Open badges Part 1: what, why, how?

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Abstract Digital badges are graphical representations of an accomplishment. Open badges are a subset of digital badges that allow the badge owner to demonstrate achievement and the viewer to see the criteria for the badge. Open badges offer the opportunity to evidence and reward skill development, and to learn that existing formal qualifications do not. In this, the first of three articles discussing open badges in science education, the reader is introduced to the scope for using these technologies to benefit pupils, teachers and schools. Part 2 proposes a badge framework for the 'Working Scientifically' strand of the National Curriculum in England. Part 3 details a case study involving pupils aged 7–11 years in an informal education setting in which practical skills were taught overtly, using language and processes detailed in the badging framework, to facilitate the transition into secondary school science. Open badges offer the scope for explicit learning trajectories and a personalised record of skills, experience and interests to the benefit of an array of stakeholders.

The 'Working Scientifically' strand of the National Curriculum in England lays out the progression of scientific skills from key stages 1 to 4 (ages 5–16). Open digital badges offer the opportunity to recognise, evidence and reward the development of these skills. The first of this series of three articles describes open badges and their application in science education. The second article provides a comprehensive open badges framework for the 'Working Scientifically' strand of the National Curriculum. Finally, the third article details a trial using this framework to support practical skill development at key stage 2 (ages 7–11) in preparation for the demands of secondary school science education. Open badges provide a mechanism for enhancing existing assessment systems by enabling students to demonstrate their proficiency at manipulating laboratory equipment, as well as their ability to explain a practical technique in a written exam.

Open badges

Traditionally, badges have been physical artefacts that represent a judgement made by an authority regarding someone's experience, skills and knowledge. A digital badge is an image file; it can be copied and pasted by anyone to anywhere, whereas open badges must be issued. Open badges are a subset of digital badges that contain metadata embedded within the file and that provide a verifiable audit trail of the credential. Not only will an open badge contain a description of the badge, the criteria, the issuer and issue date, but also, when appropriate, standards, tags, expiry date and evidence (Figure 1). Open badges are an 'open source' technology (i.e. designed to be technically interoperable, portable and transparent) and conform to the Open Badge Standard that is shepherded by IMS Global Learning Consortium (https://openbadges.org/community/). The universal format enables an individual to earn and display badges from organisations as diverse as NASA and the National Health Service, provided that the issuer's specific criteria have been met.

Having earned the badge, the learner can then move it into their badge portfolio, called a backpack, an independent web space in which they can store their badge collection. Once the badges are in their backpack, individuals can choose which badges they want to display and where, such as on social networks and employment sites

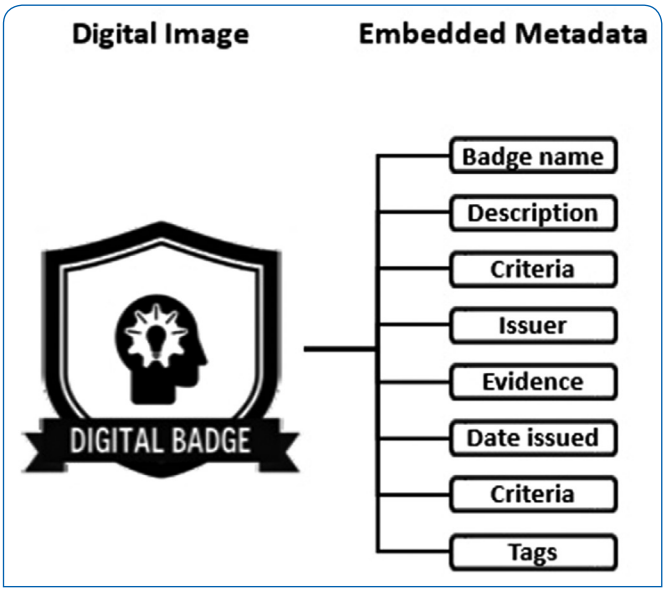

Figure 1 Open badges are a subset of digital badges that are built on free open-source software. Additional data are embedded within the image file and so clicking on the badges reveals information about the award criteria, the issuer and supporting evidence: in short, a verifiable audit trail of the credential.

or on their résumé or digital portfolio (Figure 2). Digital badges enhance digital portfolios '*because they can act as top-level visual organizers for the portfolio through a "learner dashboard"*' offering '*a quick and powerful visual review of the student's accomplishments… which are "media rich"*' (Anderson and Staub, 2015).

