

Electrifying the country house: taking stories of innovation to new audiences

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Abstract

Could country house museums be indispensable sites for learning about both science and history? Given current logistical constraints, would it be worthwhile for school teachers to arrange student visits to such places to learn about STEM subjects? At first sight, such epitomes of British heritage do not appear to offer much to such audiences. However, recent research shows that some country houses were once key sites of technological innovation, especially in the Victorian invention of electric lighting. Our collaborative work with staff at Cragside, Lotherton Hall and Standen demonstrates their capacity and enthusiasm to use such insights to present more STEM-related content to visitors within the context of their existing historical offers. Drawing on the results of an AHRC-funded impact and engagement project, we show how co-produced stories of household electrification can supply fresh inter-disciplinary ways of engaging STEM audiences with the historic country house.

Key words: country house, STEM, electricity, learning, heritage

Introduction

Recent changes in the UK school curriculum have led to increasing fragmentation of subject coverage. In particular, the prioritisation of STEM subjects - science, technology, engineering and maths - has reduced timetabled opportunities to engage with creative subjects and the humanities.¹ Many concerns have been raised against this strategy. In July 2013 the National Museum Directors' Council warned that these changes would reduce opportunities for schools to arrange museum visits (National Museum Directors' Council 2013). Their warnings about the difficulties for schools seeking to take students out of the classroom are now being realized as primary teachers struggle to deliver the new SATS focus on learning by rote to achieve 'old school' literacy and numeracy.² The Sutton Trust has also shown that this broader move away from creative and cultural opportunities has negatively impacted on the attainment of pupils from low socio-economic groups (Toth, Sylva and Sammons 2015).

Against this background, 'Electrifying the Country House', a project funded by an AHRC Follow-on Funding for Impact and Engagement grant, set out to work with three country houses: Cragside in Northumbria, Standen in West Sussex and Lotherton Hall in Yorkshire.³ The project team co-produced with curators and educators a range of interpretative activities and resources that embedded STEM learning into these museum environments, thus facilitating cross-curricular learning. While not usually associated with STEM, these houses are ideal spaces to meet the requirements to study electricity at Key Stage 2. In co-creating resources for such learning, we went beyond conventional STEM approaches to electricity to evidence the importance of including social and cultural histories of the electrification of country homes in late nineteenth-century Britain in the curriculum.

In particular, Cragside and Standen were early innovators in their experimental approaches to designing technology for power and lighting systems. They also provide, in different ways, useful historical examples of sustainable energy generation: Cragside was a pioneer in hydro-electric generation. Standen used a combination of wind- and water-power for various purposes on the estate, along with the oil engines used to generate its electrical

supply. Narrating these stories in context demonstrates both how such narratives can inform the sustainability debates of today, and also the need for a cross-disciplinary approach to invention. The latter seemed vital to the project team at a point when the celebration of the success of the UK's creative industries has a decreasing profile in the classroom, with art and design decoupled from the science and technology with which they were originally integrated (Warwick Report 2015). Our case studies below are set up to allow the outcomes of such projects to be shared most effectively; we thereby aim to pre-empt any return to 'Two Cultures' debates which have unproductively presented science as marginalized from the arts (Snow 1959; Collini 1993).

Background and origins

The UK has a rich history of cross-disciplinary education delivered in a country house setting which has inspired historians and educators internationally. Changes in the curriculum, however, have led to the closure of bespoke resources, such as Clarke Hall in Wakefield, once the 'jewel in the crown' of Wakefield's educational offering, held up as an example of innovative, interactive learning which reached out to a wide range of young people. Clarke Hall was closed in 2012 as a result of spending cuts and was sold by the Council in 2014.⁴ Such examples of cross-disciplinary history teaching developed in the 1970s when history learning in Britain was at the forefront of experiments in progressive learning that were founded in the idea of the importance of pupils' cognitive understanding.⁵

The 'Electrifying the Country House' project revived some of these ideals for a more student-centred learning experience. Specifically it brought together the resources of social history with histories of technology, art and design, by drawing on the insights of Graeme Gooday's book, *Domesticating Electricity* (2008), to harness the role of country houses as key social laboratories in the late Victorian invention of electric lighting. After all, it was at Cragside that incandescent electric lights first lit the British home in 1880, with owner William Armstrong supporting the lighting experiments of his Newcastle friend Joseph Swan. Adopting the new illuminant slightly later, Standen and Lotherton Hall both still have original early electric lighting, marking them as pioneering sites of illumination at the turn of the twentieth century. Seen in this spirit, all of the partner sites offered an under-utilized resource for integrating public experience of social history, art history and physical science for teachers, parents and pupils.

