

A DESIGN GUIDE FOR OPEN ONLINE COURSES

Written by Dave Pratt, Seb Schmoller, David Jennings, Will Buckman, Matt Bush, David Squire and Nick West.

Edited by David Jennings.

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Foreword by Maren Deepwell and Joe Wilson

Two of the key challenges of using technology effectively for learning, teaching or assessment are keeping pace with the demands of different communities, and deciding how best to use the tools and resources we have at our disposal. It can be hard to access the documentation that lies behind the creation, planning and commissioning of new types of learning resource; it can be hard to understand how others have solved problems and how their experiences can inform our efforts. That is why we think it is a great idea that Citizen Maths is making this an open publication: it provides a useful resource for anyone thinking about developing an ambitious resource like Citizen Maths, while contributing to the open sharing of innovation across sectors.

This publication provides a well-documented, accessible, step-by-step guide to setting up a project of this kind – from policy and vision, through to practical guidance on materials development. Above all, it is clear and honest in the decisions and hurdles that the team overcame in creating and running Citizen Maths as a pretty unique resource, in an area where there has been a surprising dearth of open learning materials.

We hope that Citizen Maths is leading a charge in providing more open and supportive learning materials for all those who need to brush up on their mathematical skills for learning, life or the workplace. It would be great to see more people in the science, technology, engineering and maths learning sectors creating free and open learning materials.

The models and the means of production may change, but the Citizen Maths journey is worth a read – especially if you are thinking about exploring the space of developing online learning for a mass audience or thinking about commissioning a project of this kind. We encourage you not only to explore this publication but to use it as inspiration for sharing this and similar resources more widely.



Joe Wilson
MA, MBA, DipEd, PGCSE
Co-founder, Open Scotland
ALT UK Ambassador
@ioecar

Joe Wilson



Maren Deepwell
PhD, CMALT
Chief Executive, Association for
Learning Technology (ALT)
@marendeepwell

Maren Deepwell

About this guide

This guide is a comprehensive summary of how we went about creating Citizen Maths, an open online maths course and service.

The guide shares our design principles and the techniques we used to put them into practice.

Our aim is to provide – with the appropriate ‘translation’ – a resource that will be useful to other teams who are developing online education initiatives.

About Citizen Maths

Citizen Maths is a free, open online mathematics course for adults. The course is at ‘Level 2’ – the level that a 16-year-old school leaver is expected to achieve in maths. It comprises five parts, each focused on one ‘powerful idea’ in mathematics, and each taking 5–10 hours to complete. Participants can start whenever they choose, can complete as much of the course as they like, in any order, as quickly or slowly as they wish.

Milestones in the project were:

- First Powerful Idea (proportion) made available and course opened for registration – **August 2014**.
- Review of ‘proof of concept’ and options for an adaptive design – **2015**.
- Launch of two more Powerful Ideas along with exploratory design features – **November 2015**.
- 3,000 registered learners – **January 2016**.
- Launch of final two Powerful Ideas and next iteration of design features – **May 2016**.
- 6,000 registered learners – **August 2016**.
- Final iteration of the course and service design within the project – **November 2016**.
- 9,000 registered learners and conclusion of the project grant funding – **February 2017**.
- 12,000 registered learners – **May 2017**.

Team and credits:

The design and development of Citizen Maths was intensely collaborative at every step, with the team geographically spread across England. Roles tended to overlap with each other. This list of credits is therefore a rough approximation in places.

- The [Ufi Charitable Trust](#) provided grant funding for Citizen Maths between summer 2013 and spring 2017.
- Calderdale College backed and owned the project, administered the grant, and promoted its take-up through its work-based learning networks. People involved included Alex Abel, Howard Browes, Rachel Callaghan, Karina Crabtree, Ebrahim Dockrat, Eleanor Guthrie, Jas Hayre, Katherine Hutt, Chris Jones, Russell Moody, Joanne Patrickson and John Rees.
- Seb Schmoller conceived the project with advice from Chris Jones, CEO of Calderdale College, and Professor Richard Noss from the UCL Institute of Education, and then directed the project.
- Professor Dave Pratt designed the approach of the course with Seb (see Appendix A), and led the writing of the content, supported by Piers Saunders. Dave and Piers are based at the [UCL Institute of Education](#).
- Noel-Ann Bradshaw (University of Greenwich) and Paula Philpott (South Eastern Regional College, Northern Ireland) developed the tutorial parts of the content, based on their experience of teaching mathematics, and are the public faces (and hands) of Citizen Maths in the course videos and screencasts.
- DESQ produced the course videos and designed the presentation of all parts of the course content and public website (see Appendices C and D). Their team included Will Buckman, Matt Bush, Phil Nichols, David Squire and Nick West.
- Knowledge Integration (Adam Fredericks and Ian Ibbotson) developed and managed the Citizen Maths technical infrastructure, particularly the course’s use of Google Course Builder. They developed a number of extra components for Course Builder to fulfil Citizen Maths’ goals, and these are [published as open source software](#).
- OCR provided advice on accreditation issues with Citizen Maths, as well as some funding. Their team included Charlotte Bosworth, Will Burrows, Garry Haynes, Natalie Jenkins, Eddie Orija, Emily Ryan, and Liam Salmon.
- Graham Griffiths, also of the UCL Institute of Education, helped inform the development of the course by collecting and presenting evaluation data from within the team. Ian Chowcat, of Sero Consulting, wrote a more independent evaluation report.
- Michel Benard, Pavel Simakov and John Orr, of Google Research, provided occasional advice and support, particularly in relation to our use of Google Course Builder as the course platform.
- Richard Stacy of Stacy Consulting provided advice and support on reaching our audience, including use of social media.
- CogBooks (Jim Thompson, Robert Rogowski, Morna Simpson, Melanie Manohar, Sam Edwin, Sarah-Louise Quinnell and Lars Hyland) contributed to the project up to May 2015.
- David Jennings (DJ Alchemi) coordinated the contributions of all the above as project manager, leading the development of plans, budgets, progress reporting and project documentation. He also led the work to collect and interpret usability testing data (see Appendix B).

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1.Design principles

1. Design principles

1.1 Understanding of need

In the document, *The Thinking Behind Citizen Maths* – included in Appendix A and also [online](#) – we outline the need that Citizen Maths (CM) is designed to meet.

Data from the OECD's 2013 'PIAAC' Skills Report, shows that about 1 in 3 of the UK's adult population – say ten million people – have a current level of mathematical capability that would enable them to benefit from Citizen Maths. This represents a challenge that is very difficult to address through traditional methods of learning and teaching: many are disenfranchised by life circumstances from taking part in face-to-face courses; and the challenge would be also be very costly to solve conventionally. Of course, nothing like all people will have the necessary self-motivation, ICT access and ICT skills to use Citizen Maths. But the absolute number of people in the UK population for whom Citizen Maths should be suitable, is nevertheless large; and, if Citizen Maths is successful with learners, we will have made a contribution to solving the "intermediate level" maths challenge, at a low enough cost per learner for the course (and similar courses) to be offered more widely.

1.2 Understanding of context

Design should be rooted in an understanding of who the users are, what they need to do, and how the context in which they are situated affects the means by which they meet their needs. In taking this position Citizen Maths borrows from the definition of usability that has underpinned ISO standards frameworks in this field: –

the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

Within Citizen Maths:

- the **product** is the course together with the website and registration process via which people get access to the course;
- the **specified users** are self-motivated adults whose level of mathematical capability is at or above NVQ Level 1, but is not yet at NVQ Level 3;
- the **goals** are for some of these users (or their associates), variously,
 - to increase their own grasp of maths at NVQ Level 2,
 - to find out if the course will suit them, their students (in the case of teachers) or their organisation (in the case of human resources professionals),
 - to find out how the course is run;
- **effectiveness** relates to metrics of how well users achieve their goal(s); **efficiency** to how much time and effort they have put in; and **satisfaction** to how enjoyable, motivating and safe they find the experience.

Finally the **context of use** covers a wide range of variables that affect users' experience, from their age and background, their prior learning, the environment in which they do the course (e.g. whether it's a tablet on a commuter train, a PC in a learning centre or a laptop on the kitchen table) and what gave rise to their motivations in relation to their life and work profile.

Context thus plays a big part in determining usability. So we invested time in mapping and articulating the context of use for Citizen Maths in a Context of Use description, comprising mainly hypothetical user personas and scenarios, which is included in **Appendix B**.

1.3 Learning model/approach

The design of our learning model sets out to put mathematics in the context of many adults' everyday lives, rather than portraying it as something abstract. Seeking to avoid presenting mathematics as a sequence of apparently disconnected routines and procedures, Citizen Maths engages people in familiar activity to reveal the 'maths inside' and give access to its power. From this and from Herbert Simon's axiom, below, we take a focus on what we refer to as 'powerful ideas' and on putting them into action.

Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn.

This is explained in more detail in Appendix A and developed in other aspects of the design below.

We modelled Citizen Maths in part on the 2011 artificial intelligence (AI) MOOC (Massive Open Online Course) designed and run by Google's Director of Research Peter Norvig and Stanford University's Sebastian Thrun (now CEO of MOOC provider, Udacity). Our aim is to give thousands of learners the feeling that they are in a one-to-one tutorial. So Citizen Maths is made of very short instructional videos by our two "to-camera" tutors, who are very experienced maths teachers. However, Citizen Maths has features not in the AI MOOC. For example:

- we provide purpose-made app-based activities to help learners build up their mathematical understanding, including a small amount of programming, using Scratch;
- we provide automated learner support and adaptive encouragement to help learners stay motivated to progress with the course.

Our approach to supporting learners was informed by the thinking in British Standard BS 8426:2003: A code of practice for e-support in e-learning systems, from British Standards Institute (to which David Jennings and Seb Schmoller contributed).

1.4 Coherence and consistency

By making Citizen Maths coherent and consistent we increase the chances that learners will find that it meets their expectations, and thus is transparent, effective and satisfying to use. Coherence and consistency apply at different levels, from the visual branding to the underlying model of the maths curriculum.

To address the former, Desq has produced a Brand Guidelines Document for Citizen Maths – see Appendix C. As Desq, supported since 2015 by Knowledge Integration, has been responsible for setting up both the Citizen Maths course (using Google Course Builder) and the websites (using WordPress), they have been able to apply a fairly consistent look and feel across the whole experience.

Regarding the curriculum, we have structured Citizen Maths according to the OECD's PISA Assessment and Analytical Framework for Mathematics, Reading, Science, Problem Solving and Financial Literacy, which provides an internationally recognised framework for mathematical content. (We started with the 2012 version, and then used the draft 2015 version, which happily retains the same various categorisations of content, processes, contexts and so on as those that we drew upon in our curriculum spreadsheet based on the 2012 version.)

Using the PISA framework brought several advantages:

- it is used internationally;
- thus it is subject to broad-based scrutiny and consultation, which should ensure its coherence;
- it is well regarded by mathematics educators because it focuses on how people can use mathematics rather than on mathematics as a set of abstractions, without falling into the trap of oversimplification.
- it offers an active problem-solving oriented framework, which matches well the underlying philosophy for Citizen Maths.

1.5 Sustainability through low unit cost and technical resilience

One subsidiary purpose of Citizen Maths is to provide “proof of concept” for the idea that a MOOC-style course is feasible for learning mathematics at Level 2 and is also economically scalable – i.e. can it support this kind of learning at a cost of one or two pounds, rather than tens or hundreds of pounds, per user? This requires not simply that the course can provide an effective experience for the individual, but that it can both attract and manage participation from a large number of people at a time.

To help Citizen Maths be sustainable it is desirable that it become a robust, self-managing, design-once-use-over-and-over-again entity. That means:

- it is built on a technology platform that
 - can support thousands of learners at very low cost
 - is proven, robust and low-maintenance
 - has an upgrade path which – as far as is possible in a fast-moving environment – ensures that the platform can evolve without requiring major changes in the course
- the requirements for direct support from teachers and teaching assistants are near zero, with the great majority of support being provided via automated means built into the course;
- the curriculum is only loosely coupled to individual qualifications so that it does not have to change every time that a qualification changes or another one becomes more desirable.

2. Application of principles

2. Application of principles

2.1 Curriculum

2.1.1 Derivation and premise

The curriculum was derived from:

- the initial rationale for Citizen Maths as set out in documents from the project proposal;
- the [PISA 2012 Assessment and Analytical Framework for Mathematics](#);
- an internal review by Dave Pratt of this framework;
- the context of use document;
- tutor and student workshops that we ran in November 2013 and May 2015 at Calderdale College, April 2015 (TUC), June 2015 (University of Greenwich) and November 2015 (Institute of Education).

The design premise was based on a Udacity-style MOOC that emulates a one-to-one tutorial. These are characterised by the way in which they provide learners with sequences of short or very short (mainly 2–8 minute, say) learning and assessment activities, and feedback episodes. A consequence of activities being short is that for each learning hour there will be perhaps 15 or 20 activities of different types. For this reason we decided to develop the curriculum for Citizen Maths, from the start, in a granular way, with a view to it being:

- a cornerstone for the creation of the content;
- a key input into the accreditation mapping work;
- the main vehicle for representing the relationship between Citizen Maths and the PISA Assessment Framework.

2.1.2 Structure of the curriculum

The curriculum is mapped out in a very structured form, showing how mathematical concepts are built up from smaller themes and ultimately from the ‘granules’ of short learning activities. The key levels of this structure are:

- **Powerful Idea** – the mathematical idea that is the focus of the course segment. For example, the Powerful Idea for segment one is proportion.
- **Utility** – a sequence of activities that learners undertake through which they learn about the aspect of the Powerful Idea to which the utility relates. We also refer to utility when addressing students as ‘powerful-idea-in-action’. Between them the utilities provide broad complementary coverage of the idea in active use.
 - The curriculum’s five utilities for proportion are: comparing, sharing, mixing, scaling, trading-off.
 - Each utility is associated with a single learning outcome, which serves also to describe the focus of the utility.

¹Available at https://docs.google.com/document/d/14SxHI--EJ4YBuJexzq_m9c3rQ_xhay14tQdcOy9DKk8/edit (access permission granted on request).

- Activity – an element within the learning sequence or sequences that makes up the utility, categorised by its type. Types of activity currently in use are:
 - video of tutor talking;
 - video of teacher activity using pen and paper or other materials;
 - video of tutor working with Scratch code;
 - video of tutor demonstrating with Scratch app;
 - video of tutor using an application such as a spreadsheet or dynamic geometry software;
 - video of tutor using an applet on the internet;
 - student activity: written challenge;
 - student activity offline using pen and paper or other materials;
 - student activity offline with Scratch code;
 - student activity offline with Scratch app;
 - student activity offline with an application such as a spreadsheet or dynamic geometry software;
 - student activity offline with an applet on the internet;
 - assessment: student compares own outcomes with tutor activity on video;
 - assessment: ready to move on?
 - assessment: multiple choice;
 - assessment: check value;
 - assessment: student compares own outcome with a written response;
 - reflection: student makes notes for themselves about what they've learned from the utility.

The utilities are presented in a broadly arbitrary order, allowing for some obvious interdependencies. For example, we avoided making 'scaling' the first utility since we did not want to begin with activity which was programming-intensive. Nevertheless scaling needed to come fairly early on as some activities require the knowledge of programming developed in that utility. Also, 'trading-off' requires knowledge of proportion developed in the earlier utilities and so was placed last.

In contrast, the activities are in a designed order, taking account of how a learner will develop their understanding of the utility.

We decided not to include assessment criteria for each utility.

2.1.3 Mapping of curriculum against PISA framework

The curriculum design is presented in a large spreadsheet (111 activities in rows, and 28 columns), which is broken down by powerful idea/utility/activity, and:

- provides for each a descriptive and indicative overview of the planned learning activities and assessments;
- maps each utility and each activity against the PISA 2012 Assessment and Analytical Framework for Mathematics.

For the PISA mapping we use:

- PISA content category – these are the four overarching ideas (quantity, space and shape, change and relationships, and uncertainty and data) which, according to the PISA framework, ‘relate to familiar curricular strands such as numbers, algebra and geometry in overlapping and complex ways’. We show the PISA content category or categories in three columns of the spreadsheet, applying them at the level of the utilities rather than the individual activities.
- PISA process category – these describe what individuals do to connect the context of a problem with the mathematics and thus solve a problem. In the spreadsheet these are mapped them at the level of individual activities. They are defined in terms of three categories:
 - formulating situations mathematically;
 - employing mathematical concepts, facts, procedures and reasoning; and interpreting, apply;
 - evaluating mathematical outcomes.
- PISA capability category – each of the three processes draws on the seven ‘fundamental mathematical capabilities’ – also mapped at the level of individual activities:
 - communication;
 - mathematising;
 - representation;
 - reasoning and argument;
 - devising strategies for solving problems;
 - using symbolic, formal and technical language and operations;
 - using mathematical tools.
- PISA context category – we apply the four categories – personal, occupational, societal and scientific – which concern the context to which a mathematical problem primarily relates – also mapped at the level of individual activities.