STEM careers and open badges

The versatility and potential of open badges has attracted much interest from the science, technology, engineering and mathematics (STEM) community. Those who are already implementing open badges do so for any combination of four core purposes (see Riconscente, Kamarainen and Honey, 2013):

- fostering motivation and identity;
- expanding STEM learning areas and contexts;
- making STEM pathways visible and accessible;
- supporting selection processes.

At the 2016 British Science Festival, Siemens became the first engineering company in the UK to launch their own STEM skills programme with open badges. Siemens aim to use open badges to enrich and enhance STEM teaching and learning in the classroom and beyond to nurture engineering talent for the future (see www.siemens.co.uk/education/en/digitalbadges.htm). Open badges offer the opportunity to recognise and reward education from informal institutions such as after-school clubs, online activities, museums and NHS England (Figure 3),

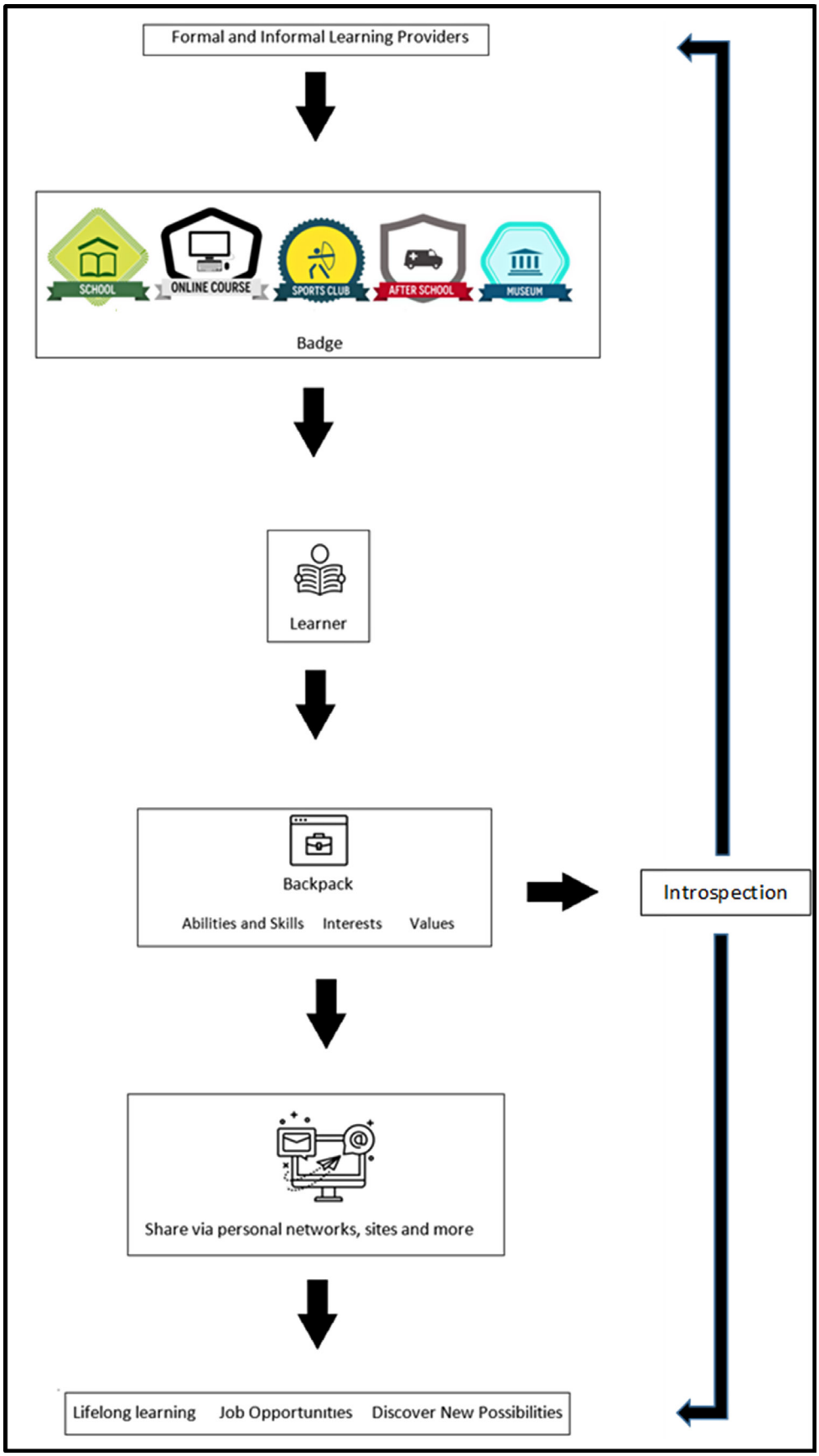

Figure 2 Using open badges to recognise and reward learning wherever it takes place, enabling self-actualisation and informed decision-making. The image shows learning being acknowledged by rewarding the learner with a badge. The badge is then added to the backpack where it is stored until the learner chooses to display it. The badge collection forms a unique aptitude profile, a visual representation of the skills they have developed, allowing the learner to identify interests to pursue or gaps to be filled. Thus, badges promote introspection and encourage students to take ownership over their learning.

Figure 3 NHS Open Badges: NHS England launched 12 digital badges for 5- to 16-year-olds – grouped into NHS Explorer, NHS Reporter, NHS Inspector and NHS Citizen and aimed at supporting children and young people's education in health and well-being. Recent research describes teachers' and pupils' positive views of the badges 'as tools that have the capacity to build perseverance, develop emotional awareness, build relationships and enhance skill and knowledge acquisition' (Alexander and Neill, 2018).

providing a mechanism of assessment that recognises and rewards learning that until now has been ignored. Research in this area is demonstrating very clearly that out-of-school STEM programmes contribute to both academic and social measures of student success (see STEM Education Coalition, 2016). When young people are helped to identify and name the skills that they develop through the activities they enjoy, wherever the learning takes place, their unique aptitude profiles will become apparent. If a young person is able to discern that they have a flair for skills as diverse as numeracy, teamwork, persistence, logical reasoning and communication, for example, they may be more likely to consider STEM careers. The current STEM workforce shortfall exceeds 40 000, reflecting a low interest in and uptake of STEM careers by young people, and yet gaming and healthcare careers are those most aspired to (see Dunn, 2016).

