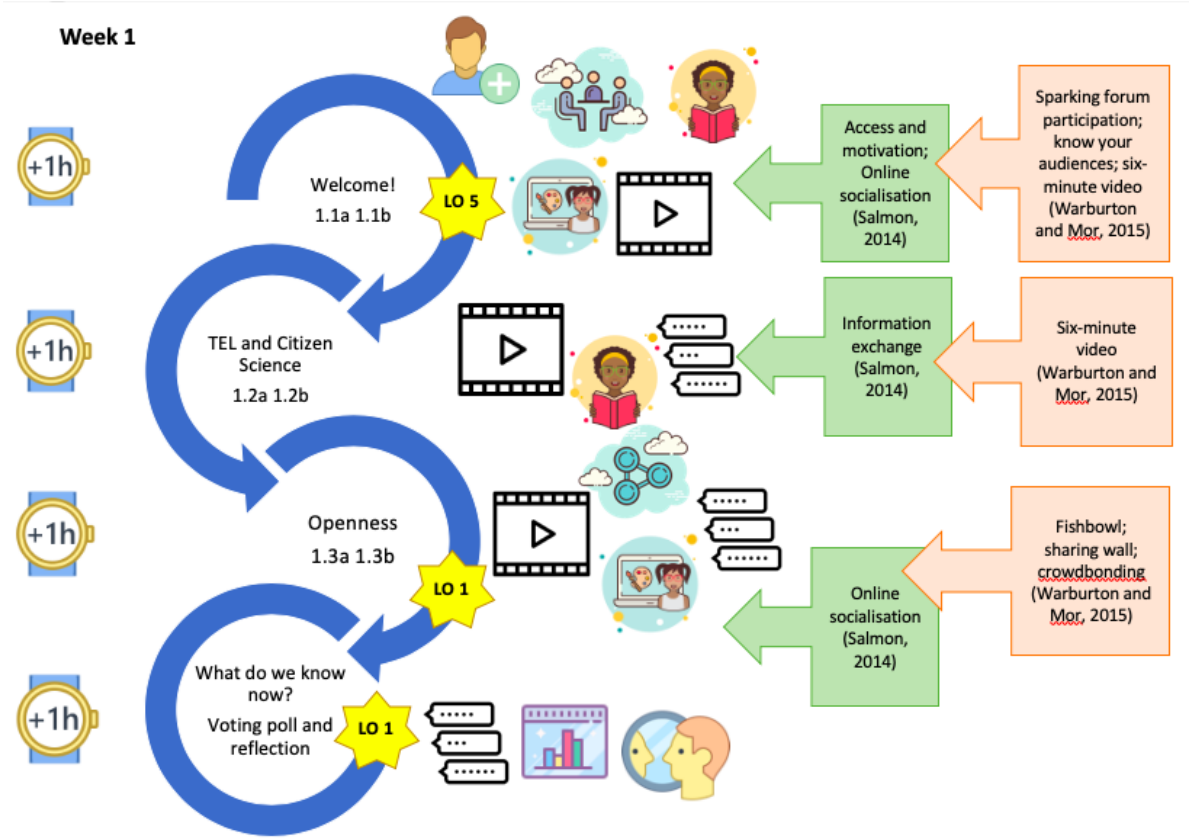
Appendix G. Overview of learner-centred pedagogy (Crompton, 2013).