2.2 Course content

2.2.1 Design process

The course content was developed from the curriculum via a collaborative process involving:

- mathematics educators from the UCL Institute of Education – activity definition, outline scripting, Scratch coding;
- the to-camera tutors (also maths educators in their own right) – developing and adapting the outline scripts for video elements as they ‘performed’ them;
- the e-learning production company – producing the video elements, integrating these with text, applets and other media and mounting them on the platform;
- the project director – overall direction.

2.2.2 Support tools and technologies

Table 1 shows the tools and technologies we chose to support the learning activities.

Medium and tool	Pros	Cons
Video – YouTube	<ul style="list-style-type: none"> • Free to use • Easy to embed • Widely used and familiar to large proportion of target users • Automatic synchronisation of transcribed audio – increases accessibility and navigability of videos 	<ul style="list-style-type: none"> • Feature to vary speed of playback (as per some MOOC platform videos) is not that easy to find • Blocked in some jurisdictions
Spreadsheet – Google Sheets	<ul style="list-style-type: none"> • Free to use • Works in any (recent) browser • Makes no assumptions about what software users have installed, more device-independent than client-software-based options 	<ul style="list-style-type: none"> • Only a small proportion of users will be familiar with it • Not as powerful as client-software-based options
Programming – Scratch	<ul style="list-style-type: none"> • Free to use • Developed for educational use, with a philosophy that is one of the inspirations of the Citizen Maths approach • No obvious competitor 	<ul style="list-style-type: none"> • Programming is a powerful yet abstract domain that can be confusing at first • Few if any of target users will have experience of anything similar • Designed with school-age children in mind, and sometimes this shows • Requires Flash, which rules out tablet and smartphone use
GeoGebra Tube	<ul style="list-style-type: none"> • Dynamic geometric visualisation and construction of mathematical concepts 	<ul style="list-style-type: none"> • Neither content nor links under our control
Other maths apps and simulations	<ul style="list-style-type: none"> • Freely available online • Selected for fit to Citizen Maths approach and powerful idea in question • Often offer visually effective metaphor for conceptual content 	<ul style="list-style-type: none"> • Requires Java which in a significant number of cases rules out tablet and smartphone use, and may be complicated with some PC platforms • Neither content nor links under our control

Table 1: pros and cons of tools used for Citizen Maths course content

We enhanced some of the tools. To the YouTube videos we added professional transcriptions of all videos from the start, to ensure that the subtitles were word-perfect. We later added written transcripts, linked under each video on the course pages, as well as help on viewing (automated) translations of the subtitles, and on speeding up or slowing down the videos.

The tools in the bottom three rows aim to offer an on-screen example of each of the powerful ideas, which learners can manipulate to gain a feel for how the powerful idea behaves. This is important to provide an holistic hands-on grasp of the idea, which helps the learner to see it as a somewhat concrete object prior to working in more detail on computational aspects of the concept. This approach helps to make the concept more visible, countering the trend for mathematics to become ever more hidden in the technological world.

In particular [Scratch](#), a programming environment developed at the MIT Media Lab, makes it possible for a learner to ‘teach’ the computer how to do the mathematics. In return, the mathematics not only becomes more visible, but the learner also sees the pay-off for getting the mathematics (i.e. the program) correct, and is offered immediate system feedback when that is not the case.

However, the ‘cons’ column for Scratch in Table 1 is non-trivial, so we ran a session with six tutors and five students at Calderdale College, each of them involved in Level 1 or 2 learning, to test whether using this tool would be viable as part of a usable, learner-centred experience. Based on feedback from, and observation of, session participants, we arrived at the implications that we should:

- not be frightened to exploit Scratch as appropriate in developing the materials;
- maintain parallel access to video tutorial support alongside hands-on activity;
- maintain parallel access to instructions for a task alongside hands-on activity;
- take seriously the need for Scratch support prior and during maths activity (see section 2.3.2 for details of the support we added).

2.2.3 Design of activity types

Table 2 shows the design considerations for creating course content for each kind of activity. This is supplemented by the more detailed video direction and design document in Appendix D.

Activity	Design considerations
Video of tutor talking	See Appendix D. We aimed for informality – with excellent audio quality – rather than ‘high polish’, because these are more consistent with the feel of a one-to-one tutorial which we were aiming for
Video of teacher activity using pen and paper or other materials	See Appendix D. The ease with which the tutor’s writing can be read is more important than an authentic representation of the act of writing, so ‘tricks’ with editing and camera placement may be used to ensure ease of reading.
<ul style="list-style-type: none"> • Video of tutor working with Scratch code • Video of tutor demonstrating with Scratch app • Video of tutor using an application such as a spreadsheet or dynamic geometry software • Video of tutor using an applet on the internet 	With all screen-based activities, the definition and legibility of what is on-screen, and the clarity of the audio, are paramount, so we used Camtasia software to capture ‘screencasts’ and added tutor voice-over. See also Talking Applications section in Appendix D.
<ul style="list-style-type: none"> • Written challenge • Student activity offline using pen and paper or other materials • Student activity offline with Scratch code • Student activity offline with Scratch ap 	Activities that are offline and/or open-ended cannot be supported at a step-by-step level. It is necessary to set up the activity with clear background and instructions and a clear goal or point of closure, while leaving it to learners’ discretion to decide how, in their disparate contexts, they achieve this.
<ul style="list-style-type: none"> • Student activity offline with an application such as a spreadsheet or dynamic geometry software • Student activity offline with an applet on the internet 	These depend on third-party sites, so it is necessary to provide bespoke instructions on how to navigate these sites and any potential troubleshooting steps (e.g. in relation to plug-ins and different platforms), and to check these sites frequently to see if they have changed. It is also necessary to monitor that third-party sites are up, so we developed, and have open sourced, a tool that does this.
Assessment: student compares own outcomes with tutor activity on video	We designed several sequences as ‘triples’ where, first, a tutor would introduce a concept and set up an activity, then second, the learner does the activity, and third, the tutor talks through the activity and shows their working to a solution. In Google Course Builder we were able to create course pages that comprise all three elements of a ‘triple’.
Assessment: multiple choice	We were able to rank these assessments in order of difficulty (based on the proportion of learners whose first answer was wrong). This offered help in refining the assessments and their placement/sequencing.
Assessment: check value	It is important to check that all possible formats of answers are correctly assessed. For instance, if the answer is 1.7l then 1,700ml should also be recognised as a correct answer. If this is complex or difficult, the question should provide guidance, such as ‘please provide your answer in litres’. Feedback should take account of the recommendations of BS 8426, for example that it should ‘point to revision and/or extension materials, including, if appropriate, previous sections of the course materials, or further learning opportunities [... and] offer learners a means of obtaining further feedback’.
Assessment: student compares own outcome with a written response	The BS 8426 recommendations on feedback are also relevant here.
Reflection: student makes notes for themselves about what they’ve learned from the utility	At this stage Citizen Maths is not looking to integrate with any e-portfolio or learning journal system, so we leave learners to decide how and where they make these notes.

Table 2: Design considerations for Citizen Maths activities

Even with these clear specifications we were not immune to a small number of errors. These we found and corrected later, sometimes as a result of learner-feedback. For this reason it is important to provide learners with easy and clear ways in which to provide feedback that is specifically linked to the part of the course to which it relates. (There is more on this in Section 2.3.3 below.)

2.3 Course support

Our approach to the design of course support is based on the principles of:

1. minimising the need for support through intuitive design of course content and activities;
2. minimising the cost of support by:
 - a. automating it where possible;
 - b. pre-empting the demand for it where possible and meeting that demand as far as possible;
 - c. solving support problems quickly to minimise the number of people who experience each problem.

This section focuses mainly on (2), since (1) is addressed in the previous section.

2.3.1 Automating support

The course provides basic automated feedback on submission of ‘multiple choice’ or ‘check value’ assessments, including hints and pointers if the learner gets the answers wrong.

Adaptivity would enable us to provide more personalised and sophisticated support. In Phase 1 we found it challenging to reconcile, on the one hand, an adaptive approach based on resequencing of instructional elements with, on the other, a pedagogic approach that seeks to avoid presenting maths as ‘disconnected’ elements (see Section 3.3 on learning model, above). In Phase 2 we revisited this challenge from a different angle, but again were unable to overcome it. We concluded that we had to agree with the verdict of Sebastian Thrun – when interviewed by Seb Schmolter as part of work for the Ufi Charitable Trust in 2012 – that artificial intelligence techniques are still some years from being capable of adapting the learning and activity/content presentation processes to meet learners’ needs in the way that a skilled teacher does, whilst continuing to give learners agency over what to do next.

We did, however, find one context in which it was useful and feasible to automate learner support which adapts and responds to learners’ behaviour (though it does so on the basis of simple rules, rather than any machine learning). We wanted to send email messages to learners (where they had given consent for this) to encourage them to overcome the small hurdles that are likely to surface in any open learning experience. Having tried to do this manually on the basis of learner activity reports, we realised this was too complex to be sustainable. Instead, within Google Course Builder, Knowledge Integration developed software to send motivational emails to learners with four broad goals, to encourage:

- the provision of feedback;
- participation in the course;
- those signed up to get started;
- those who’ve stopped doing the course after a period of activity to re-engage with it.

We developed ten standard messages to support these goals, each of which is sent only when a set of learner activity conditions are satisfied. The goals and conditions are included in Appendix F. The code to implement this adaptive encouragement in Course Builder is open source and available at <https://github.com/CitizenMaths/coursebuilder-adaptive-encouragement>.

2.3.2 Anticipating demand for support

British Standard BS 8426 identifies a responsibility for ‘E-learning providers [to] review their planned provision to identify the parts of the learning materials, and of the delivery, dialogue and assessment processes that are likely to need most e-support.’

Pre-course self-assessment

The first area we focused on was how people decide whether Citizen Maths is going to work for them. There is a known issue with MOOCs that the ‘free’ tag encourages people to register without any serious consideration of whether a course is genuinely likely to meet their needs. Instead the behaviour that MOOCs encourage is for people to sign up and postpone judgement until they start the course.

So, we decided to have a pre-course self-assessment before inviting people to register for the course. This can be found at <https://www.citizenmaths.com/checklist/>. Key design considerations include:

- **brevery and simplicity**, with the assessment comprising just nine yes/no answers – we were able to draw attention to this on the Citizen Maths website with a clear call-to-action, and we believe this was a factor in the very high proportion of website visitors who completed the pre-course assessment. As of 12 December 2014, this proportion was 19 per cent (2,367 pre-course assessments completed by 12,561 unique visitors). In the year to 27 February 2017 this proportion rose to 21 per cent (10,785 pre-course assessments completed by 50,953 visitors), despite us having removed the mandatory requirement to complete the pre-course assessment in November 2016. The website design was also successful in funneling users towards the pre-course assessment – see Figure 3 below.
- **clear signposts**, dividing the assessment into three clearly-labeled areas – there is a strong evidence in the behavioural science literature that suggests these signposts will increase the likelihood of people completing a task (source: advice from Cabinet Office Behavioural Insights Unit)
- **anonymity**, in that people did not have to give their name in the assessment – this lowers the stakes in submitting the assessment, because people realise they won’t lose face, whatever their answers
- **potential confidence boosting** – there is evidence that, if you give people a simple task to complete which gives them a sense of self-efficacy they are more likely to complete a more intensive task – in this case completing our reasonably detailed registration form. Thus, making the process a two-step one, rather than just a one-step registration, may counter-intuitively increase the likelihood of registration among those who are able to answer most of the pre-course questions in the affirmative (source: informal advice from a service design company).

²This is also consistent with BS 8426, which recommends, ‘If learners’ ability to complete a course successfully is likely to be dependent on their current knowledge, aptitude, or competence, then learners should be asked to undertake a pre-course assessment to assess these attributes prior to acceptance onto the course. This assessment should identify any particular needs of individuals in order to allow adjustments to delivery of the course to meet those needs where possible.’

Frequently Asked Questions

Our review of likely areas where support would be needed identified some parts of the registration process and course where we anticipated people might benefit from support. We pre-populated our FAQ section with notional questions in each of these areas, to which we provided answers, for example:

- [How do I track my progress on the course?](#)
- [How can I get a Google Account to use the spreadsheets in the course?](#)
- [How do I make course videos display full screen or in HD?](#)
- [How do I make course videos run faster or slower, or see subtitles?](#)

These support resources are also referenced, with links, at appropriate points in the course itself. For example, when the first video is introduced in each unit of the course, the text says, 'If you find that the pace of the course videos is too slow or too fast for you, you may find it helpful to read our help on [how to change the speed at which videos play](#). This will open in a new window or tab.'

Scratch

The use of Scratch in Citizen Maths is central to the design philosophy of showing 'powerful ideas in action' (as explained in Appendix A). It is also one of the most innovative, distinctive and risky elements of the course – at least on the surface, and probably more deeply as well. 'Programming using Scratch' is the aspect of the course that was rated least well by participants in our Phase 1 impact assessment and by completers of our Phase 2 end-of-course questionnaire.

There is evidence from the relative completion rates of each unit that learners' first experience where Scratch moves centre-stage (in particular, Unit 3 – Scaling) is a watershed in the course. Some learners get stuck here and progress no further. Others, once they have passed this test, are able and quite likely to proceed to the completion of the rest of the Powerful Idea, and sometimes the whole course, without further problem.

Since the latter category is a substantial minority, the lesson we take is that Scratch is not a show-stopper. Indeed getting the hang of this aspect of the course may be a key determinant of success in grasping Powerful Ideas.

Because of this, and because Scratch is an important medium for putting Powerful Ideas into action – a cornerstone of Citizen Maths' holistic approach – it was not an option to partition off the Scratch elements or make them optional. In Phase 2 of the project, the challenge we set ourselves was to find ways of supporting learners in overcoming this hurdle, and/or making it feel less hurdle-like. We hoped that some adaptive personalisation, providing successive layers of backup help to those who appeared to need it, could be a part of the solution to this challenge, but this did not prove possible. However, we expanded our Scratch help and made it easier to find.

We had identified Scratch as an area where we should 'take seriously need for ... support prior and during maths activity (further testing might clarify where this support should be focused)', based on user feedback at our session near the start of the project in November 2013.

In the event, we were unable to schedule further testing until Phase 2 (though in Phase 1 we did an internal usability review of our self-produced Scratch apps). However, we developed two screencast guides to introduce course participants to using Scratch and also collected a set of further Scratch support resources in a [Scratch help guide](#) – referenced from the course help, where abbreviated ‘quick start’ help for Scratch is also provided. Finally, for Scratch coding activities in the course, we were able to embed in the lesson pages help on the relevant blocks of Scratch code from the official Scratch help site at MIT.

Across more than two years of running the course, we have had fewer than ten requests for support specific to Scratch issues.

Setting expectations and boundaries

We also provided some proactive resources and policies to make clear to course participants what they should and should not do while participating. These include:

- the [Terms of Use](#) of the course, which also provide information about how to make a complaint, linked from the footer of every page of the course;
- the [Privacy policy](#), also linked from the footer of every page of the course;
- the [Attribution statement](#), linked from the Terms of Use, and from every page of the course.

2.3.3 Meeting support demands quickly

BS 8426 recommends that ‘E-support for communication should minimize the effort for learners by making the path to initiate support as short as possible’, and this makes sense in terms of addressing problems before they escalate and/or learners get too angry. Thus we provide a ‘Tell us your views’ link on every page of the course. Clicking this link brings up a feedback form that automatically captures the URL of the page the learner was on when they clicked the link. We also ask them what they were doing on Citizen Maths immediately before arriving at the form. This information makes it easier for us to diagnose issues and provide support that resolves the issues.

Support requests via this form, as well as via the FAQ page, are immediately notified by email to the project manager and project director. Recognising that not all support requests come through the proper channels, comments on our [contact page](#) and emails to support@citizenmaths.com (an address we did not advertise) were also notified immediately to the same people. We use Zendesk, the popular cloud-based customer support software, to manage these requests. By using Zendesk’s email gateway, together with the ‘Email Notifications for Google Forms’ Chrome extension, we are able to ensure that enquiries from our two Google Forms, our FAQ form, and via our support email address, all converge in the same place in Zendesk where we manage our responses.

Throughout the project nearly every support request received some response in less than one working day, and frequently within only a few hours.

³ This should be qualified by saying that all aspects were rated above 4, on average, on a scale of 1 to 5 – so none were rated badly. Conversely, in the end-of-course questionnaire there may be some confirmation bias: people who struggled with any aspects of the course, including Scratch, will not have reached the end of the course.

2.4 Course platform

2.4.1 Learning platform

We initially intended the learning platform to integrate Google Course Builder with the CogBooks platform, but in Phase 1 we took the decision to use solely Google Course Builder. Fortunately, because of the technical architecture design – such that CogBooks effectively ran on top of Google Course Builder – we were able to remove this layer without fundamentally altering those lower down. This meant that, initially, the only additional design work we had to do was to skin Course Builder according to the brand guidelines document (see Appendix C).

2.4.2 User interface

The Course Builder user interface is simple and foolproof: it presents the course as a hierarchy of lessons within units, and learners navigate through the lessons with simple 'next' and 'previous' buttons. This simplicity is important for an open course, free of charge, because learners need to feel in control and confident about getting around in their first 20 minutes or else they will feel no compunction about leaving and never coming back.