Gooday's book, out of which this project grew, challenges the view of the history of electrification as a simple teleological process, where each new development necessarily had to be adopted at the expense of the old. Instead his story of the 'domestication' of electricity focuses on the stories of people adopting, adapting, or resisting technological change in a much more complex manner. By introducing pupils to such nuanced human stories of electrical innovation, we aimed to not only develop their historical understanding but also to help develop a range of historical skills such as using evidence, weighing significance, exploring cause and consequence, and continuity and change (Lee 2004; Lee 2005). In this work the process of storytelling played a key role, which we will explore in more detail below. As the Sutton Trust identifies, with the development of such 'advanced cognitive skills' being a key differentiating factor discouraging young people from aspiring to study in 'high status universities' across the globe, educational resources that aim to encourage cognitive understanding seem more vital than ever (Jerrim 2014).

With the broader support of the National Trust (Cragside and Standen) to take this scheme forward nationally, and Leeds Museums and Galleries (Lotherton Hall) to pursue the project locally, we aimed to facilitate a permanent shift in the overall roles of country houses as educational spaces, enabling them both to enhance the public understanding of science, and to appreciate the social history of country houses far beyond their traditional appeals. Moreover, by ensuring that young people are familiar early on with the deep interconnections between science, history and art, this project hoped to overcome early biases in subject choices formed during primary education (Pell and Jarvis 2001).

Although studies suggest that at primary school no significant differences exist between male and female pupils' attitudes towards or attainment in STEM subjects, a gap does appear later, when pupils move to secondary school level. This is prominent by GCSE age, and very

pronounced at A-Level (Department for Education 2007; Zecharia *et al.* 2014; Pell and Jarvis 2001: 852; Marchant and Hall 2003: 2). Recent research into attitudes towards STEM subjects among young people in the UK and Ireland, undertaken by the management consulting company Accenture, suggests that stereotypically gender biased perceptions of STEM subjects reduce female pupils' interest in studying these subjects, and that a visible decrease in interest occurs at ages 11-14, after starting secondary school.⁶

Education researchers Tony Pell and Tina Jarvis pointed out in 2001 that a general reduction in interest in science, which was not strongly gendered, could be seen by age 11: at this point both boys' and girls' enthusiasm for science appeared to be decreasing (Pell and Jarvis 2001). A survey of multiple studies, published by the Institution of Engineering and Technology in 2008, notes that an effective way to tackle both the reduced interest in science at this age, and the gender divide which emerges later, would be to create a new image of science in pupils' minds, to ensure that they remain interested as they grow older: '...the target audience for re-imagining STEM should be pupils in primary school, before that declining motivation and interest in STEM takes hold, i.e. pupils younger than 11 years-old...' (Haynes 2008: 9).

One way to achieve this re-imagining of STEM may be the integration of arts and humanities and STEM learning, and the use of the former may help promote the understanding of the latter. The application of more creative approaches to STEM subjects has become a pertinent debate over the past ten years, and particularly in the past five years some educators, especially in America, have pushed for the integration of the arts into STEM, promoting a new acronym: STEAM. Their argument is that the two areas are closely linked, one contemporary example being the important role of design in the success of the technology company Apple and its products such as the iPod and iPhone (Robelen 2011; Bequette and Bullitt Bequette 2012; Sousa and Pilecki 2013; Connor *et al.* 2015). In March 2013 a STEAM journal was founded (Maeda 2013). In October 2015 the Science Museum, London, brought together artists, scientists and teachers to discuss how a STEAM-driven ideology might be used to reshape the National Curriculum.⁷

Scholars in the field of education are arguing that history - and more particularly historical thinking and historical understanding - 'provides students (and the general public) with the best epistemological framework and analytical tools that they need to understand and navigate a complex social world' (Sandwell 2014: 81; Barton and Levstik 2004). This project, with its origins in the research of an historian of science and technology and an art historian, aimed to use historical thinking and interpretation to open up a wide range of creative questions framed by the idea of 'electricity'.