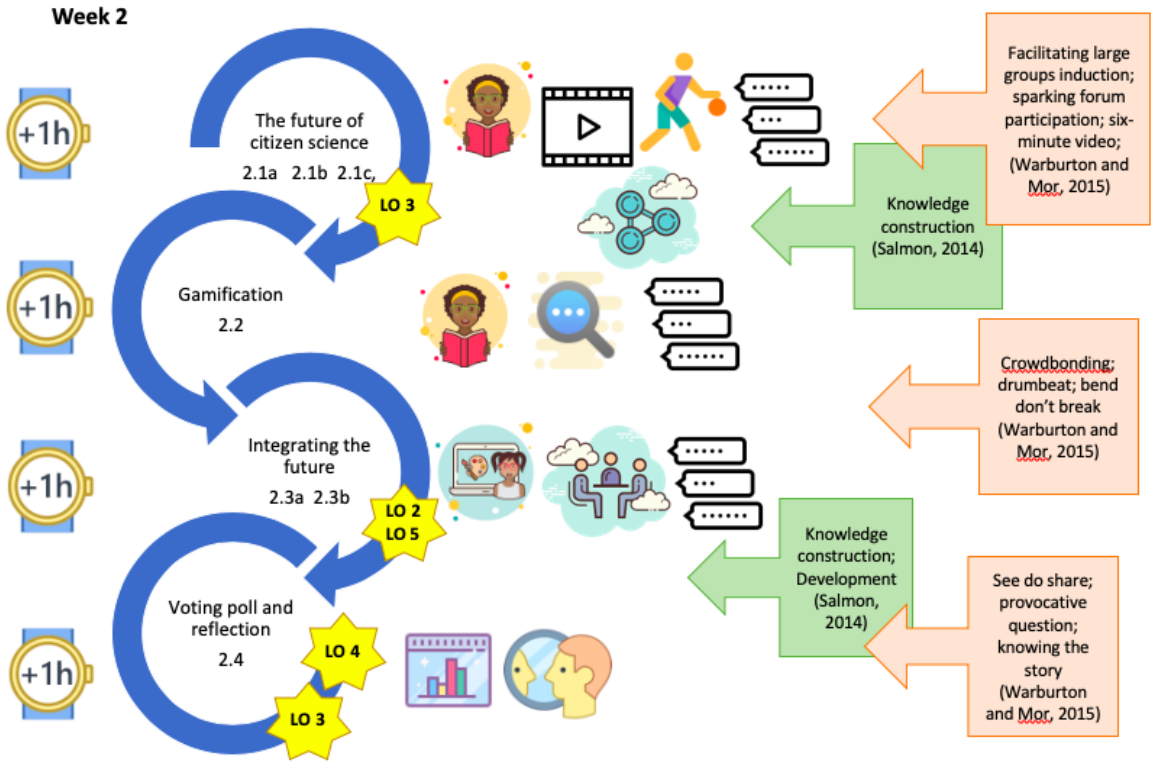
Learner pedagogies/theories	Decade	Main tenets of the pedagogies/theories
Discovery learning	1970s	Knowledge is discovered through active participation in the learning process
Constructivist learning	1980s	Knowledge develops through interactions with the environment
Constructionist learning	1980s	Knowledge is gained through actively creating social objects
Problem-based learning	1990s	Knowledge is developed through working on tasks and skills authentic to the environment in which those particular skills would be used
Socio-constructivist learning	1990s	Knowledge is co-constructed interdependently between the social and the individual