However, Phase 2 of Citizen Maths saw the course expand from five units to eighteen, and we needed a way to represent all units grouped within their Powerful Ideas. We developed a simple dashboard – see Figure 2 – to represent the whole course visually. The boxes each have four states – empty/not begun, quarter full/just begun, half full/half complete, three quarters full/nearly complete, and full/complete – indicating progress. Each Powerful Idea is represented by an icon, which we purchased royalty-free at nominal cost from the [Noun Project](#).

Powerful ideas

Proportion

Using proportional thinking in everyday and work contexts



Uncertainty

Making sense of situations that need judgement under uncertainty



Representation

Interpreting data, graphs and charts



Pattern

Appreciating patterns in nature and in human activity



Measurement

Estimating, converting and using scales



Your feedback on Citizen Maths

Help the team improve Citizen Maths



Figure 2: learner dashboard for Citizen Maths Phase 2 on Course Builder

The software code for this dashboard is open source and available at <https://github.com/CitizenMaths/coursebuilder-course-homepage-dashboard>.

2.4.3 Website

When originally designing the learning platform it became clear that the public website would have to be designed and managed separately. Through the process of developing marketing plan for learner engagement in Phase 1, we identified the need for three semi-independent sites with different purposes and audiences.

Overview	Audience	Purpose
<p>Simple transactional website that provides basic information about the course – citizenmaths.com</p>	<p>Enquirers and browsers who want to find out more about the course, either for themselves or for others they work with</p>	<p>(a) understand the benefits and features of the course (b) go through the registration/pre-course assessment process</p>
<p>Social hub for sharing updates and stories about Citizen Maths – info.citizenmaths.com</p>	<p>Range of audiences interested in keeping up with developments, including intermediaries (e.g. colleges, employers, trade unions), actual and potential learners</p>	<p>Provide a commentary on salient developments and relevant assets (e.g. the thinking behind the course, the team etc.) in a form optimised for sharing across social media platforms</p>
<p>Learner community for asking and answering questions – support.citizenmaths.com</p>	<p>Actual and potential learners (pre- and post-registration)</p>	<p>Provide support from peers and project team members</p>

Table 3: audience and purpose for three web properties in Phase 1 of Citizen Maths

Our experience in Phase 1 was that the learner community did not develop momentum or a community feel, so in Phase 2 we simplified to one site, www.citizenmaths.com, with the learner community being replaced by the FAQ section of the site, and the Social Hub being replaced by, or renamed as, the blog.

Throughout the project, we submitted the text of the main website to a readability test in order to keep its language level to about Level 1, thereby making it as intelligible as possible to our target audience. Indications from Google Analytics data are that this, along with the simple design of the site with a repeated call-to-action, was successful in getting visitors to the desired endpoint, where they would view and submit a pre-course assessment.



Figure 3: user flow (left to right) through pages of Phase 1 citizenmaths.com website

2.4.4 Forums and feedback

Phase 2 of the project was divided into four iterations: Preparatory, Exploratory, Developmental and Evaluative. In the Exploratory iteration, we experimented with adding some learner forums to each lesson of the course. For a variety of reasons we abandoned this experiment in the following iteration:

- after the novelty wore off in the first lesson, contributions to the forums were rare, and were mostly directly to us as course providers (reporting difficulties or errors) rather than to fellow learners;
- the location of the forums between the bottom of the lesson and the new feedback widget introduced to Course Builder meant that – as shown by our user reviews (see Section 5) – many learners did not notice the feedback widget, which would have been a better channel to report difficulties and errors;
- feedback from user reviews also indicated that the forum user interface had too many confusing links and UI 'furniture' – learners observed that the forums looked like they'd been bolted on with no clear purpose in mind, which we felt was a fair point.

In disposing of the forums, we were able to make more of the Google Course Builder feedback widget and the data that it provided. We responded directly to feedback and criticism or questions where appropriate. We could see which parts of the course got lowest ratings and what comments had been made about them. This enabled us to prioritise which parts of the course we reviewed and updated for subsequent iterations.

2.4.5 Monitoring and managing the course

We extracted data from Google Course Builder and used this to update a series of metrics on a daily basis:

- completed pre-course assessments,
- completed registrations,
- numbers in progress and completed on each of the units in the course.

We used averages and derivatives of these to plot trends at different stages of the process. In Phase 2 we were also able to use these metrics to measure the impact of a number of experiments with the website and registration design. For example, we tried making the pre-course self-assessment optional, rather than mandatory, first on the same page as the 'Register' button and then on a separate page to offer a clear uncluttered path for those who place a premium on this, while also clearly recommending the pre-course self-assessment, in line with the principles in Section 2.3.2 above.

It is fair to say that the impact of these changes were modest. We felt there was a trade-off between offering simplicity and brevity on the one hand and ensuring that learners had realistic expectations on the other. So far the extra simplicity does not seem to have produced a significant increase in learners with unsatisfied and unrealistic expectations, so we are maintaining the 'uncluttered path' option, but keeping it under review.

2.4.6 Extensions

Over the months of operation of the course, we identified requirements for a number of enhancements to the Course Builder platform to make it better suit our needs. Knowledge Integration developed code to meet these requirements and we have now published it as open source software on the Citizen Maths repository on GitHub – see <https://github.com/CitizenMaths>.

In addition to the adaptive encouragement (Section 2.3.1 above) and dashboard (2.4.2), these include:

- registration form validation – to check that users provide data in valid formats and answer all mandatory questions;
- registration form non-standard character checking – to overcome a bug where some accented characters in users' names led to their names being misrepresented on the completion certificate;
- integration with other software (GitKit for authentication without Google ID, SendGrid for email to learners);
- monitoring of third-party services that Citizen Maths depends on (e.g. Scratch for program editing, GeoGebra for manipulating geometrical shapes) to enable us to alert users in the event of significant downtime;
- auto-removal of dormant accounts and archiving of anonymised data, in line with our privacy policy;
- reports for partner organisations, to enable them to view data on their learners' progress according to the consent that each learner has provided.

3. User feedback on design

3. User feedback on design

3.1 Quantitative: lesson feedback widget

At the end of every page ('lesson') in the Citizen Maths course, there is a feedback widget, which learners can use to provide numerical and, if they wish, narrative feedback. The widget is shown below.

Rate this lesson:

Not at all useful Not very useful Somewhat useful **Very useful** Extremely useful

Additional comments... Submit

Figure 4: lesson feedback widget

Data from the widget is extensive, and analysis of it informative. Between June and October 2016 over users provided a total of nearly 2,600 ratings of which about 15 per cent contained narrative. Figures 5 and 6 show the average lesson ratings for each Powerful Idea and for each unit within the course.

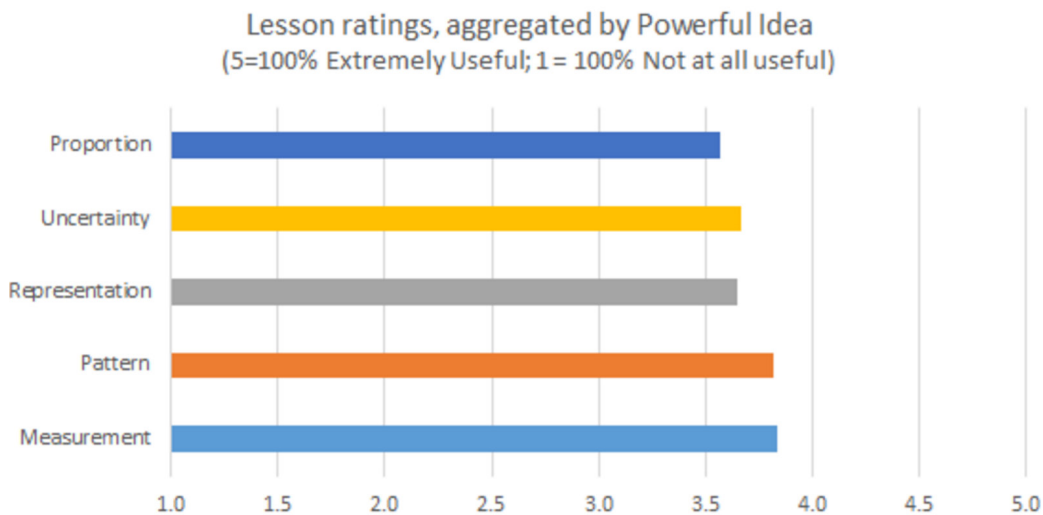


Figure 5: lesson ratings, aggregated by Powerful Idea

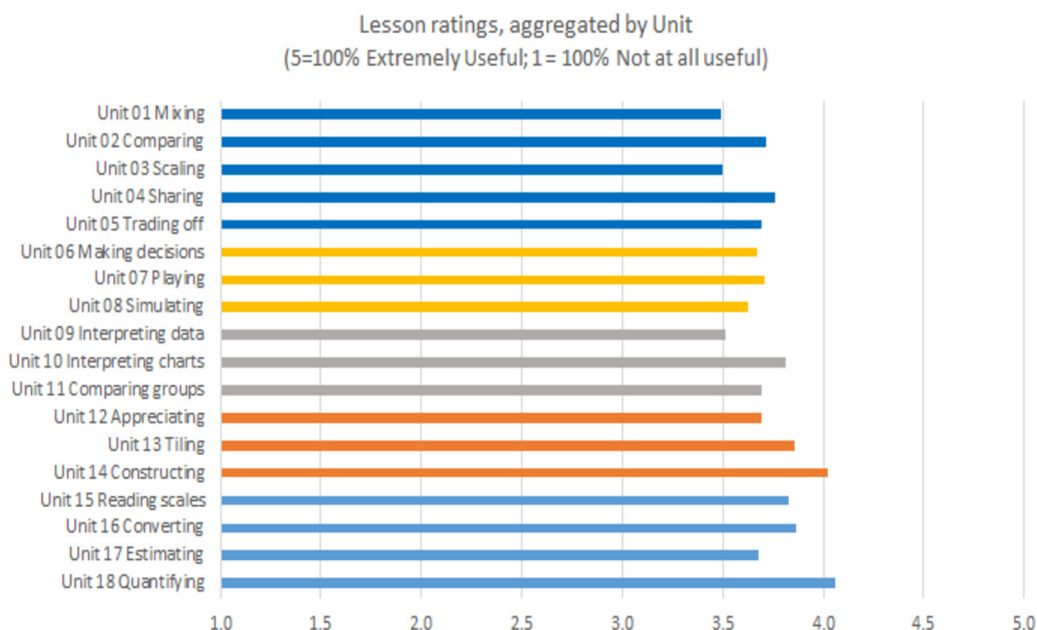


Figure 6: Lesson ratings, aggregated by unit

The lesson ratings make it possible to identify any particularly poorly rated parts of the course, and the narrative can give an indication of what is behind a consistently poor rating.

In addition, learners who complete the course and wish to obtain a certificate of completion are required to complete an end-of-course questionnaire. This provides additional feedback, though clearly with an element of confirmation bias (that is: people who complete are by definition sufficiently satisfied with the course’s design to consider it worth completing).

Figure 7 shows a sample of the feedback obtained from this questionnaire.

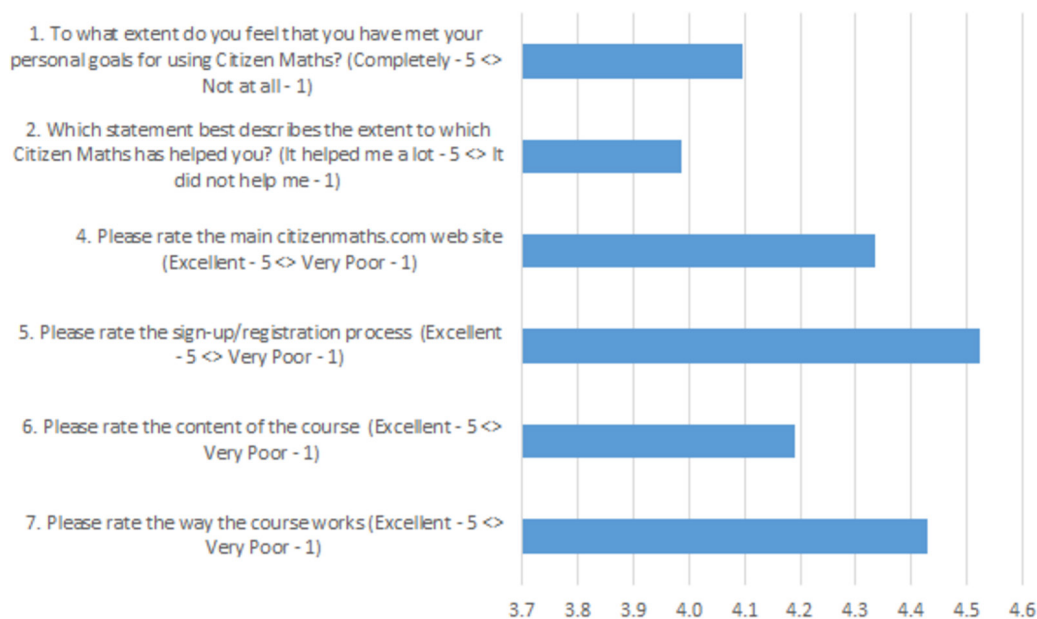


Figure 7: sample of feedback data from end-of-course questionnaire

3.2 Qualitative: video user reviews

Towards the end of 2015 we engaged the specialist user testing company What Users Do to help us get detailed feedback from users about the usability and other aspects of our website, registration process and course.

Initially we wanted them to recruit from our population of registered learners to do the reviews of the course, though we were happy for them to use a sample (selected according to criteria that match the Citizen Maths target audience) from their own population of incentivised users to review the website. However, their process recruitment process hit the same problem that our own efforts had: that Citizen Maths learners are not sufficiently invested in the course to go out of their way to support and provide feedback to it. This is a by-product of offering the course for free. So we had to rely again on What Users Do's pool of users to find a suitable sample of self-motivated adults sufficiently interested and competent to register for and do the course.

3.2.1 Exploratory iteration

In the Exploratory iteration, during January 2016, What Users Do arranged and analysed the interactions of 12 users with the Citizen Maths website and course. In each case the users made their way through the sites – providing a running commentary of their thoughts, expectations and feedback as they went, along with video of what they see on their screens – over a period of 30 to 75 minutes. The actions we took following this feedback included:

- helping learners orientate and set expectations – we created a 'How to get the most out of Citizen Maths' orientation page at the starts of the course;
- taking steps to minimise 'Scratch rage' – we observed that some learners were getting completely stuck due to small inadequacies in the course; for example,
 - the very first Scratch app did not have a foolproof design and we had to redesign it, and
 - we needed to provide help embedded in the course at the right points on basic Scratch tasks such as registering to save your programs or undoing your last action;
- making it easier to spot key links and navigation – for example, where activity instructions were embedded in paragraphs, we pulled them out into bullet points that are easier to spot as instructions and to skim;
- either integrating discussion forums fully into the course, or doing away with them – we chose the latter;
- experimenting with providing additional content on alternative methods of going about the same mathematical solution – useful when learners get stuck – to see if learners would find this useful, but they said they only would if they failed to understand the initial approach;
- paying close attention to the design of the registration process, as it can have a big impact, and you won't always please everyone.

3.2.2 Developmental iteration

In the Developmental iteration, during June/July 2016, a further ten What Users Do users reviewed the course, with five concentrating mainly on activities involving Scratch and five on activities involving Google Sheets (generally the two kinds of activities most likely to trip learners up, according to our data).

The feedback we took from this round of reviews was less radical and tended to provide incremental suggestions to refine the points from the previous round. We identified further sets of instructions which stood to benefit from being rewritten, and we were urged to experiment with making the pre-course assessment optional. We have since acted on both these sets of recommendations, along with some more minor ones.

The most significant change as a result of this final set of user feedback was the creation of a help index page, accessible from the menu bar of every page of the course, linking to further help on Scratch, Google Sheets, using the course videos and starting and navigating the course.

Appendix A:

The thinking behind Citizen Maths

Seb Schmoller and Dave Pratt, August 2014
(with minor updates in 2017 to reflect subsequent changes).

Who the course is for

Citizen Maths is a free open online maths course for:

- self-motivated individuals whose level of mathematical capability is at or above NVQ Level 1, but is not yet at NVQ Level 3, and who want to improve it;
- employers who want to provide staff (or trade unions their members) with a practical and flexible learning and development opportunity in maths;
- colleges and other learning providers who want to give enrolled learners an additional or alternative route to improving their maths.

Learners will need to have use of (and know how to use) a desktop or laptop computer with a broadband internet connection.

Our approach

Programme for International Student Assessment (PISA)

We have structured Citizen Maths according to the OECD's [PISA Assessment and Analytical Framework for Mathematics, Reading, Science, Problem Solving and Financial Literacy](#), which provides an internationally recognised framework for mathematical content.