The project: 'Electrifying the Country House'

The project team, Gooday (Principal Investigator), Abigail Harrison Moore (Co-Investigator) and Michael Kay (Postdoctoral researcher) worked with the partner houses to develop resources to help pupils understand both the science of electric lighting and how country houses played a crucial role in bringing that science into the home. At the same time, the special history and circumstances of each house were cherished with bespoke resources on electrical lighting history that aimed to highlight the particular characteristics of each house.

The resources produced included an online interactive aimed at Years 4, 5 and 6 (8-11 year olds) that enables teachers to either prepare for a visit or use the history of electrification in the houses as case studies in the classroom.⁸ This interactive has the added benefit of familiarising pupils with simple electrical components, and the way in which they can be assembled to construct an electrical circuit - one of the key learning outcomes in the KS2 science curriculum. Guided by characters from the histories of the three houses, pupils are inspired to think broadly about what it was like to experience electric lighting and power for the first time in grand country homes, including the histories, aesthetics and social implications of the new electrical technologies.

Hitherto school groups have typically only visited country houses as part of the history curriculum, but Gooday's research clearly demonstrates the potential for stories of historic lighting to facilitate learning about science and technology too (Gooday 2008; Gooday and

Harrison Moore 2015; Kay and Gooday 2018). The resources developed for this project addressed Key Stage 2 of the National Curriculum, starting from Year 4, when students are introduced to electricity, and are expected, for example, to be able to identify common appliances that run on electricity and construct simple series circuits (National Curriculum 2013: 158). Combining the history of electrical technology with science also helps students in Years 5 and 6 to develop skills in identifying and evaluating scientific evidence and separating opinion from fact (National Curriculum 2013: 160). In the International Primary Curriculum (IPC) - which is used by over 1,300 schools in England⁹ - pupils learn about electricity through thematic units which combine knowledge about electricity with the social impact of electrical technologies. In particular, pupils aged 7-9 (Years 3 and 4) learn about the history of the electric light bulb in a unit called 'Science - Bright Sparks'. Another unit covers the way that technologies affect people's lives, and how inventions have made life easier or harder. These are key themes in Gooday's research.

Our interactive resource, informed by principles of instructional design, was developed out of experimental classroom sessions with a Key Stage 2 group of 10-11 year olds at Addingham Primary School, West Yorkshire, in November 2015. Instructional design can be defined as 'the analysis of learning and performance problems, and the design, development, implementation, evaluation and management of instructional... processes and resources intended to improve learning' (Reiser 2012: 5; Gagné *et al.* 2005; Piskurich 2000). This session helped us to test the pupils' responsiveness to a question and answer style process, the use of characters to tell stories, the role of drama and storytelling in history teaching, and the ways in which we could embed basic concepts such as the electrical circuit through interesting and exciting history learning. These were all interpretive aspects developed more broadly in the project's activities, discussed in the sections that follow.

Interpretative challenges in engaging audiences.

Over the course of the 'Electrifying the Country House' project, we attempted to engage a variety of audiences with country houses as sites for interdisciplinary learning in a number of different ways: through working with volunteers and staff at each partner house, producing house trails and animation content for use in the houses, dramatic interpretation of our research materials, and the production of our online interactive learning resource. In doing so we engaged both with the different interpretative challenges in each house, and also developed a three stage model which represents the broader history of domestic electricity throughout all of our three partner houses.

The houses, Cragside, Standen and Lotherton Hall, between them offer a model for demonstrating a narrative of the development of domestic electricity which progresses through three stages: experimental, fashionable, and normalized. Cragside represents the earliest stage of domestic electricity, from the late 1870s to the late 1880s, when the technology was still very experimental, not standardized, and not always reliable. Standen represents a second, fashionable, stage in the 1890s, when the possibilities of decorative electrical fittings were being explored by various authors, designers and homeowners, using advisory manuals such as Mrs J. E. H. Gordon's *Decorative Electricity* (1891) (Gooday 2008; Gooday and Harrison Moore 2015: 158-178).¹⁰ This focus on aesthetics is appropriate for Standen given its distinctive light fittings, designed by Philip Webb and W.A.S. Benson. It also emphasizes the significance of electricity in this period as a status symbol, in particular amongst *nouveau riche* homeowners such as the Beales, who built Standen in the early 1890s. In the final stage, represented by Lotherton Hall at the turn of the twentieth century, it would not have been surprising to have found electricity in upper-class homes - although it was still not commonplace - hence our term 'normalized'. Many houses were electrified around this time, and the technology was becoming more reliable and more widespread. Although previously it may have been dismissed by contemporary observers as too impractical to be widely used, or as a passing fad of interior design, by this third stage domestic electricity looked like a more realistic and practical prospect for wealthy households around the country (Dillon 1999).