Traditionally, only achievements that are standardised into a course or position can be displayed. An employer looking for a chemistry graduate, for example, can see that a degree has been awarded but cannot readily ascertain whether the applicant has developed the hands-on laboratory skills needed for the post. Nor indeed are many other skills and abilities, such as creativity, communication, teamwork and problem-solving, clearly represented in traditional transcripts. Personal statements or covering letters provide the opportunity to discuss experience such as an online learning course or voluntary work for a non-profit organisation, but lack any supporting credentials. Open badges provide an eye-catching, certified way to represent learners' educational, social and personal achievements in a digital portfolio, a space where learner evidence of competencies and achievements can be stored, systematically evaluated and displayed. The inclusion of tags makes them searchable, enabling prospective employers to identify potential employees.

According to *The Right Combination: CBI/Pearson Education and Skills Survey 2016* (CBI/Pearson, 2016), '*School and college is not equipping all young people with what they need to succeed: around half of businesses are not satisfied with school leavers' work experience (56%) and their skills in communication (50%), analysis (50%) and self-management (48%)*'. In the same report, Josh Hardie, Deputy Director-General of the CBI, states that '*Skills have always been a vital currency and this is particularly pertinent as the UK carves out a new economic role in the world and begins the process of leaving the European Union.*'

Open badges in school science and between schools

Practical skill development

Practical competencies are currently assessed in England through the learners' ability to answer exam questions. Masters and Nott (1998) argue that written tests require 'explicit' knowledge (knowing what) to explain how to conduct an investigation, whereas carrying out the investigation requires knowing how ('implicit' knowledge) (p. 216). Practical work provides the context from which the implicit knowledge may be linked to explicit knowledge; to be successful in forging these links requires a 'hands-on' and 'minds-on' approach (Abrahams and Reiss, 2017: 17). Building skill proficiency 'hands-on' allows students to concentrate on procedures and purpose, 'minds-on' to support learning. Digital badges provide a mechanism to assess, reward and evidence skill proficiency throughout science education.

Consider measuring the volume of a liquid: this skill is taught in both primary and secondary school science using a range of equipment. A comprehensive badging programme could help students to recognise that the same skill is required, although the apparatus differs.

For a learner to be issued with a badge, an assessment must be made against specified criteria (Figure 4). A student is recorded using a measuring cylinder to obtain a specified volume of water, for example. The film is reviewed and assessed against badge criteria; if met, the badge can be issued, otherwise personalised feedback is provided to aid skill development. The next time a measuring cylinder is used, students without this badge can be assessed regardless of whether or not the teacher, or even the school, is the same.