Free and open

Citizen Maths – the first part of which was launched in September 2014, with the full course completed in June 2016 – is a course made available over the Internet without charge. If, as we hope, thousands of learners use the course, it will also warrant being referred to as a massive open online course, or MOOC. We've modelled Citizen Maths in part on the 2011 artificial intelligence MOOC designed and run by Google's director of research Peter Norvig and Stanford University's Sebastian Thrun. Our aim is to give learners the feeling that they are in a one-to-one tutorial. So Citizen Maths is made of very short instructional videos by our two 'to-camera' tutors, who are very experienced maths teachers. However, Citizen Maths has features not in the AI MOOC. For example:

- we provide purpose-made app-based activities to help learners build up their mathematical understanding, including a small amount of programming, using Scratch;
- working with Google Course Builder, we added adaptive encouragement messages to help learners stay motivated to progress with the course.

Helping to tackle an otherwise insoluble problem

Data from the OECD's [2013 'PIAAC' skills report](#), shows that about 1 in 3 of the UK's adult population – say ten million people – have a current level of mathematical capability that would enable them to benefit from Citizen Maths. This represents a challenge that is very difficult to address through traditional methods of learning and teaching: many are disenfranchised by life circumstances from taking part in face-to-face courses; and the challenge would be also be very costly to solve conventionally. Of course, nothing like all people will have the necessary self-motivation, ICT access and ICT skills to use Citizen Maths. But the absolute number of people in the UK population for whom Citizen Maths should be suitable, is nevertheless large; and, if Citizen Maths is successful with learners, we will have made a contribution to solving the intermediate level maths challenge, at a low enough cost per learner for the course (and similar courses) to be offered more widely.

⁴ Note for international readers: Level 2 is the level that 16-year-old school leavers are expected to achieve. About 60 per cent do so.

Mathematics considerations

The need for a new approach

Typically, our learners will have been through, and been failed by, the conventional education system, coming out of it with qualifications that they now feel do not reflect what they might have achieved, given different opportunities, and what they now need, either for personal satisfaction or for more utilitarian purposes. Like many others, they probably do not see the point of maths, find it hard to engage with the subject, and simply glaze over when presented with numbers. As a result, perhaps they feel a sense of disempowerment, captured memorably by the astronomer, Carl Sagan in his final interview (1996), who argued that, without scientific understanding, 'we don't run the government, the government runs us'. This view could equally be applied to mathematical understanding.

It is a key starting point for the design of Citizen Maths that these individuals will benefit from engaging with a different approach to the teaching and learning of mathematics from the conventional pedagogy that did not work for them in the past. Our design sets out to avoid portraying maths as something abstract. Instead it puts maths in the context of many adults' everyday lives.

Engaging with contextualised problems

Citizen Maths turns learning mathematics on its head. Rather than present mathematics as a sequence of apparently disconnected routines and procedures, it engages people in familiar activity to reveal the 'maths inside', and it gives access to its power. It exploits the fact that there is probably no other area of education that has such an immediate relevance to the problems we all of us have to solve every day. These problems could range from comparing deals and prices on groceries and creating a household budget, to understanding a payslip, creating sales forecasts, keeping track of savings and pensions, controlling a production process, or making political judgements.

By the careful choice of problems set in meaningful contexts, learners who follow the Citizen Maths course will begin to recognise the power of key mathematical ideas. We claim that it is this sense of the power of mathematics that makes the discipline meaningful and it is exactly this feeling that has previously evaded learners, giving them the illusory perception that mathematics is abstract, meaningless and irrelevant to their lives.

Powerful ideas in action

'Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn.'

In Citizen Maths we apply the above axiom, [attributed to Nobel Prize winner Herbert Simon](#). We've designed the course so that learners engage in contextualised problems in such a way that the power of mathematics is revealed. This is what we mean by powerful ideas in action. For example, at Level 2, the concept of proportion underlies fraction, percentage, decimals, ratio and probability, to name but a few maths ideas. Although it is possible for a student to be drilled through Level 2 assessment, no learner really understands mathematics at this level if they have not properly grasped proportion. But how might a course present proportion as a powerful idea in action?

What sort of problems?

Citizen Maths analyses ordinary contexts in which proportion is in fact powerful, such as when mixing, sharing, comparing and scaling. Another more complex situation is when trading off one quantity against another, which leads to the idea of inverse proportion. These five examples of how the powerful idea of proportion is brought into action then become the focus for designing meaningful problems, around, for example, mixing recipes or concrete, creating pie charts, looking for best buys, figuring out how the pinch gesture works on an iPhone, or deciding how many workers to deploy at the supermarket checkouts.

As well as working on problems with paper and pencil, tools such as calculators and spreadsheets are freely adopted. This is because at times it is more important to focus on the conceptual underpinning of the powerful ideas than on the details of calculation.

The course makes extensive use of applets on the web or, when nothing suitable is available, applets that are specially designed for the course. The aim of the applets is to offer an on-screen manifestation of the powerful idea, which the learner can manipulate to gain a feel for how the powerful idea behaves. Such a holistic sense of the mathematical idea helps the learner to see it as a somewhat concrete object prior to working in more detail on computational aspects of the concept.

In a way, the approach helps to make the concept more visible, countering the trend for mathematics to become ever more hidden in the technological world. To this same end, we adopt Scratch, a programming environment, through which the learner 'teaches' the computer how to do the mathematics. In return, the mathematics not only becomes more visible but also the learner sees the pay-off for getting the mathematics (i.e. the program) correct, and is offered immediate system feedback when that is not the case.

To sum up

Citizen Maths is, like many other open online courses that are being offered around the world, an ambitious experiment. Structured according to the OECD's PISA Assessment and Analytical Framework for Mathematics, Reading, Science, Problem Solving and Financial Literacy, Citizen Maths will provide a free and open means for self-motivated individuals to improve their mathematical capability at or around UK Level 2. It will give learners the feeling that they are in a one-to-one tutorial with a skilled teacher. Rather than presenting mathematics as a sequence of apparently disconnected routines and procedures, it will engage learners in familiar activity to reveal the 'maths inside' and give access to powerful maths ideas in action.

Acknowledgements

We are grateful to the following for comments on earlier versions of this document: John Barton (chair of [NANAMIC](#) – National Association for Numeracy and Mathematics in Colleges); [Professor Keith Devlin](#) (Stanford University mathematician, and creator of Coursera's Introduction to Mathematical Thinking MOOC); Mike Ellicock (chief executive of [National Numeracies](#)); Jane Imrie (deputy director of the [National Centre for Excellence in the Teaching of Mathematics](#)).

Further sources

To find out more about Citizen Maths please [go to our main website](#). You can also follow Citizen Maths on Twitter – [@citizenmaths](#).

For discussion and explanation of the pedagogic approach that underpins Citizen Maths see, for example:

[Ainley, J., Pratt, D. and Hansen, A. \(2006\)](#). Connecting engagement and focus in pedagogic task design, *British Educational Research Journal*. 32.1, 23-38.

[Noss, R. \(1997\)](#). *New Cultures, New Numeracies*. Professorial Lecture Series, Institute of Education, University of London.

[Harel, I. and Papert, S. \(1991\)](#). *Constructionism*, Norwood, NJ, Ablex.

[Pratt, D. \(2012\)](#). *Making Mathematics Phenomenal*, Professorial Lecture Series, Institute of Education, University of London. Downloaded from: http://eprints.ioe.ac.uk/14264/1/Making_Mathematics_Phenomenal_Print_ready.pdf on 24.4.2014.

[Sagan, C. \(1996\)](#). <http://goo.gl/CPI0pZ>, Youtube, viewed on 24.4.2014.

[Simon, H.](#) <http://www.cmu.edu/teaching/principles/index.html> last accessed 18.5.2014.

Appendix B:

Context of Use document

1. Purpose of this document

The overall purpose of this document is to outline a vision for how the Citizen Maths (CM) course will work for its different users, in structured narrative form.

This should be useful to a number of people in the extended project team, including (in workstream order) those people

- helping plan and implement marketing and learner engagement activity;
- developing the course platform;
- writing the course materials;
- presenting (to camera) the course materials;
- assessing the impact of the course;
- mapping the course against qualifications.

According to their roles and goals, different people will find different elements of the narrative more or less relevant.

Given the iterative approach to the project, the descriptions in this document are likely to be elaborated and to change in other ways – it is not ‘frozen’. While the description and demographics of the target learners are unlikely to change, certain groups within these demographics may be prioritised in the light of feedback from marketing, learner engagement, prototype and Phase 1 runs of the course.

2. Learners

2.1 User characteristics

Description and demographics

- Those aged over 16 who can read, write, and understand spoken English, and who are reasonably confident users of a Windows, Linux, or iOS computer with a keyboard, or of an Android or iOS tablet device.
- We distinguish two general groups:
 - A.** Those aged over 16 who are using the course alongside being enrolled on some form of formally taught maths course at NVQ Level 2, for example in a Further Education college or with a private training provider. This group – who would be able to access face-to-face tutorial support for their use of the course – is not the main target.
 - B.** Self-motivated adults (not enrolled onto some form of formally taught maths course), whose level of mathematical capability is at or above NVQ Level 1, but is not yet at NVQ Level 3, and who wish to improve their mathematical capability. This group is the primary target.
- Notes:
 - Some of Group B may have reached moderate or high levels professionally, but feel that they lack maths capability.
 - Some of Groups A and B may have physical, sensory or possibly cognitive impairments. Some may be users of screen-reader software as well as niche pointing and text-input devices. Except where indicated to the contrary, CM will conform (at Level A or better) to [WCAG 2.0](#); and the extent to which any parts of CM do not so conform will be kept to a minimum.
 - Both groups include all genders and ethnicities.
 - Both groups include people whose first language is not English.
 - Some learners will not be in employment, but some will be. Others will be in full- or part-time education. We will be neutral in our targeting between these categories, except in so far as we will be targeting learners who are self-motivated and confident with IT.
 - Interest in learning maths is assumed, as is the user having convenient access to an internet-connected device, that is capable of supporting sound, video (Flash and HTML5), cookies and JavaScript.

What motivates this interest may vary in several ways, not least across the two groups A and B above e.g.

- to 'tick the box' and get through later stages of education;
- to try and meet the demands of specific job or opportunity;
- to advance career more generally;
- to satisfy a personal curiosity.

These interests and motivations are elaborated in the goals and personas below.

Underlying it all is that we are doing something for learners who 'want to conquer something they struggled with first time round'.

Skills

These learners are diverse across several dimensions including:

- Internet/web fluency – from basic competence to expert, with the median probably lower than the average in that spectrum.
- Levels of mathematical attainment – a pre-course filter may discourage people without basic numeracy, but the spectrum may again range from people with that basic numeracy to those who feel confident with some areas of maths but not others (and again skewed to the lower end).
- Command of written and spoken English will vary. For some English will be a second language.
- Levels of educational attainment generally will extend from zero to postgraduate. It is difficult to make any assumptions about the distribution across this spectrum.
- Aptitudes and personality related to maths will vary from those with bruised or chronically poor self-confidence and self-belief through to habituated lifelong learners. These characteristics may be only weakly correlated with educational attainment – i.e. we expect to find some learners with raw (and potentially under-developed) mathematical aptitude who have attained little through the conventional system. Indeed this constituency may be a cornerstone of the course's reach.

Experience

Given the broad range of demographics, it is not possible to generalise about any experiences the learners may share.

Equipment, environment and support

Some will have all manner of technology at their disposal, including a desktop PC, tablet and smartphone (over all of which they have as much control as the suppliers allow). Others may only have occasional access to an institutional desktop PC or laptop over which the user has restricted control (including over software installation, network protocols, specific classes of website that can be reached, and access permissions for the hard disk). The course will need to specify minimum requirements for participation, and it may be that people in the latter category have to negotiate access to a computer over which they have greater control.

Access will be via both wired and wireless broadband – we assume that the availability and performance of wireless broadband will increase somewhat during the two years of the project (e.g. via 4G).

Support available through the course

Help & documentation – yet to be scoped.

Online peer support – discussion and Q&A forums.

Tutor support – yet to be scoped but likely to be very limited and certain to be entirely asynchronous.

Support available through other means

For example via

- formal tuition at an institution;
- a maths tutor known to the learner who may have recommended the course as supplementary to his/her tuition;
- other face-to-face sessions or blended learning?;
- helpful colleagues at the workplace;
- other MOOCs and OERs (e.g. Khan Academy).

There may be some participants who are students at college and who thereby have access to support. They are, however, only on the periphery of the target users of this course. They will not have access to any additional support (technical or tutorial) from the project.

2.2 Goals and outcomes

- To increase maths capability to help meet personal goals.
- To increase maths capability to help meet employment- or education-related goals.
- To find out why and how maths is important.
- To explore an unfamiliar way of learning maths.
- To get recognition for mathematical aptitude or competence.

2.3 Personas

Role	Typical quote(s)	Other features
Financial advisor	'I have a whole bundle of measures for the funds about whose performance I advise my clients, but often I can't see the wood for the trees and just rely on what I pick up about other people's opinions.'	These first five or six personas are very loosely based on Richard Noss's work in his lecture and Improving Mathematics at Work book (which I admit I've barely skimmed so far). Because my grasp of this work is (so far) superficial, I am not sure I could draw out the differences between them in terms of implications for interaction with our course. As they stand they mostly fall under the general rubric of 'having difficulty with mathematical representations and mapping them onto real world implications'. I'd love it if someone with a more nuanced appreciation could suggest some differences in expectations and how they might approach the course.
Market stall-holder	'I'm fine with the basic adding and taking away with customers (any errors in change given are always in the right direction), but it's keeping a handle on the stock, which is very seasonal, and working out what I need in the van, what I need in the lock-up – that's where I come unstuck.'	Provide a commentary on salient developments and relevant assets (e.g. the thinking behind the course, the team etc.) in a form optimised for sharing across social media platforms
Packager	'I find I get confused by all the graphs and other visualisations of the packaging process and a couple of times this has led to quality control issues. The systems designers have explained it to me a couple of times, but my eyes glaze over and I've lost my grasp of what they've told me within minutes.'	Provide support from peers and project team members
Plumber	'I got through the Gas Safe Registration process by being very good at the manual side of the work, but the theory was always the weak part for me. I can read a manual in a following-the-recipe kind of way, but I know I need to understand the underlying principles if I'm going to progress.'	
Tailor	'I'm responsible for negotiating my members' pay. I sometimes find it hard fully understanding the cost and output figures that I discuss with my employer and with my members during the negotiations. I'd like to be better at explaining things to my members and at countering my employer's arguments.'	
Union representative	'I'm responsible for negotiating my members' pay. I sometimes find it hard fully understanding the cost and output figures that I discuss with my employer and with my members during the negotiations. I'd like to be better at explaining things to my members and at countering my employer's arguments.'	
Teacher	'It's not that I need to teach maths myself, but increasingly we're having to track targets and other performance measures to spot trends in comparison to previous years, other schools and so on, and if I don't get a handle on all these stats, I bet they'll end up getting used against me. (And if I can point out where what I teach intersects with maths for my students, that's an additional bonus.)'	
Builder	'It's not just about plumb lines and the right mix of cement any more. Plans need changing to adapt to the site, and the plans now are so complex that a localised bodge won't do the trick [sigh] So we have to model the impact on later stages and what revised quantities of materials we'll need.'	

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Carer	'The amount of measuring I have to do now: temperature, blood pressure, number of "bodily functions" per day. I have to report this back to the NHS and they tinker with the treatments. I'd like to understand a bit more about what all these measures feed into, so I can be sure I'm recording them the right way. And then there's the treatments and all their interactions. I feel like I need a flowchart to decide how much to give and when. But my mind has always boggled at the thought of such things before.'	
Gambler	'I like doing complicated each-way bets but I often get confused about the odds and sometimes my winnings are not as big as I expected, while my losings are ... Well, I try not to look too closely but I know the verdict isn't good.'	
Jobseeker	'For "personal reasons" I didn't get many qualifications from my schooling. I talk well, so I can normally convince potential employers of my language skills, but they put any calculations in front of me more complex than adding and subtracting and they see me break out in a sweat. I can't be doing with the textbook-and-tutor approach, so I'm looking for something different.'	
Jobseeker (graduate)	'I got my degree last summer but have been unemployed since then. I would like to go into some kind of office work – I'm not that fussy now as to what kind – but nowadays they all seem to have psychometric tests of reasoning and numerical aptitude, and I haven't had much practice in those areas (not much call for it in an Ancient Norse languages degree), so need to gen up.'	
Gamer	'I live for games. I'm good at them. But I never got any proper qualifications at school. Or since. I want to try my hand at maths, and maybe I will have a stab at going to college in the future.'	
Sixth-former	'I've been told I need to cover maths. The way I've been taught it so far really turns me off, so I'm trying this instead.'	
Crammer	'I've got a personal maths tutor to help get me the grades I need to go to college. She recommended I do this course to supplement my sessions with her.'	
Maker	'I like messing around and programming my own games for Android and Arduino. I know I need more maths to be a better programmer, but I never could stick with maths at school – if there's an approach to maths that fits more with how you apply it, I'd like to check that out.'	
Hobbyist	'I'm keen on learning generally as an amateur hobby – I'm told the professionals call people like me "lifelong learners" – but I've always been disappointed by my lack of understanding of mathematical concepts. Now that I've had to take a severance deal from my job, I have time to devote to this – who knows, I may even be able use it to get a job working with these concepts as part of the "silver workforce".'	