Image 1. A wall-mounted light fitting in the Drawing Room at Standen.

This three stage model has been a useful way to think about the connections between the houses, and the way in which each fits into the broader national picture of electrification; Kay in particular has used this when giving public lectures and presenting conference papers. Following one talk at Standen, two volunteers noted in their feedback forms that these three stages provide a useful way to understand and explain the development of domestic electricity. One noted that they would be better able to 'place Standen's illuminations in a historical setting ie. the 'fashionable/aesthetic stage...'¹¹The three stages also serve to draw together different aspects of the technology which would otherwise be considered the domain of three separate disciplines: science, art and design, and social history. Together therefore they comprise a useful tool for interdisciplinary learning about electricity which has emerged from this project.

Each of our three partner houses offered its own specific set of challenges when it came to embedding our research into their interpretative materials and structures. The differences between the houses became apparent as we worked collaboratively on the original AHRC application with curators, educators and visitor experience experts at the houses, when they identified the most effective potential interpretation and educational tools for their audiences.

Lotherton Hall and Standen wanted house trail leaflets which could be given to visitors to guide them around the electrical points of interest in the houses. The priority at Cragside however was to minimise paper interpretation and encourage visitor interaction with volunteers instead. Given the National Trust's focus on the 'Spirit of Place' of invention and wonder at the property, it was appropriate for the Cragside volunteers to have a more technologically sophisticated method of talking to visitors about the use of electricity in the house (Lithgow *et al.*). However, due to the unreliability of wi-fi in the house, and the impracticality of assuming that guests would find this an unproblematic technology to use - factors which we also encountered in our other two partner houses - we decided that this resource should not need to rely on an internet connection.

When collaborating with the Cragside Visitor Experience Consultant on the form and content of this resource he noted that, while considerable emphasis is being placed on digital displays in museums, these tend to encourage digital interactivity at the expense of human interaction. At Cragside they preferred rather to preserve the house as a space where the visitor experience is not mediated solely through technology - visitors can thus escape from digital interpretation, and enjoy a more direct experience. In light of this we aimed to create digital

tools that would encourage interactions between visitors and house stewards and volunteers, thereby delivering a more dynamic form of interpretation in which the volunteers, rather than the technology itself, remained the mediators of the visitor experience.

To this end we employed an animator, a design student at the University of Leeds,¹² to produce three short animations about key electrical artefacts or systems in the house: the cloisonné lamps in the Library, the arc light which was used in the Picture Gallery from 1878-80, and the hydroelectric system which powered the lights. These animations are now being used on tablets by volunteers when talking to visitors. Over the course of the development process, we ensured that each of these animations was informed by our more general research into the history of domestic electricity, and by specific content from Cragside, and that the clear visual style would make it easy for volunteers to explain the content to visitors. We also provided documentation to accompany these animations, enabling volunteers to learn quickly and easily how to use the animations and thus securing the legacy of the resource.