Title
Measuring the volume of a liquid

Description
KS3 Measurement

This badge rewards the ability to measure the volume of a liquid by reading the scale at eye level from the bottom of the meniscus.

Criteria

Know how to select the appropriate measuring device for the volume of liquid required

Know that the divisions on different sized measuring cylinders and different equipment for measuring volume have different values.

Know that the top of a liquid forms a smile called the meniscus and that we read from the bottom of the meniscus.

Know that the reading must be taken from eye level.

Be able to safely use measuring equipment. Make sure equipment is filled below eye level -NEVER to crouch down so your head is on the same level as the table top when pouring liquid into a graduated cylinder

Be able to use the appropriate measuring unit

Be able to carry out a repeatable and reproducible measurement of volume.

Issue Date
07/10/18

Figure 4 Exemplar measurement skill badge for correctly using a measuring cylinder. Details of issuer, issue date and criteria have been included.

Cross-curricular projects

Open badges can be used to facilitate cross-curricular projects, each subject contributing experience and evidence as learners work towards a common goal. As visual symbols, badges highlight common practices, such as rearranging equations shared by science and mathematics, forging curricular links, and building learners' confidence. Recent research into the use of badges in STEM education reports '*statistically significant increases in measures of motivation including self-efficacy, self-regulation and perceived competence*' (Elkordy, 2016). Implementing an open badge framework of skills not only supports the learner, but also makes visible the school's commitment to the adoption of those factors identified by Ofsted as promoting high achievement. There are badges available, such as the O2 App Designer badge, for which an interactive design of an app idea needs to be created that could help make a difference or tackle a problem within a community, around which a cross-curricular project could be structured (see www.openbadgeacademy.com/badge/90), or departments could design, build and accredit their own badge using a digital credential service provider such as Credly (https://info.credly.com/).

Smooth transition

The September 2016 issue of *School Science Review* (*SSR*) methodically re-explored the issues that surround primary to secondary school transition believed to account for the ensuing decline in science, engagement and attainment. Resolution, it was suggested, would require science teachers either side of the interface to work collaboratively before and after the transition, to support continuity of learning and to alleviate concerns about the quality of early science learning (Collins and Reiss, 2016). A learner's badge portfolio could be shared between schools, providing not only a learning history but also evidence to support it. To make this a practical solution, a common framework is required either side of transition to avoid repetition and an increase in workload, and to provide continuity for the learner.

A common framework of the development of science skills already runs from key stages 1 to 5 (ages 5–19 in England): 'Working Scientifically'. Within this strand, there is an emphasis on both practical experience and spoken language. Yet how many educators are aware of what prior learning had occurred upon which they can build? Are learners taught to use a common language to accurately communicate prior learning? Are the learners themselves aware that the curriculum is a spiral that allows them to revisit and build upon this prior learning? If pupils are aware of their learning trajectory, they are better placed to regulate their own learning.

Coming up

Part 2 of this series of articles (Hennah, 2018), in this same issue of *SSR*, details a 'Working Scientifically' open badge framework that makes progress through the strand overt. The framework draws influence from the Ofsted

(2013) recommendations in its *Maintaining Curiosity* report: developing spoken language as a gateway to both understanding and learning, as well as the importance of practical work and practical skill development.

The final article will report on a case study, in an informal setting, with children aged 7–11 in which the methods described by the 'Working Scientifically' framework were put into practice to build practical and investigative skills in preparation for secondary school science.

Further information

Siemens and NHS England open badges can be earned through the Open Badge Academy, which hosts a library of badges available for young people: www.openbadgeacademy.com/badgelibrary.

Digital badges have been introduced in years 5–8 (ages 9–13) at Shireland Collegiate Academy in the West Midlands to accredit informal education in their Saturday School, to raise attainment by giving students the opportunity to build an online portfolio of work that can be used as a 'record of achievement' – see www.ocr.org.uk/Images/232862-digital-badges-toolkit.pdf.

The most comprehensive implementation of open badges in schools found by the author is that of the Aurora Public Schools (Colorado, USA) digital badging programme – https://sites.google.com/aurorak12.org/badge/.

The Open Badge Academy for students over 13 years of age offers a basic package that is free, whereas the more functional packages cost from £50 per month.

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