2.4 Use case scenarios

The following matrix maps a set of activities against the personas.

Activity	Financial advisor, packager etc.	Union rep	Teacher	Carer	Gambler	Jobseeker	Jobseeker (graduate)	Gamer	Sixth-former, crammer	Maker, hobbyist
Initial exploration of the site/course										
Evaluate whether to do it	S01									
Register, complete pre-course assessment			S03							
Understand how the course works		S02								
Watch Udacity-style teacher video				S04						
Undertake multiple choice questions					S05					
Do quizzes (single answer, multi-answer, drag and drop)						S06				
Submit an 'answer' (e.g. Scratch object) for peer review							S07			
Undertake peer review								S08		
Interact with CC instructional activity on the web										
Reading instructional material on the web										
Evaluate whether to do it										
Interact with bespoke instructional interactivity										
Pose questions for other learners									S09	
Undertake a learning activity away from course environment (e.g. on a piece of paper)							S07			
Browse and participate in discussion forum									S09	
Monitor/visualise own progress										
Monitor/visualise progress of friends and/or other peers										
Undertake self-assessment										

Once this matrix is completed and validated, we could develop narrative sketches of how users might participate in the portal, one for each shaded cell in the matrix.

S01	Professional deciding whether to do the course
<p>Background, prior education and experience</p>	<p>Sophie is finance manager for an SME manufacturing and selling toiletries and cosmetics to the Body Shop and related retailers. She has a Level 3 accountancy qualification. She did not go to university. She's comfortable and confident with spreadsheets and the everyday arithmetic of finance. However, when the marketing team and brand manager give presentations on the benefits of different campaigns, they often present figures, graphs and statistics in a way that feels to Sophie like voodoo, and her eyes glaze over. She believes in evidence-based decision-making, but suspects that some of these graphs are BS disguised as evidence. She'd love to be in a position to challenge the presentations, but as she has never understood statistics and probability, she is nervous that she might be made to look stupid even by others with only a tiny bit more grasp than she has.</p>
<p>Other relevant characteristics</p>	<p>Sophie has computers at home and in the office, but since she got her iPad she more or less refuses to use anything else (even though it's a pain to type on). Sophie has two boys aged six and eight who, taking after their dad, love mathematical puzzle games and play them all the time on the iPod Touch they share, so she's been exposed to the kinds of simulations that are possible with current technology.</p>
<p>Learner goal(s)</p>	<ul style="list-style-type: none"> • Work out how this course works <ul style="list-style-type: none"> • Can you just do the bits that are relevant to you? (Sophie thinks she's already competent in some areas of maths, and wants to take as little time as possible learning what she needs to – she has no interest in getting any accreditation) • What kind of activities and learning are involved? • Is it relevant to real business or is it just for 'Jobseekers Allowance people'? • Find out what it covers <ul style="list-style-type: none"> • Does it cover statistics and their presentation? (This is Sophie's overriding interest and motivation) • What level is it? Hopefully not too basic, but equally not so advanced that it would just go over Sophie's head) • Assess whether the involvement required by the course is practical <ul style="list-style-type: none"> • Find out how much time is required, over what period • Can it all be done on an iPad? • What support could Sophie get if she gets stuck, either direct from the course or indirectly from other people/sources?
<p>First-person account of steps to achieve goals</p>	<p>I can ...</p> <ol style="list-style-type: none"> 1. Look for some way of sampling the course and try it out 2. Review the coverage of the course 3. Find general information about the course and review it 4. Try to understand what (if anything) is different and special about this course compared with other online maths courses 5. Have a look at the registration process to see what's required 6. Look for some means of assessing her own readiness for the course, and try it out if she can find it
<p>Important features and notes (where not immediately obvious)</p>	<p>N/A</p>

S02	How complicated is the course to run?
<p>Background, prior education and experience</p>	<p>Kerry works in Jobcentre Plus in Dudley. She's a union learning rep for her branch, so, with that experience, combined with her knowledge of jobseeking, she knows quite a bit about the demands for different types of competence, literacy and numeracy – and what options are available to address skill gaps. For herself, she's been looking to develop her maths and computer skills for over four years. She tried evening classes at the local college, but that just reminded her of bad school experiences in maths lessons. She's tried various kinds of online courses, from learndirect to Khan Academy, but they've either been too noddy, too much like formula fetishes, or too bitty. The ones that required lots of symbols just wouldn't work on the family PC, which runs Windows XP.</p>
<p>Other relevant characteristics</p>	<p>Kerry wants something that she can study casually – 20–40 minutes here or there – on the home PC and ideally on her Android tablet (to which she has more guaranteed access).</p>
<p>Learner goal(s)</p>	<ul style="list-style-type: none"> • Find out whether the course is at the right level <ul style="list-style-type: none"> • Understand level of the course in terms the currency of accreditation • Understand level of the course in a more subjective sense, in terms of particular things that feel difficult or easy • See what kinds of activities are involved <ul style="list-style-type: none"> • View the range of activities • Try one or more of the activities • Check what the technical requirements are to participate in the course <ul style="list-style-type: none"> • Will it run on the PC? • Will in run on the tablet? • Does anything special need to be installed, and if so, how straightforward is this?
<p>First-person account of steps to achieve goals</p>	<p>I can ...</p> <ol style="list-style-type: none"> 1. See how simple or complicated the activities are 2. See how simple or complicated it is to get up and running on the course 3. Work out which of my devices it will run on, and 4. What I need to do to make it run 5. See how easy it is to take the course at my own pace
<p>Important features and notes (where not immediately obvious)</p>	<p>N/A</p>

S03	Teacher registering interest in doing the course
<p>Background, prior education and experience</p>	<p>Fergus is a geography teacher in a secondary school. He qualified three years ago. Having been using short elements of online learning materials in his teaching, he's recently been taking first steps towards 'flipping' his classroom occasionally – getting his students to study online materials for their homework and then supervising their activities and questions in class. He's collecting some data about his students completion of materials, activities and so on, and – from watching TED videos about Khan Academy – he feels it ought to be possible to do something clever with that data. He doesn't know how and his first dipping of toes into a data analytics MOOC convinced him he ought to brush up on some more basic maths first.</p>
<p>Other relevant characteristics</p>	<p>He's 20-something and pretty web-savvy, happy to move between devices and use whichever one is best for the job. Since he knows he has to complete a form, he chooses one with a keyboard.</p>
<p>Learner goal(s)</p>	<ul style="list-style-type: none"> • Confirm that the course is for him and he is for the course • Self-assess against any pre-requisites • (Subject to these steps) get a confirmed booking on the course
<p>First-person account of steps to achieve goals</p>	<p>I can ...</p> <ol style="list-style-type: none"> 1. Understand the process (why is it necessary? what's in it for me?) 2. Complete my basic details (name, email – or can I register using my Facebook, Google, Twitter id?) 3. Outline my experience of maths and self-assessment of my confidence 4. Understand what commitments the course requires of me and confirm whether I can make them 5. Find out what happens next and when I can start
<p>Important features and notes (where not immediately obvious)</p>	<p>N/A</p>

S04	Work through instructional video
<p>Background, prior education and experience</p>	<p>Juliet is 70-something and long retired but spends much of her day looking after her older husband who suffers from complications and side effects of prostate cancer, as well as dementia and other symptoms of advanced old age. Her respite is a weekly visit to the bridge club. She thinks brushing up on her maths might help – and generally she learnt from her mother’s old age that keeping pushing your mind can help stave off dementia – so she’s signed up for one of these free courses that her son has told her about.</p>
<p>Other relevant characteristics</p>	<p>She has a four-year-old PC that she uses for online shopping, emailing children and grandchildren, and laying out the parish magazine. She knows one person in the village who is one step ahead of her in terms of using computers, but doesn’t have a strong network of computer support. In the early 1950s she got a School Certificate in mathematics and enjoyed the subject. She didn’t go to university.</p>
<p>Learner goal(s)</p>	<ul style="list-style-type: none"> • Learn something about mathematics and how it might be used • ‘Take her mind to the gym’
<p>First-person account of steps to achieve goals</p>	<p>I can ...</p> <ol style="list-style-type: none"> 1. Work out how to get under way with the course, picking up where I left off before 2. Start the video and watch it, making occasional notes by hand on a pad as I go 3. See where the video stops and I am asked a question – to which I respond by clicking one of the options and getting some automated feedback 4. Get to the end of the video and find out how to practise what I’ve learned
<p>Important features and notes (where not immediately obvious)</p>	<p>N/A</p>

S05	Do you feel lucky?
<p>Background, prior education and experience</p>	<p>Shane lives by his wits. He's worked as a professional sportsman, sports journalist and done a spell as a professional poker player. At the moment he's having a 'career development break'. He likes to gamble – on horses, cricket, and some things he knows less about. When he wins (undeservingly often) he often has little idea how much his winnings will be. He's noticed some friends are more confident about this, and they can also work out how to place multiple bets in such a way that, if and when they lose, they don't lose too much. Shane would like to be able to do that, especially on the days when early winnings seem to evaporate in successive wagers. He has signed up to Citizen Maths mainly with a view to making himself look employable to a broader range of mainstream employers – but also to see if he can get his head round those calculations of betting odds that his mates try in vain to explain to him.</p>
<p>Other relevant characteristics</p>	<p>Shane stores his life in the cloud. He has a handful of different online identities that he shuffles between, accessing them via whichever borrowed device is nearest to hand.</p>
<p>Learner goal(s)</p>	<ul style="list-style-type: none"> • Take a step in the direction of getting some recognition for skills that the 'straight' world will acknowledge • Understand probability, what it means and how to calculate it
<p>First-person account of steps to achieve goals</p>	<p>I can ...</p> <ol style="list-style-type: none"> 1. Identify the part of the course that I'm most practically interested in and jump straight to it (I might as well start there and work outwards – if this part doesn't work for me, the rest of the course is unlikely to) 2. Work through some of the learning materials 3. Skip some of them and go straight to the test just to see if I can do it 4. Read the multiple-choice question and see if I can work out what it's getting at 5. Work out what cues there are to help guess the right answer (four of the answers have x2in, so the one that doesn't probably isn't correct) 6. Take a stab at the answer, submit and get feedback 7. Locate the passage in the materials (inevitably one of the bits I skipped) that explains the concept that would have enabled me to get the right answer
<p>Important features and notes (where not immediately obvious)</p>	<p>N/A</p>

S06	Complete quizzes
<p>Background, prior education and experience</p>	<p>Andy is 19. He was offered a good education but largely declined. In a portfolio of consistent underachievement, his maths stood out as a remarkable failure, though with help from a personal tutor, he got the required GCSE grade to qualify for the sixth form. Leaving school with two Ds and an E at A Level, Andy worked for six months as a hospital porter and then had a year off to travel round southeast Asia. His well-to-do parents have now called a halt to underwriting his lifestyle and adult reality is beginning to bite.</p>
<p>Other relevant characteristics</p>	<p>The computer Andy uses most for his work and studies is his personal Chromebook</p>
<p>Learner goal(s)</p>	<ul style="list-style-type: none"> • Make a fresh start with maths, with a fresh approach • Be seen to be making credible attempts to get employer-friendly skills/competences
<p>First-person account of steps to achieve goals</p>	<p>I can ...</p> <ol style="list-style-type: none"> 1. Find the activities and quizzes that are most useful for the next step in my learning 2. Get an overview of these activities and consider which to do first 3. Do some of the activities which involve real world examples and transformations, for example <ol style="list-style-type: none"> a. Making kennels for small dogs and for large dogs (scaling) b. Photocopying to produce larger size prints (scaling) c. Creating dishes from recipes (sharing – or possibly scaling) d. Sharing the pot between winner, runner-up, losing semi-finalists etc. (sharing) e. Creating shades of colours by mixing RGB (mixing) f. Creating new drinks from mixtures of fruit (mixing) 4. Carry out these activities by interacting in a variety of ways, such as <ol style="list-style-type: none"> a. Dragging the sides of a shape to alter its size and symmetry, and working out how this translates into numbers b. Entering some numbers to achieve some desired transition in a shape, graph or other visualisation c. Describing the expected impact of changing some numbers in a shape, graph or other visualisation 5. Get feedback on my answers <ol style="list-style-type: none"> a. What's right and wrong b. What this says about the progress I'm making c. What this says about what areas I should work on, or review, next 6. Start exploring one of these areas
<p>Important features and notes (where not immediately obvious)</p>	<p>N/A</p>

S07	Complete a program of instructions and get it reviewed
<p>Background, prior education and experience</p>	<p>Scott recently completed a BA in Viking Studies at UCL. He had been planning to move into a job helping the girlfriend he met on a Norwegian archaeology dig during his year abroad, but those plans evaporated with the relationship. Since his teenage years he's defined himself as a 'poet' rather than a 'quant' – his relationship with numbers being mostly mediated through ancient numerology, runes and tarot, plus the tips and earnings he makes as an al fresco entertainer and pop-up stall owner at summer music festivals. Realising that his work on a 'deep ecology' poetry journal is never going to pay the rent, but intrigued by what he has learned of HTML and JavaScript through working on the journal's website, Scott is exploring whether there might be a career path for him working as a freelance coder, ideally on a range of 'artisanal' websites. Citizen Maths seemed promising to him because it offers a slightly different take on the subject, one that he relates to hands-on making.</p>
<p>Other relevant characteristics</p>	<p>N/A</p>
<p>Learner goal(s)</p>	<ul style="list-style-type: none"> • Integrate some of the ideas learned on the course so far to define how to do/make something • Understand how and why this kind of approach could be applied in the real world • Get feedback on my approach <ul style="list-style-type: none"> • Whether it will work • Whether it could be done more elegantly/efficiently
<p>First-person account of steps to achieve goals</p>	<p>I can ...</p> <ol style="list-style-type: none"> 1. Read a specification for what I am supposed to do or make 2. Refer back to the learning materials that might be useful to enable me to do this 3. Work out the steps necessary to meet the spec – probably on a scrap of paper 4. Organise these into the right order – again on paper 5. Review the strange, unforgiving precision that is required in the formal language of writing instructions for a machine to understand and follow 6. Write out a program 7. Test it, and tweak it to make it work better until I am happy with it 8. Submit it for review, ideally by people on the course with whom I have already been in touch and developed some trust 9. Wait and then get feedback – try to understand it and how I might apply it
<p>Important features and notes (where not immediately obvious)</p>	<p>N/A</p>

S08	Test, review and give feedback on someone else's exercise
<p>Background, prior education and experience</p>	<p>Jen is 28. She left school with next to no qualifications and, as a way of dodging the tricky issue of employment, had a child with her childhood sweetheart at 17, married the next year, and had two more children over the next four years. Now the youngest is at school, her husband's regiment has been disbanded, and they're exploring the idea of taking over and growing her father-in-law's import/export business. Besides her husband, the one constant in Jen's life since she was 13 has been her love of gaming, working up from early Nintendos through shoot-'em-ups and role playing games to the Kinect 2 console that she now plays games on with her kids. Jen's thumb-eye coordination and reflexes are second to none. Though she's well off in game currency, the current changes in family circumstances are focusing her on the long haul of generating real income for the next 35 years, and she's willing to go to college or even university if that's what it takes.</p>
<p>Other relevant characteristics</p>	<p>Jen is studying alongside Scott (S07) and has taken a bit of a shine to him as though she were his older sister, or even his aunt. She can't believe that he's gone through most of his life with what seems to her like an overbearing Tolkien obsession, yet he's never played a MMORPG and had never heard of Dungeons and Dragons. Kids these days.</p>
<p>Learner goal(s)</p>	<ul style="list-style-type: none"> • Find out what is required in peer review activities • Give feedback on other learners' work
<p>First-person account of steps to achieve goals</p>	<p>I can ...</p> <ol style="list-style-type: none"> 1. Understand the nature of the activity and what counts as doing it well 2. Do the activity myself (equivalent to the description in S07) 3. Find whether Scott has submitted his attempt at the activity, and get his work 4. Review it by eye 5. Try and 'run' it (assuming here that the activity is to produce an executable program) 6. Find and understand the assessment guidelines 7. Apply the assessment guidelines to the code and its execution 8. Write some notes 9. Soften them, as Scott is a sensitive soul, and send them to him
<p>Important features and notes (where not immediately obvious)</p>	<p>N/A</p>

S09	Asking questions
<p>Background, prior education and experience</p>	<p>Theo is 17. Labelled as having behavioural problems when he was 11, his education since then has been a patchwork of home education, a couple of years at the self-managed learning college and some private tuition. During his time at the college he identified a goal of working in ship navigation (he's a keen sailor), after which it was pointed out that he'd need to develop his maths skills and qualifications. The college staff and a private tutor have been coaching and supporting him on that, but also encouraging him to develop independent study skills, so it's been suggested that he try Citizen Maths in his own time.</p>
<p>Other relevant characteristics</p>	<p>Theo's not shy or afraid of anyone. When he's motivated – through curiosity, anger or other factors – questions fire out of him like impulsive tics.</p>
<p>Learner goal(s)</p>	<ul style="list-style-type: none"> • Find out more about fellow learners <ul style="list-style-type: none"> • Why are they doing this course? • How does it fit into their lives? • Do they think it's any good? • Get tips to help answer questions on the course
<p>First-person account of steps to achieve goals</p>	<p>I can ...</p> <ol style="list-style-type: none"> 1. Find out who else is on the course and a bit about them, like what jobs if any they have 2. Find the place(s) where course participants are having different kinds of discussions, distinguishing between <ol style="list-style-type: none"> a. General personal stuff b. Course-related stuff 3. Ask some nosy and direct personal questions of fellow participants 4. Ask them general stuff about their experience of the course 5. Ask them specific questions about which bits they've managed to complete and how they did it
<p>Important features and notes (where not immediately obvious)</p>	<p>N/A</p>

3. Management, administration and support roles

3.1 Preliminary observations

In this section we treat four roles together:

1. members of the extended project team ('internals'), including:
 - a. learning support team, including to-camera teachers;
 - b. learning platform administrators;
 - c. learning support volunteers (past learners);
2. managers and teachers of groups of learners affiliated to the project ('externals' e.g. training managers for an employer organisation, FE lecturers in a college).