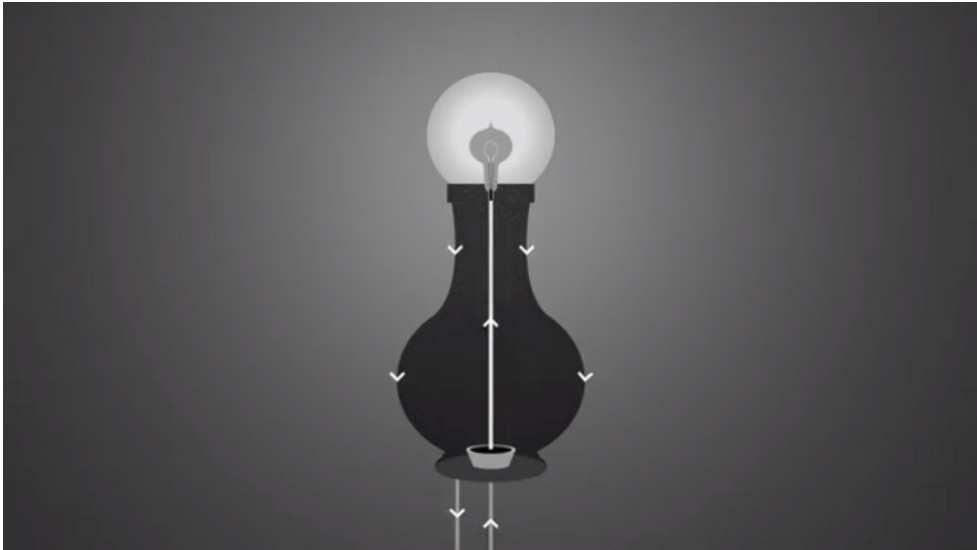


Image 2. The animation showing the workings of electrified cloisonné lamps at Cragside.

Technology and innovation have always been strong themes at Cragside due to the legacy of William Armstrong. However, at Standen, emphasising science and technology in house interpretation was something quite new. The house has traditionally focused on the significance of its architectural and design heritage as one of the most complete surviving examples of an Arts and Crafts house. However, as Harrison Moore and Gooday have demonstrated, Webb was an innovative designer in many respects, including his incorporation of electricity into the designs for Standen from the beginning (Harrison Moore and Gooday 2013). At Standen, therefore, the focus we were given by the house staff was to introduce volunteers and visitors to a subject which had previously been peripheral: although the fact that electricity was used at Standen from the beginning was emphasized as something significant, the way in which this connected with the aesthetic aspect of the history of domestic electricity, and in particular with the important role of women in deciding to bring electricity into the home, was not a focus. It was therefore appropriate to hold two talks at Standen, aimed both at volunteers and at the wider public, and to produce two house trails: one for adults, and one for families, the latter being a core focus for the property at present.

Lotherton Hall was the site of the original collaborative work which served as a pilot for our 'Electrifying the Country House' project; Gooday first worked with Lotherton Hall to interpret material from *Domesticating Electricity* in 2012, so this partnership was already well-established.

We were therefore able to build on previous experiences - including school group sessions and a public lecture - when working with house staff to plan our outputs for this project. Lotherton, due to its proximity to Leeds and due to the size and layout of the house itself, receives more school groups than Cragstone or Standen, and outside of term time will entertain a younger visitor demographic. Our outputs, as developed with staff at the house, reflected this: first, we ran an 'Old Science Week' during the summer holidays in August 2015, including activities focusing on the history of lighting and other electrical technologies for younger children. For example, we borrowed handling objects from Leeds City Council's object loans service, Artemis, and also made cup and string telephones as a crafts activity which could be used as a way to discuss the introduction of telephones into houses for the first time. Later in the project we also produced a template for a house trail for school children, as well as an adult visitor trail, and a short film which could be used as a school resource.

For all three houses we were able to make use of the fact that in most cases the artefacts or systems which we were interpreting were still in situ, and the visitors could thus see where they would have been used, and get a better idea of how and by whom. In February 2016, in the second half of the project, we held a workshop to which we invited country house and other heritage professionals to demonstrate and discuss our project aims and resources; one point which emerged strongly from our discussions with this audience was that technical artefacts and systems pose particular challenges for interpretation in a heritage setting for educational or curatorial staff who do not have relevant specialist knowledge. It is therefore important to help such interpreters to understand these aspects of their collections in order to support their subsequent engagement with the broader visiting public.

The resources of the project can be viewed on the project website.¹³ In the remainder of this paper, we will now focus in on three specific aspects of our activities and outputs: our work with volunteers, our dramatic interpretation outputs, and our KS2 online interactive resource.

Working with volunteers

From the beginning of the project it was important for us to engage with the volunteers and staff at each of the three country houses with which we were collaborating, as they are responsible for day-to-day interactions with visitors. As such, engaging tour guides and room stewards with our materials was the best way to ensure that the new research reached as wide an audience as possible. In addition, we sought to empower volunteers as an educational audience themselves; we asked for their advice and feedback about the content of the house trails in order to ensure that they were fit for purpose. We presented these to the volunteers before they were finalised in order to incorporate their feedback into the final versions.