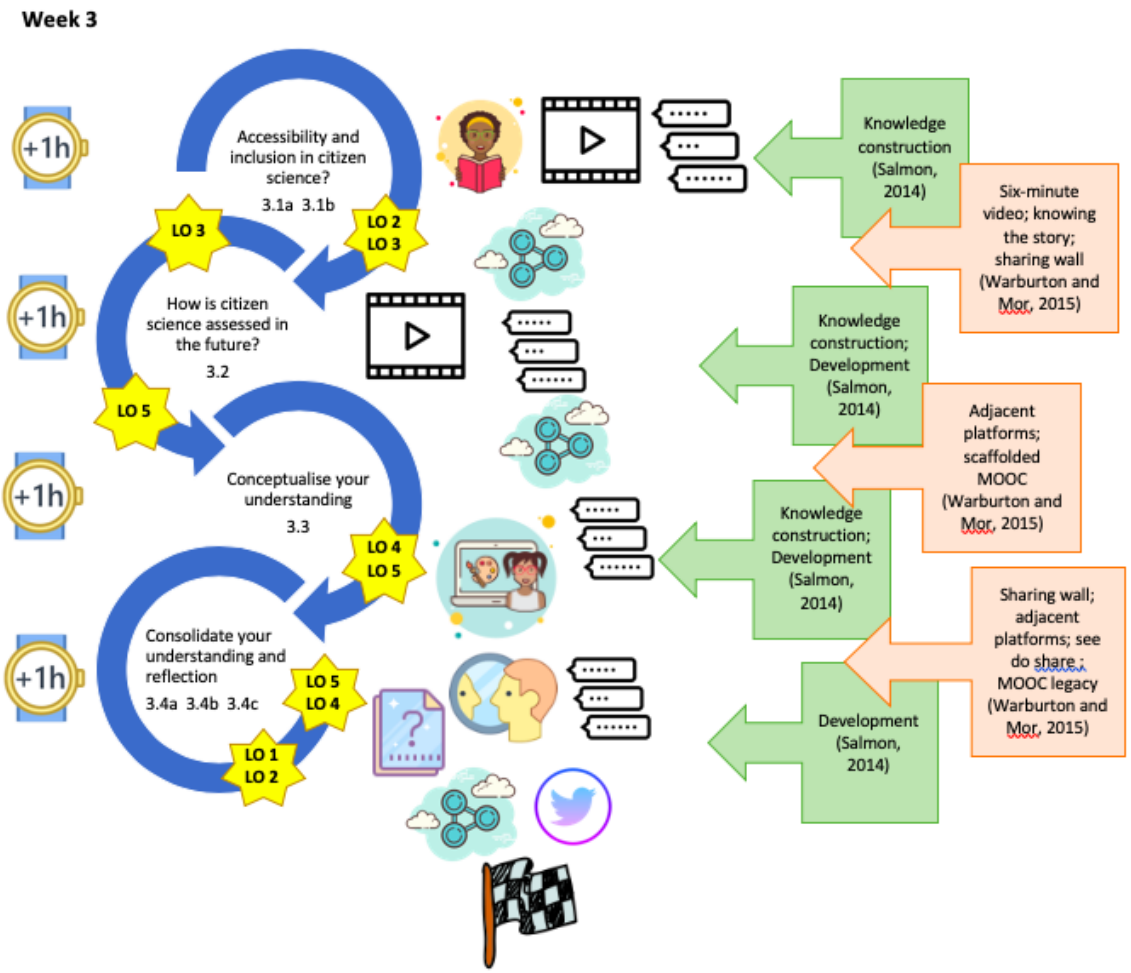
Appendix H. Evaluation of my MOOC's learning design according to Salmon's five-stage model (2019).



Appendix I. Weekly overview of The Citizen Science Educator MOOC.




Week 2
+1h
The future of citizen science
2.1a 2.1b 2.1c,
LO 3
+1h
Gamification
2.2
+1h
Integrating the future
2.3a 2.3b
LO 2
LO 5
+1h
Voting poll and reflection
2.4
LO 4
LO 3
Facilitating large groups induction; sparking forum participation; six-minute video; (Warburton and Mor, 2015)
Knowledge construction (Salmon, 2014)
Crowdbonding; drumbeat; bend don't break (Warburton and Mor, 2015)
Knowledge construction; Development (Salmon, 2014)
See do share; provocative question; knowing the story (Warburton and Mor, 2015)


Week 3
+1h
Accessibility and inclusion in citizen science?
3.1a 3.1b
LO 3
LO 2
LO 3
+1h
How is citizen science assessed in the future?
3.2
LO 5
+1h
Conceptualise your understanding
3.3
LO 4
LO 5
+1h
Consolidate your understanding and reflection
3.4a 3.4b 3.4c
LO 5
LO 4
LO 1
LO 2
Knowledge construction (Salmon, 2014)
Six-minute video; knowing the story; sharing wall (Warburton and Mor, 2015)
Knowledge construction; Development (Salmon, 2014)
Adjacent platforms; scaffolded MOOC (Warburton and Mor, 2015)
Knowledge construction; Development (Salmon, 2014)
Sharing wall; adjacent platforms; see do share ; MOOC legacy (Warburton and Mor, 2015)
Development (Salmon, 2014)

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