We treat them together because they share an overall goal – aiming to optimise and enhance the learners' experience of the course – but we also identify differences between them.

In general, these users are not so 'usability-sensitive' as learners. They have chosen roles that, to varying degrees, require engagement with Citizen Maths, so their use is not so discretionary and optional, and they are less likely to be thrown by usability hurdles. But, and this is a very important but, the long-term sustainability of CM may turn out to be very dependent on the extent to which non-learner users can use the platform productively.

For example:

- an employer or a college might pay better money for CM if its staff can access data about learner progress and interact with learners who are using CM;
- if the CM platform could support other vocational MOOCs then ease of content authoring/deployment (not covered in this document) will be a factor in determining its uptake.

Users in these roles

- will be much more narrowly drawn than learners;
- can be reasonably expected to make at least some effort to learn how to use the platform from documentation and/or through training;
- can be provided with human support to a much greater extent than can learners;
- can have their access to the platform made conditional on having demonstrated competence;
- will have considerably greater tolerance of faults and problems than learners and, through frequent use, will be better able to overcome these problems.

Users in roles 1a and 1b

- will be working for project partners or subcontractors;
- their terms of working (hours, limitations of responsibility, interactions with other project support staff) will be defined, for example in a handbook or agreement.

Role 1c reflects that it is conceivable that a category of learner support role will eventually comprise people who've been very successful past users of CM as learners, especially people who've proved themselves to be adept at helping other CM learners.

3.2 User characteristics

	Support team	Platform administrators	Support volunteers	Externals
Scale of use – Phase 1	<10	1–2v	0	<5 (may be 0)
Scale of use – Phase 2	<25	<5	<10	<15
Description and demographics	will want to ‘give CM the benefit of the doubt’; will be responsible about asking for help and flagging problems for resolution; will be motivated to be fluent users of the platform	as for support team.	<ul style="list-style-type: none"> will be enthusiastic advocates of the CM approach; will know what being a CM learner feels like; will not have much invested in CM and may tend to be fairweather friends; will probably not reliably take instructions from the project, even if they’ve gone through a selection process. 	<ul style="list-style-type: none"> will tend to think of themselves as ‘customers’ with demanding expectations of the platform and a low tolerance for complexity, work-arounds, stuff not happening as they might expect; may be lacking in web- and systems-fluency; may be unconvinced by aspects of the design and focus of CM, for example, they may think CM ought to involve drill and practice.
Interests	Learner has given consent to be sent motivational emails	In the previous 7 days no more than 1 encouragement email has been sent.	As soon as 1 narrative feedbacks ≥ 10 characters have been submitted	<ul style="list-style-type: none"> the success of their learners or staff; the impact of CM on their learners or staff; will CM make my working life easier or will it be a time and energy trap?
Skills and experience	<ul style="list-style-type: none"> variably skilled with web-based systems, and in providing support to online learners; variably knowledgeable about learning mathematics. 	<ul style="list-style-type: none"> highly skilled with web-based systems; limited/variable experience of contact with end users; variably knowledgeable about learning mathematics. 	<ul style="list-style-type: none"> variably skilled with web-based systems, and in providing support to online learners; likely to be fluent users of whatever forum system CM uses. 	very variably skilled with web-based systems, and in providing support to online learners.
Equipment, environment and support	<ul style="list-style-type: none"> desktop and laptop PCs connected to the internet; restricted range of corporately approved software (e.g. IE not Chrome) or restrictively set firewall (e.g. no access to XYZ web site; port ABC blocked); likely not to be an insurmountable problem; potentially somewhat limited access to technical support; likely to want to ‘do basic things’ using a small form-factor device with a touch screen. 	<ul style="list-style-type: none"> desktop and laptop PCs, tablet and smartphone. Desktop PCs may be the exception rather than the norm – other devices will dominate? will regular or frequent users need to use the Android/iOS Moodle apps? mostly using wireless broadband – assume facilities for primary target group are good at most elite athletic venues, but may be more patchy elsewhere. 	<ul style="list-style-type: none"> desktop and laptop PCs connected to the internet; to have succeeded with CM as a learner means that technical problems likely to be minor; likely to want to ‘do basic things’ using a small form-factor device with a touch screen. 	<ul style="list-style-type: none"> desktop and laptop PCs connected to the internet, possibly with restricted range of corporately approved software (e.g. IE not Chrome) and a restrictively set firewall (e.g. no access to XYZ web site; port ABC blocked); potentially severely limited access to technical support; likely to want to ‘do basic things’ using a small form-factor device with a touch screen.
What support is available?	<ul style="list-style-type: none"> help and ‘how to’ documentation; online support – synchronous and/or asynch? face-to-face sessions? 	<ul style="list-style-type: none"> help and ‘how to’ documentation; online support – synchronous and/or asynch? face-to-face sessions? 	help and ‘how to’ documentation.	help and ‘how to’ documentation.

Number <10 (probably < 5) during Phase 1. <50 (probably <10) during Phase 2.

We should assume that during Phase 2 some of these users are very successful past learners rather than those with a professional learner management or learner support role (see role 1c above).

3.3 Goals and outcomes

- Identifying where best to target a finite amount of support to help Citizen Maths learners achieve their learning goals.
- Providing that support in the most cost-effective way.
- Keeping the Citizen Maths show on the road and running smoothly.
- Identifying and managing risks that threaten this smooth running.
- Collecting evidence about support needs to help improve the design and delivery of the course so that
 - the need for support is minimised (e.g. learners get stuck less often);
 - support for common problems is readily available to learners when needed;
 - the process for us (managers, supporters and administrators of learning) intervening is more efficient and satisfactory both for us and for the learners;
 - other solutions to make the course run more effectively, efficiently, satisfyingly (in terms of reliability, privacy and the full range of factors that concern users) can be implemented.

3.4 Personas

Personas for these users are more limited and predictable than for learners. This is because they are more driven by the specific job roles that might engage with Citizen Maths, whereas learners are driven by a much more diverse set of personal and career motivations. At the time of writing we believe it is sufficient to base our description of the Context of Use on the four main roles identified in 3.1 above.

	Support team	Platform administrators	Support volunteers	Externals
Typical quotes	<p>Learning support lead person: 'I need high-level representations of data about all the learners signed up for CM and their progress. Ideally I would like to be able to drill into the data to get reports by learner characteristic. I will need easily to be able to send targeted emails to subsets of learners according to particular criteria.'</p> <p>'I need to be able to spot and quickly deal with offensive behaviour in the forums, if necessary by disabling a user or users' account(s).'</p> <p>To-camera teacher: 'I need to be able to look at what is going on in the discussion forums (assuming there are any), home in on hot topics, and post in a way that makes it clear I'm "one of the teachers".'</p>	<p>'I want to have time to analyse how the platform is working and what tweaks might improve it – I don't want to be firefighting reliability issues or answering repetitive questions about technical glitches from learners.'</p> <p>'I need to be able to manage the process of substituting one activity and the content associated with it for another, without this breaking learners' links to their progress in the course.'</p> <p>'I need to be able to undertake version management in a professional way.'</p>	<p>'I found the course much more enjoyable than I was expecting, but the real kick for me was how rewarding I found it to help out other users when they were struggling with a problem that I'd just overcome. In fact I found it so rewarding, I've offered up my time to do more of it for the next run of the course. I'm looking forward to seeing what the learning process looks like from the outside.'</p>	<p>Teacher in an FE college: 'I want to find out easily which parts of CM I might want to suggest my learners use.'</p> <p>Training manager in a large enterprise: 'I would like data about the use my staff have made of CM. Specifically, who has used it, for how long, with what effect?'</p>

¹Note issue pertaining to the legal responsibilities of entities hosting services like CM.

3.5 Use case scenarios

The following matrix aims to map a set of features and activities, which may be part of the offer, against the user profiles.

	Support team	Platform administrators	Support volunteers	Externals
T01 – Monitor response to specific learning activities	Frequently	Occasionally	Occasionally	Rarely / Never
T02 – Monitor progress of specific (groups of) learners	Occasionally	Never	Occasionally	Frequently
T03 – Arbitrate in peer review process	Occasionally	Never	Occasionally	Rarely
T04 – Identify which learners are in need of help, and what kind of help	Frequently	Never	Frequently	Frequently
T05 – Collate and visualise bespoke data sets to understand trends in usage	Occasionally	Frequently	Never	Never
T06 – Identify and diagnose glitches in the running of the course on the platform	Never	Occasionally	Never	Never
T07 – Contribute public feedback about an activity or to a specific individual	Occasionally	Never	Occasionally	Never
T08 – Contribute private feedback to a specific individual	Rarely	Rarely	Rarely	Rarely
T09 – Spot design problems with particular activities, sections of instructional content, or items of feedback	Occasionally	Rarely	Rarely	Occasionally
T10 – Make changes to course content	Occasionally	Occasionally	Never	Never
T11 – Manage course versions	Rarely	Occasionally	Never	Never
T12 – Test and retest course content	Occasionally	Occasionally	Occasionally	Never
Manage and archive learner data	Rarely	Occasionally	Never	Rarely

Given that these users are – as stated in 3.1 above – less sensitive to usability issues, the costs of creating detailed narrative scenarios for each of the use cases in the table above would probably outweigh the benefits. We believe the one-line use cases should be sufficient, but future versions of this document will revisit this if necessary.

4. Other stakeholders

1. **Learning providers** who might want to build use of the course into their provision.
2. **Employers** who might want to encourage staff to use the course.
3. **Agencies, intermediaries, sector bodies, interest groups** who might want to encourage 4. people and organisations in their sphere of influence to use the course.
4. **Parents and carers** who want to help someone get to grips with maths.

Appendix C:

Brand guidelines document

The logo

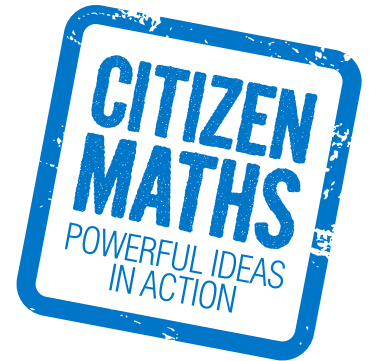
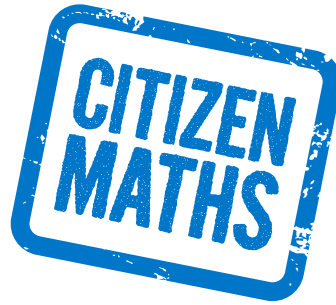
The basics

The mark is the core element of the identity and provides an instant point of recognition for the brand. It needs to be presented in a clear and consistent way.

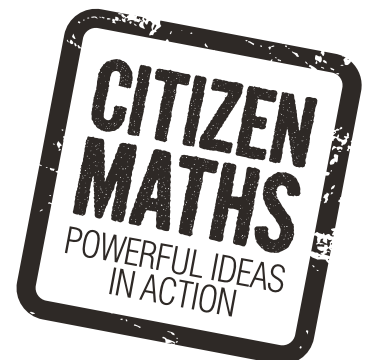
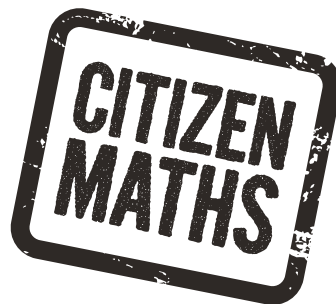
It is available in a full colour version and a mono version.

NEVER ALTER OR REDRAW THE LOGO IN ANY WAY.

Full colour versions



Mono versions

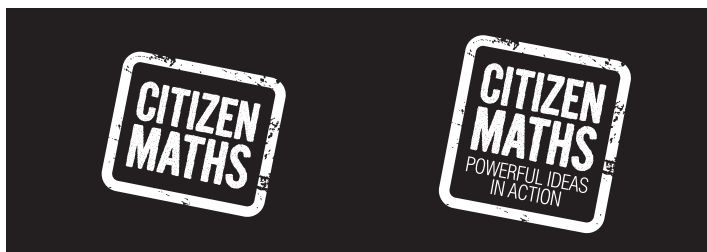


The logo

Reversed out versions

Ideally the logo will appear on a white background in full colour. However, on some occasions it will be necessary for the logo to sit on colour. In this case a white or black version of the logo is available. Please choose the logo that will stand out the most, i.e. white out of a dark colour and black on a light colour (as shown).

1. White out of black



2. White on colour tint



The logo

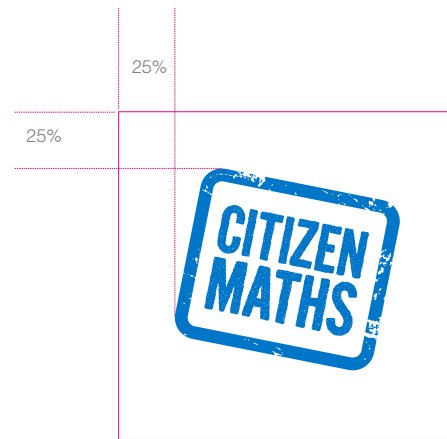
1. Exclusion zone

The logo should always have a minimum area of free space around it. This exclusion zone is equal to 25% of the logo length. The exclusion zone applies to both versions of the logo.

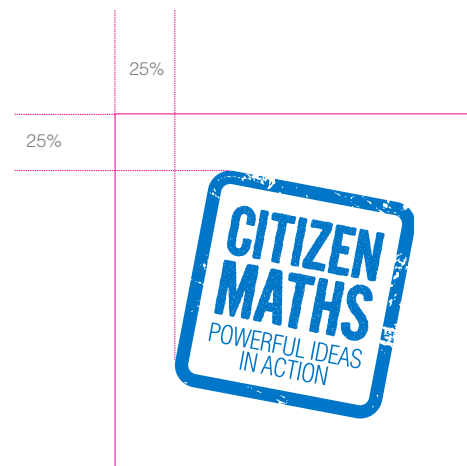
2. Minimum sizes

The logo should never be used smaller than the minimum size specified here. The logo is always measured by the width as shown.

1. Exclusion zone

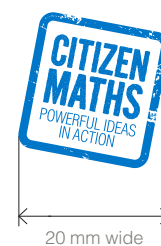


25% of the logo length



25% of the logo length

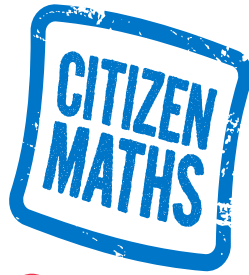
2. Minimum sizes



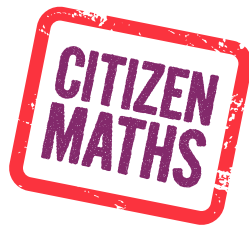
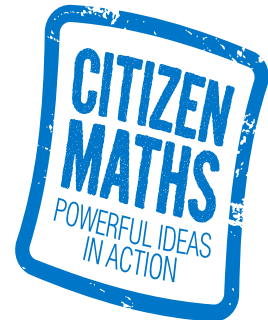
The logo

Dos and Don'ts

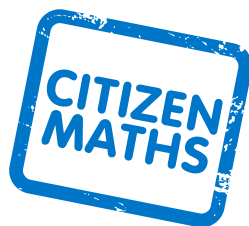
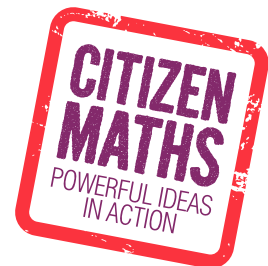
The logo should always be applied consistently and accurately. It must not be altered in any way.



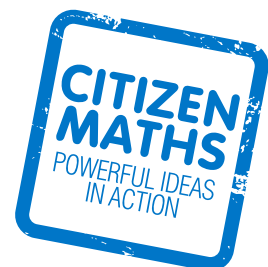
✘ Don't distort the logo



✘ Don't use any colours other than those from the specified colour palette



✘ Always use the original artwork, never redraw the mark or parts of it or replace the typeface



Colour palette

This colour palette details the Pantone numbers and colour breakdown for all elements of the identity.