Volunteers are responsible for delivering the project outputs which will have the longest lasting impact within the partner houses themselves: the Lotherton and Standen house trails and the Cragstone animations. The animations will be used in Cragstone by volunteers, who will show them to visitors on tablets when appropriate - for example when visitors ask about electricity in the house. In addition to the animations themselves, Kay also produced a comprehensive training document which suggests how the animations might be explained to and discussed with visitors. The house trails produced for Lotherton and Standen explain to visitors how electricity was used and what different people thought of it, and volunteers will play a key role in discussing these with visitors and helping them to engage with the content. They are now part of the regular visitor offer in each house, alongside more traditional content such as art trails or architectural information, and show visitors key electrical heritage artefacts or systems around the house. This demonstrates to visitors how important country houses were in the history of domestic electricity.

As an important part of our engagement with volunteers, as well as country house visitors, we gave public talks for each of our three partner houses which volunteers were encouraged to attend. In the case of Cragstone, Gooday and Kay spoke at the Newcastle Literary and Philosophical Society instead of at the house itself in order to reach a broader audience; as the original venue where Joseph Swan demonstrated his first electric lightbulbs in 1879 this was particularly appropriate. This talk was free and was well-attended by both Cragstone staff and volunteers and by the general public. Harrison Moore's and Kay's Standen talks also saw

large numbers of Standen volunteers, and lively question and answer sessions after the talks ensured both we and the volunteers got the most out of the sessions.

In our interactions with volunteers we were concerned with three main points: first, how we could build legacy into our work with volunteers, second, how talking to an academic about these project materials would make a difference to their interactions with visitors, and third, how we could effectively capture and incorporate their knowledge as part of the project. With regard to the first point, the main concern was that, as volunteers come and go, any knowledge and training which we provided directly could be lost within a short space of time. In addition, on a practical level we might not be able to meet with and talk to all of the volunteers in each house due to constraints on our, and their, time. Thus we provided the houses with resources to facilitate the future training of volunteers with regard to the project materials. This will enable volunteers to train one another and thereby maintain continuity.

Secondly, we wanted to ascertain the impact which speaking to an academic about the history of electricity in their respective houses would have on their visitor interactions. To better understand what participants felt they had gained from our talks, we used feedback forms, and asked attendees to tell us the most interesting thing they had learnt. One of the most common responses to this question was the role of women in the story of the uptake of domestic electricity. Some respondents noted that the importance of women in promoting the acceptance of the new technology was something of which they had been unaware; for others what was most interesting was the concerns of women regarding the brightness of electric lighting compared to softer gas, oil or candle lighting.

To assess the impact this would have on volunteers' practice, we asked: 'how will what we have discussed in this evening's lecture affect your work in the house and how you interact with visitors?' Responses to this question highlighted how the volunteers felt they would be better able to talk to interested visitors about the electric lighting in the house. Volunteers noted that many visitors were very interested in electricity, but they did not always feel able to answer questions on the topic. After our talk, most said they thought they would be much more confident discussing electricity. This supports the point noted above which came out of our February project workshop: many people working or volunteering in country houses find that scientific or technical topics pose particular interpretative challenges due to their lack of specialist knowledge. In addressing this our specific sessions for volunteers, as well as public talks which volunteers also attended, helped to familiarize them with this content.

Finally, we wanted to capture the specialist knowledge of volunteers about the houses in which they work. We encouraged them to feedback into the project and give us the benefit of their experience - for example, facts they may have picked up from visitors over the years. To this end we set up a section on our project website where they could write to us to share their stories. However, this was not successful, and we can conclude that gathering feedback and input from an audience of house stewards and volunteers, for whom computers and the internet are not necessarily second nature, should not rely primarily on these means. Rather, information might more effectively be gathered through interviews, or through a written activity conducted as part of a facilitated group exercise.