Main colours:



Pantone 3005c
C:35 M:0 Y:39 K:0
R:0 G:122 B:201
HTML: 007AC9



Pantone 431c
C:15 M:0 Y:0 K:75
R:94 G:106 B:113
HTML: 5E6A71

Secondary colours:



C:0 M:72 Y:100 K:0
R:255 G:99 B:25
HTML: FF6319



C:64 M:24 Y:4 K:0
R:66 G:162 B:206
HTML: 42A2CE



C:85 M:72 Y:0 K:50
R:38 G:63 B:106
HTML: 263F6a



C:0 M:100 Y:66 K:35
R:158 G:48 B:57
HTML: 9E3039

Fonts

Helvetica is the Citizen Maths corporate typeface and thus should be used whenever Citizen Maths is the primary brand.

Helvetica is used in all printed communications material for headlines and secondary headers. It can be applied in several weights. However, no more than 3 different weights should be used together in each single application.

Where Helvetica is not available, Arial should be used as the substitute font.

Main font:

Helvetica

Helvetica Bold

abcdefghijklmnopqrstuvwxy 0123456789
ABCDEFGHIJKLMNOPQRSTUVWXYZ
0123456789

Helvetica Roman

abcdefghijklmnopqrstuvwxy 0123456789
ABCDEFGHIJKLMNOPQRSTUVWXYZ
0123456789

Substitue font:

Arial

Arial Bold

abcdefghijklmnopqrstuvwxy 0123456789
ABCDEFGHIJKLMNOPQRSTUVWXYZ
0123456789

Arial Regular

abcdefghijklmnopqrstuvwxy 0123456789
ABCDEFGHIJKLMNOPQRSTUVWXYZ
0123456789

Appendix D:

Video production guidance

Matt Bush, David Squire and Nick West, Desq Ltd

1. Talking heads



Tutor talking to camera. Mostly used to introduce screen recordings, but could be used to top and tail any other style of clip.

1. In our first shoot the shot was too wide and we need to focus in, to make it feel more personal and conversation-like.

For example:



This is the desired head and shoulder 'talking heads' shot.

- The tutor will be sitting on a straight chair. On some occasions a wider shot has been used to allow a tablet computer to be shown, or a table with props on it.
- The tutor will be shot against a neutral, pale background (plain wall).
- For each utility the tutor needs to wear the same top and have similar hair styling for consistency. Clothing should be casual and relaxed, plain with no obvious logos. (The shirt in the example shot works well).
- The lapel mic needs to be out of shot as far as possible.
- The tutor needs to look directly into the camera, to make it feel as though they are talking to you.

Lessons from filming (November 2014)

- For long introductory pieces to camera it's helpful to have some notes written in large text on A4 paper which can be held up by the camera. The notes should be short though, because if the speaker seems to be reading aloud it is noticeable. Alternatively an autoprompt app on a tablet (out of shot) could be used.
- If props are being used in shot (such as a recipe book) these need to be quite small. Before a video is shot the tutor and cameraperson should plan and agree where the prop will be positioned in shot.

For reference, the Udacity 'talking heads' clips that we are emulating look like this:



<http://www.youtube.com/watch?v=dtiKDBO4nMc>



<http://www.youtube.com/watch?v=CRYn30--PPk>

2. Talking hands

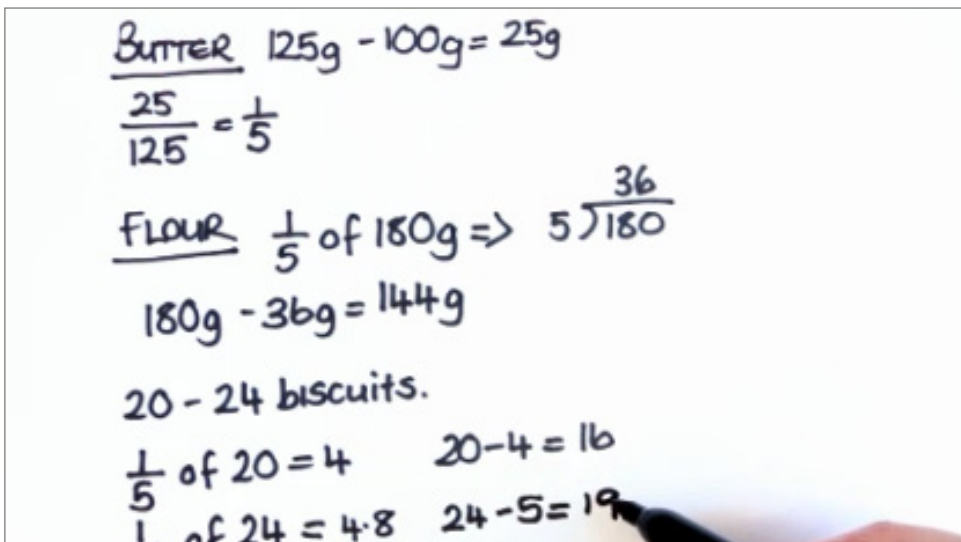
This is where tutors explain a maths concept by writing/drawing and talking.



Our demo shoot (above) used an 'over the shoulder' approach to make it feel as though you were literally looking over the shoulder of the tutor

However, the angle of the paper and the distance in shot makes the writing/drawing difficult to understand. We also want to more closely emulate the Udacity style of 'talking hands' clips, albeit using a more lo-fi filming and editing method.

This is more like the result we want (from filming in November 2014):



- The tutor writes/draws as they speak.
- Ideally tutors use a combination of clear hand writing, simple drawings, underlining or circling or different coloured pens for emphasis and to help visually explain something.
- Such shots are framed as closely on an A4 sheet of paper as possible, ideally not showing the edges of the paper, though these can be removed in the edit.
- Sleeves need to be rolled up in case they get into shot.
- Tutors can start with a blank sheet or part-prepare something. However, the filming must include writing/drawing, and not simply feature the tutor pointing at a pre-existing writing/drawing.
- Stopping writing and moving the hand a little away (but still in shot) is a good way to emphasise points or reiterate something.

- We recommend tutors use Sharpie Fine Point or Sharpie Ultra Fine pens. A limited colour palette is preferable (black, red, green). Other pens may be used if legible on-screen. Note on colour blindness TBC
- We recommend writing on good quality white paper (90gsm) or – ideally – card (200gsm). This ensures ink doesn't bleed, while the heavier the paper, the less likely it is to move about on the table top. An A4 or A3 whiteboard and non-permanent pens could be used if tutors need to rub out as part of the explanation. The paper should be taped to the table at all four corners, using double-sided tape.

We filmed this using a camera under a tripod, set over a desk, with a light and natural light. We used the same lapel mic as in the 'talking heads' shoot.

In post-production we edited out any errors made, using a quick cross-fade. We will also use cross-fades or sped-up sections where there is lots of writing and no narration. However, this is best avoided by using some pre-prepared content on the paper and adding to it.

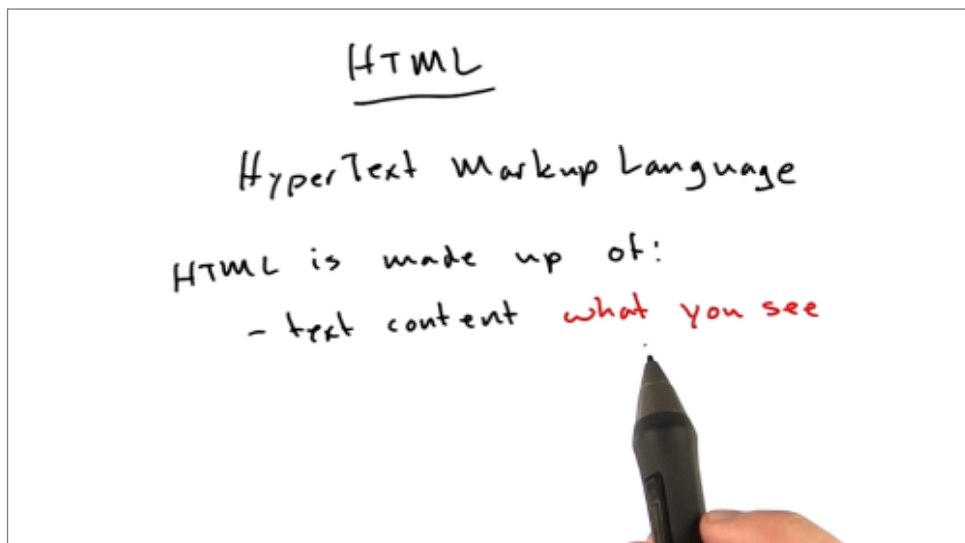
Lessons from filming in November 2014

- It's helpful to have the sums / text written down on a piece of A4 paper (out of shot) to be copied from.
- Writing should start about 4cm from the top of the A4 page and 4–5cm from the left edge.

Notes following feedback about the hand covering what is being written:

- Tutors should hold the pen as best they can to ensure we see as much of what they are writing as possible.
- At appropriate points tutors should move their hands off screen (or at least from over the writing). This should be planned in each script before filming to identify points at which to do this.

Here are examples of the Udacity style that we are emulating:



<http://www.youtube.com/watch?v=Tronlx9tlqk>



http://www.youtube.com/watch?v=hvFNsm_chUw

3. Talking applications

This is where tutors will talk using an app or software application to demonstrate a maths concept that is best illustrated by an application.

This may include using the Scratch applet, a spreadsheet, dynamic geometry software or a computer calculator.

- The tutor completes activities on the computer as they speak.
- A lapel mic should be used to record narration, ideally of the same type as used for the other recordings.
- It's a good idea, where possible, to use the cursor or pointer to point at relevant areas of the screen.

Lessons from filming and content review in November 2014

- Ensure all fonts used are as large as possible.
- In post-production we will zoom in on areas such as formula in spreadsheets so that they can be seen clearly.
- Avoid having to scroll on-screen. What you are showing should fit in the view that is being recorded.

In post-production we edited out (using a quick cross-fade) any errors made. We also used cross-fades or sped-up sections where there is activity on-screen but no narration.

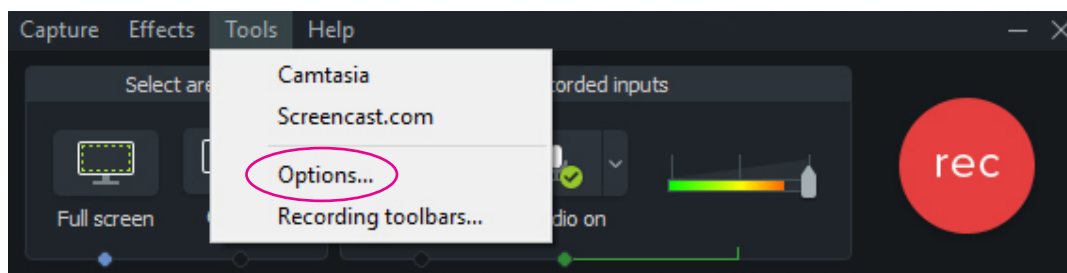
Setup

When setting up to capture, make sure that what you are going to capture is as large as possible on the screen. The resolution of the screen to be recorded on should be 1920x1080 pixels. Text should be large enough to be easily read when the video is watched at a lower resolution, e.g. 800x450 pixels (the size at which videos are currently embedded in Google Course Builder).

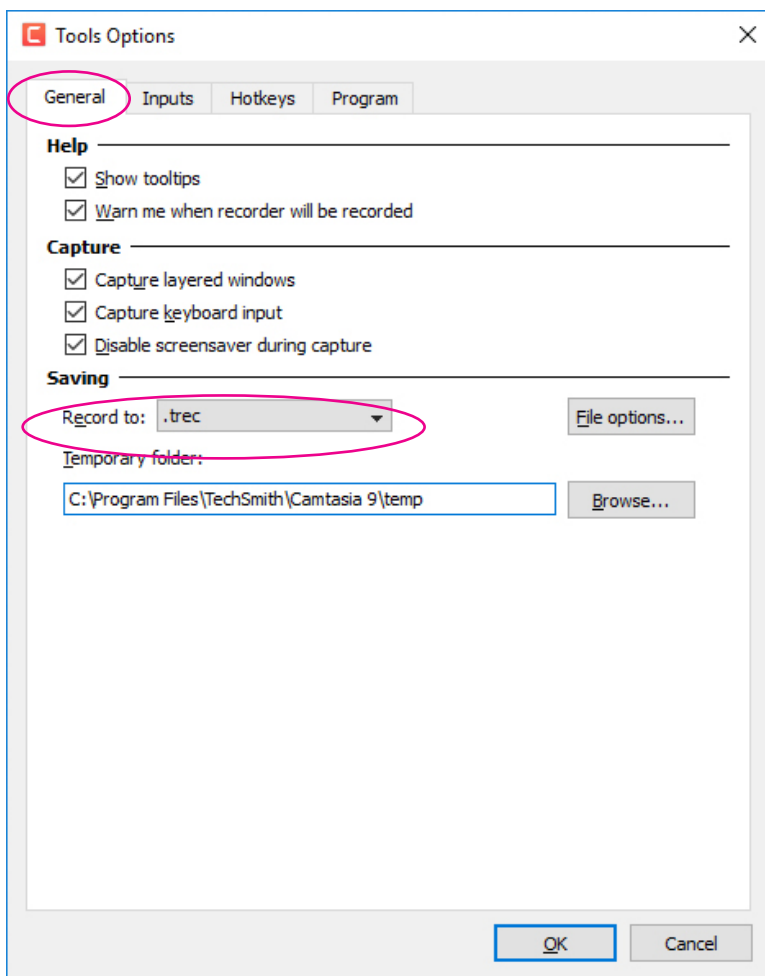
Please also make sure that you set up the video and sound quality each time you do a recording.

Video setup

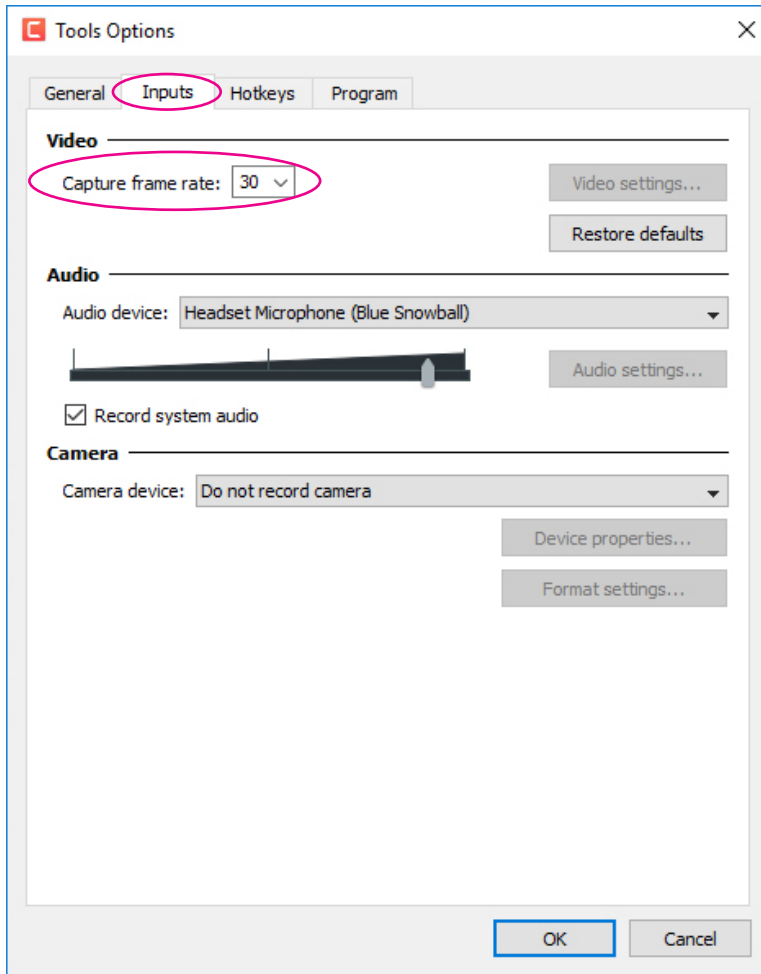
On the capture bar click 'Tools', then 'Options...'



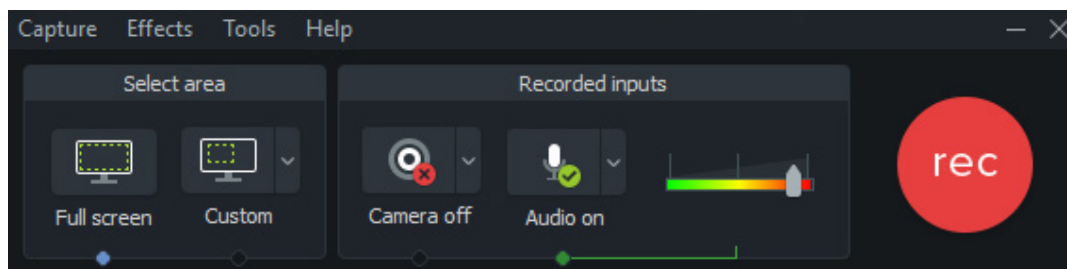
On the 'General' tab ensure 'Record to' is set to .trec.



Then click on 'Inputs' in the top bar and ensure the 'Capture frame rate' is set to 30.



When recording ensure the level on the audio monitor does not peak in the red, as shown below. To prevent this test the microphone position and input level position slider below audio monitor) before starting recording. The monitor should peak in the yellow / orange section.



Appendix E:

Forms and policies

4. Camera settings / position

Filming talking heads

ISO: 2500

Shutter speed: 320

Aperture: 6.3



Filming talking hands

ISO: 4000

Shutter speed: 125

Aperture: 9

Note: These settings might not be the same each time we film but may be a useful reference.



This appendix includes

- Pre-course assessment checklist,
- Terms of use,
- Privacy policy, and
- Attribution statement.

Pre-course assessment checklist

Checklist: is Citizen Maths right for me?

To help you decide if the course is for you, here is an anonymous check-list with nine quick Yes/No questions. After you press 'Submit' at the bottom, you will be able to decide whether to carry on and sign in or explore some alternative pointers we provide for learning maths.

If you check "Yes" to all or nearly all the statements then Citizen Maths should be worth a try.

After you submit the form you will be able to register.

All questions require a response.

Learning approach

1. I like the idea of being able to learn at a time and place to suit me.

Yes / No

2. I understand that, if I decide to do all of the course, it might take me around 35 hours, spread over as long or short a time as I want.

Once registered, you can start right away if you wish to. You can do as much or as little of the course as you choose.

Yes / No

3. I know that I'll be largely on my own whilst learning, without direct access to a teacher; and I understand that support will be limited and that it may take up to two working days to get answers to questions

Yes / No

Comfort with maths

4. I can do simple maths problems. I have *basic* knowledge of percentages, fractions, measuring, and can use simple graphs and tables.

You do not have to be expert at these things, but if maths is a total blur to you, Citizen Maths may not be right for you.

Yes / No

5. I am less happy when I need to decide how to apply maths in real-life situations.

Yes / No

6. I have not done maths for some time. I could do with a refresher.

Yes / No

Technical requirements

7. I've got a computer (Mac or PC), with sound, that can connect to the Internet. I know that I will be using my computer (and my email address) to do the course.

Note: you will be able to do some parts of the course with a tablet device or smartphone.

Yes / No

8. I'm happy to do a course in which I will need to use my computer in what may be new ways for me, for example, using spreadsheets, and doing interactive tasks.

Note: you won't normally need to install any extra software.

Yes / No

9. I'm happy to take a few short steps to create an account with Citizen Maths, and then to complete an online registration form. I am aware that some course activities use tools like Scratch and Google Spreadsheets for which I will need to set up an account.

Setting up a Scratch or Google Account is easy, and we provide guidance on how to do it.

You do not need either to make a start with Citizen Maths.

Yes / No

On submission, users are directed to a page that says

If you checked "Yes" to all or nearly all the statements in the check-list why not give Citizen Maths a try?

If you've decided that Citizen Maths is not for you, there is a summary of [some possible alternatives](#) on our blog.

Terms of Use

By using the Citizen Maths open online course and/or the Citizen Maths website you agree that you have read, understood and agreed to these Terms of Use. These terms are in addition to the Citizen Maths [privacy policy](#), and should be read alongside it.

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- V7.1** – last updated by Seb Schmoller, Citizen Maths project director, 2016-12-15

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 - name and type of the organisation that may have encouraged you to register for Citizen Maths;
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V7.3 – Last updated by David Jennings, Citizen Maths project manager, 2016-11-16

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Section	Ref no.	Location	Description	URL (if applicable)	Originator or source
Scaling	10001	100	Map with scale	http://solargis.info/doc/_pics/freemaps/1000px/ghi/SolarGIS-Solar-map-United-Kingdom-en.png	By kind permission of Marcel Suri, managing director of GeoModel Solar s.r.o., Pionierska 15, 831 02 Bratislava, Slovakia
Scaling	10002	100, 109, 115, 121, 124	Image of statue of Alan Turing	http://commons.wikimedia.org/wiki/File:Alan_Turing.jpg	Jon Callas
Sharing	10004	190, 193, 195	Pie chart of distribution of UK government spending	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293759/37630_Budget_2014_Web_Accessible.pdf	HM Treasury
Sharing	10005	190	'Apple pie baked dessert' from Microsoft Clip Art	N/A	Microsoft
Sharing	10006	202, 205	'House with red roof' from Microsoft Clip Art	N/A	Microsoft
Mixing	10008	127	Concrete mixer	https://www.flickr.com/photos/david-masters/2600467841/	David Masters
Mixing	10009	127	Cocktail	http://commons.wikimedia.org/wiki/File%3APeach_Bellini.jpg	Heather Hutchinson
Mixing	10010	127	Paint being mixed	https://www.flickr.com/photos/rhian/10842801033/	'Rhian vK' on Flickr
Mixing	10011	130	Shot of the cover of Easy Baking – 100 fuss-free recipes for everyday cooking	N/A	Marks and Spencers
Trading off	10012	178	Picture of supermarket queue	https://www.flickr.com/photos/oatsy40/6198212129/in/photolist-WWESK-bH	'oatsy40' on Flickr
Trading off	10013		The 'How high?' interactivity shown in the introductory and summary videos of the 'Pour liquids' section, and the screenshots from the interactivity are the copyright of Utah State University and have been used with permission. A wide range of other interactivities are available from The National Library of Virtual Manipulatives.	http://nlvm.usu.edu/en/nav/frames_asid_275_g_3_t_4.html	Utah State University
Making decisions	10014	3000	Packet of generic paracetamol	N/A	N/A
Making decisions	10015	3004, 3006	Data grid showing numbers killed using different modes of transport	http://www.medicine.ox.ac.uk/bandolier/booth/Risk/transportpop.html	Bandolier Journal, an independent journal about evidence-based healthcare

⁵Internal resource reference number

Making decisions	10016	3008	Data about screening for breast cancer and screenshot in video	http://understandinguncertainty.org/node/18	Understanding Uncertainty, a web site produced by the Winton programme for the public understanding of risk based in the Statistical Laboratory in the University of Cambridge.
Playing	10017	3011	Shot of chess-set	N/A	Team-owned generic and old chess-set. Source not known.
Playing	10018	3011	Shot of snakes-and-ladders board	http://www.johnlewis.com/johnlewis-snakes-and-ladders-ludo/p231306500	John Lewis Partnership
Playing	10019	3012, 3014	Image of roulette wheel	https://www.flickr.com/photos/the-barrowboy/7471763958/	AJ Barrow on Flickr
Playing	10021	3015	Image of one-armed bandits	https://upload.wikimedia.org/wikipedia/commons/3/34/Slot_machines_at_Wookey_Hole_Caves.JPG	Rod Ward
Playing	10022	3029	Image of Pass the Pigs instruction card, and shots of pigs in play	http://shop.winningmoves.co.uk/categorylist/pass-the-pigs/	By kind permission of Winning Moves
Simulating	10023	3032	Images based on Met Office weather forecasts	http://www.metoffice.gov.uk/public/weather/forecast/gcpcvn15h9	Met Office
Simulating	10024	3032	Screenshots of Met Office pages about supercomputers	http://www.metoffice.gov.uk/news/in-depth/supercomputers	Met Office
Interpreting data	10025	2000	Picture of Florence Nightingale c. 1860	https://commons.wikimedia.org/wiki/File:Florence_Nightingale_three_quarter_length.jpg	Photographer not known
Interpreting data	10026	2004, 2005	Screenshot of data-sheet for the drug Fluzone	http://www.rxlist.com/fluzone-drug.htm	RxList by WebMD LLC
Interpreting data	10027	2007		http://www.ons.gov.uk/ons/rel/crime-stats/crime-statistics/focus-on-violent-crime-and-sexual-offences-2013-14/sty-facts-about-lcohol-related-violence.html	Office for National Statistics
Interpreting data	10028	2010	Polling data	http://www.icmunlimited.com/media-centre/polls/guardian-poll-27th-april-2015 ; http://www.tns-bmrb.co.uk/news/tns-poll-noparty-has-made-a-clear-break-1 ; https://d25d2506sfb94s.cloudfront.net/cumulus_uploads/document/evhbhxbwz2/YG-Archive-Pol-Sun-results-270415.pdf	ICM Unlimited; TNS BMRB; YouGov Consulting
Interpreting charts	10029	2014	Polar diagrams by Florence Nightingale	https://commons.wikimedia.org/wiki/File:Nightingale-mortality.jpg	The Royal Collection
Interpreting charts	10030	2018, 2019, 2020	Charts of most-missed media activity, average time per day using communications services, adoption of new technologies by age, and social media use by age group	http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr14/2014_UK_CMR.pdf	Ofcom
Interpreting charts	10031	2021, 2022, 2023	IFS 'Where do you fit in?' app and data	http://www.ifs.org.uk/wheredoyoufitin/	By kind permission of the Institute of Fiscal Studies
Comparing groups	10032	2024	Line diagrams by Florence Nightingale	http://static.guim.co.uk/sys-images/Guardian/Pix/maps_and_graphs/2010/8/12/1281630631398/Nightingale-line-chart-gr-006.jpg	
Comparing groups	10033	2026, 2028	Household density data from ONS data from 2011 Census	http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tc%3A77-284349	

Comparing groups	10034	2028	Screenshot of ONS 2011 Census opening page	http://www.ons.gov.uk/ons/guide-method/census/2011/index.html	
Comparing groups	10035	2029, 2030, 2031	Android phone battery usage screenshots	N/A	Samsung Galaxy S5
Appreciating	1036	4000, 4003	Face of labrador dog	https://pixabay.com/en/dog-the-most-obvious-labrador-black-996489/	'HS61' on Pixabay https://pixabay.com/en/users/HS61-994420/
Appreciating	1037	4001	Face of papillon dog	https://pixabay.com/en/papillon-dog-animal-274183/	'SergVG' on Pixabay https://pixabay.com/en/users/Serg-VG-170532/
Appreciating	1038	4001	White trillium flower	https://pixabay.com/en/trillium-flow-er-white-ontario-432528/	'Natasha G' on Pixabay https://pixabay.com/en/users/NatashaG-363234/
Appreciating	1039	4003	Starfish	https://pixabay.com/en/starfish-sea-africa-kenya-holiday-74535/	'Florian Berger' on Pixabay https://pixabay.com/en/users/fbfoto-17653/
Appreciating	1040	4004	The Parthenon	https://www.flickr.com/photos/tiseb/26519426/	Sébastien Bertrand on Flickr
Appreciating	1041	4004	Yellow chamomile head with spirals	https://en.wikipedia.org/wiki/Fibonacci_number#/media/File:FibonacciChamomile.PNG	Joaquim Alves Gaspar on Wikimedia https://commons.wikimedia.org/wiki/User:Alvesgaspar
Appreciating	1042	4006	Golden Ratio Wikipedia page	https://en.wikipedia.org/wiki/Golden_ratio	Various https://en.wikipedia.org/w/index.php?title=Golden_ratio&action=history
Appreciating	1043	4007	Broad Street cholera outbreak Wikipedia page	https://en.wikipedia.org/wiki/1854_Broad_Street_cholera_outbreak	https://en.wikipedia.org/wiki/1854_Broad_Street_cholera_outbreak
Appreciating	1044	4007	John Snow's cholera map	https://commons.wikimedia.org/wiki/File:Snow-cholera-map-1.jpg	John Snow
Tiling	1046	4011	Leeds Tiled Hall Cafe	https://www.flickr.com/photos/62766743@N07/7267551612	Carl Milner on Flickr https://www.flickr.com/photos/62766743@N07/
Tiling	1047	4011	Knitting pattern	https://www.flickr.com/photos/breibeest/3303630724	'Breibeest' on Flickr
Tiling	1048	4011	Aeonium tabuliforme plant	https://pixabay.com/en/aeonium-tabuliforme-succulent-dish-1061603/	'Foto-RaBe' on Pixabay
Tiling	1049	4011	Bees in honeycomb	https://pixabay.com/en/queen-cup-honeycomb-honey-bee-337695/	'PollyDot' on Pixabay
Tiling	1050	4012	Tiled floor	https://www.flickr.com/photos/robben/3141199483	Roberto Venturini on Flickr
Tiling	1051	4015	Honeycomb	https://pixabay.com/en/honeycomb-bees-hexagons-comb-330755/	'Seagul' on Pixabay
Tiling	1054	4021	Giant's Causeway	https://en.wikipedia.org/wiki/Giant%27s_Causeway#/media/File:Giant%27s_Causeway_(14).JPG	'Chmee2' on Wikimedia
Tiling	1055	4021	Chicken wire	https://pixabay.com/en/rooster-poultry-animals-bird-248029/	Mark Valencia on Pixabay
Constructing	1056	4022	Weaving cloth	https://www.flickr.com/photos/dfa-taustralianaid/10706359235	Department of Foreign Affairs and Trade, Australian Government, on Flickr
Constructing	1057	4022	Celtic pattern	https://www.flickr.com/photos/8593364@N06/3487308982	'k4dordy' on Flickr
Constructing	1058	4022	Navajo rug	https://www.flickr.com/photos/ruthanddave/22752824602	Ruth Hartnup on Flickr
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Reading scales	1062	5000	Hygrometer	https://commons.wikimedia.org/wiki/File:Haar-Hygrometer.jpg	'Daniel FR' on Wikimedia
Converting	1063	5015	Currency converter website	http://www.xe.com/currencyconverter/	© copyright XE.COM Inc.
Converting	1064	5014	US gas station		Joshua Bradshaw (CC BY)
Converting	1065	5014	French petrol station	https://commons.wikimedia.org/wiki/File:Total1807.JPG	'Tostaki1' on Wikimedia
Estimating	1066	5032, 5034	Crowd of people	https://pixabay.com/en/strike-protest-human-group-51212/	'LoggaWiggler' on Pixabay
Estimating	1066	5029	Rochdale bus crash	http://www.theguardian.com/uk-news/2015/sep/09/double-decker-bus-hits-railway-bridge-rochdale	© copyright Rossparry.co.uk, used by permission
Quantifying	1068	5039	Black Sea satellite photo	https://en.wikipedia.org/wiki/Russian_conquest_of_the_Caucasus#/media/File:Black_Sea_Nasa_May_25_2004.jpg	Jeff Schmaltz, NASA
Quantifying	1069	5043	Wallpaper calculator	http://www.wallpaperdirect.com/wallpaper-calculator.php	© copyright C. Brewer & Sons Ltd, permission requested

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Appendix F:

Adaptive Encouragement Framework

The table shows the goals and conditions for each of the ten standard messages we composed to support the goals of obtaining feedback from learners and encouraging their progress through the course.

No.	Broad Purpose	Condition 1	Condition 2	Condition 3	Condition 4
1	Encourage the provision of feedback	Learner has given consent to be sent motivational emails	In the previous 7 days no more than 1 encouragement email has been sent.	2 feedback widget (FW) completions have been made	Learner registered after the feedback engine was switched on.
2	Encourage the provision of feedback	Learner has given consent to be sent motivational emails	In the previous 7 days no more than 1 encouragement email has been sent.	6 further FW completions have been made	
3	Encourage the provision of feedback	Learner has given consent to be sent motivational emails	In the previous 7 days no more than 1 encouragement email has been sent.	6 further FW completions have been made	
4	Encourage the provision of feedback	Learner has given consent to be sent motivational emails	In the previous 7 days no more than 1 encouragement email has been sent.	As soon as 1 narrative feedbacks ≥ 10 characters have been submitted	
5	Encourage the provision of feedback	Learner has given consent to be sent motivational emails	In the previous 7 days no more than 1 encouragement email has been sent.	As soon as 3 further narrative feedbacks ≥ 10 characters have been submitted	
6	Encourage participation in the course	Encourage participation in the course Learner has given consent to be sent motivational emails	In the previous 7 days no more than 1 encouragement email has been sent.	As soon as learner has completed any 2 "main lessons" (ML) in a Powerful Idea	
7	Encourage participation in the course	Learner has given consent to be sent motivational emails	In the previous 7 days no more than 1 encouragement email has been sent.	As soon as learner has got only 1 "main lessons" (ML) to go in a Unit	
8	Encourage participation in the course	Learner has given consent to be sent motivational emails	In the previous 7 days no more than 1 encouragement email has been sent.	As soon as learner has got only 3 "main lessons" (ML) to go in a Powerful Idea	
9	Encourage those signed up to get started	If a learner has not made a start within 7 days of signing up	N/A	If a learner has not made a start within 7 days of signing up	This "get started" email has not been already sent
10	Encourage those who've gone silent to get back involved	Learner has given consent to be sent motivational emails	N/A	If a learner has made a start, but has not been active for 14 days	Learner has not completed the End of Course Questionnaire. [i.e. it is only sent once!]

Written by Dave Pratt, Seb Schmoller, David Jennings, Will Buckman, Matt Bush, David Squire and Nick West.
Edited by David Jennings.
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