Dramatic interpretation

Although working with Theatre and Performance students on dramatic interpretation of our research materials was not something we originally envisioned being a large part of this project, our collaborations in this area nevertheless produced some of our most innovative and creative outputs. These included a musical, filmed guide characters for our KS2 history of electricity online interactive, and a short film shot at Lotherton Hall. Each of these outputs presents scientific and humanities subjects within a country house context. In using the medium of drama to deliver this historical content, we were aware of the advantages, but also of the limitations, of storytelling and the subjectivity of narrative. As Mieke Bal reminds us, 'narrative functions socially, ideologically, historically', highlighting 'the interplay between subjectivity and the cultural basis of understanding' (Bal 1994: 97). By presenting the materials in the form of a story we were, however, able to draw out the essence of the period, highlighting people's reactions to and opinions regarding electricity. Although events did not occur exactly as portrayed in our outputs, and characters were not representations of actual historical people, nevertheless the message conveyed about the characters and context was accurate.

To illustrate this, educational theorists Cathy Coulter *et al.* make a helpful distinction between a faithful representation and a literal representation: while the latter equates to what actually happened in a given circumstance, the former is the 'story-truth', which in some ways can help to provide a more realistic, relatable portrayal which is easier to learn a lesson from. Thus, as they note, we use a fictional story to demonstrate how people lived in as faithful a manner as possible (Coulter *et al.* 2007: 108). As educational philosopher Kieran Egan has argued in his classic text *Teaching as Storytelling*, this use of storytelling as pedagogy can be particularly effective when working with children, as it makes use of a fundamental way in which they understand the world, and of the power of their imaginations as learning tools. Stories, Egan says, reflect 'a basic and powerful form in which we can make sense of the world and experience.' (Egan 1988: 2).

Our musical output, called *Electrified*, was performed in December 2015 by third year Theatre and Performance students as their final year project.¹⁴ Written by the students, it took as inspiration Gooday's and Harrison Moore's work. It is based in December 1882, and addresses the aftermath of the death of William Dimmock, a labourer at Hatfield House, the ancestral home of the Gascoyne-Cecil family. Dimmock died of an electric shock when he accidentally came into contact with electrical wires in the Hatfield garden a year before the events of the play, and the characters, both the family and servants, have differing views about the desirability of having electrical lighting in the house.

In the musical, Robert Arthur Gascoyne-Cecil, 3rd Marquis of Salisbury, feels guilty for Dimmock's death, and Dimmock's two sisters Ruth and Mary have begun working at Hatfield House and at the Savoy Theatre, London, respectively. As Mary is a dancer in the new Gilbert and Sullivan operetta, *Iolanthe*, she emphasizes the significance of theatre to the story of electrification. The Savoy had been electrified shortly before - the first theatre to be so lit - and *Iolanthe* was the first production to be staged with the new electric lights. This represents another site traditionally associated with the arts but which also has a significant scientific and technological heritage with which we have engaged a new audience.



Image 3. University of Leeds Theatre and Performance students as electrically illuminated fairies from Gilbert and Sullivan's 1882 comic opera *Iolanthe*, performed as part of their original musical *Electrified*. Reproduced with kind permission of Alan Firth.

The musical, although fictional except for characters' names and the death of Dimmock, illustrates how not everyone was comfortable with, or convinced about the safety of, electricity. In particular it demonstrates the concerns of women that the electric light could be detrimental to their complexion – this is very memorably depicted in a musical number which sets the lyrics from a contemporary *Punch* poem 'A Lady on Electric Lights' (*Punch* 1882: 37) to new music. The dancers are shown the electric light under which they will perform for the first time, and are shocked at how bright it is - they lament their pale and pallid appearances under the glare. All three performances of the musical were very well-attended. As a full length production featuring new songs as well as music and lyrics from the period, the show can engage audiences with the research materials in an entertaining and amusing way, whilst emphasizing the importance of country houses in the domestic electricity narrative.

Our short film *Lotherton Electrified* was filmed with a small cast of students from the musical. In it, a reporter visits Lotherton Hall in 1904 to interview the family and servants about the new electrical lighting in the house, but is also concerned about an accident which recently occurred on the property. Like the musical, this is also fictional, but the fears and concerns which it illustrates were real, and electrical accidents, although not normally fatal, were not uncommon. Thus, although there never were any electrical accidents at Lotherton Hall, in writing the script for the short film Kay created characters able to portray the range of responses which Gooday and Harrison Moore's work have found in sources from this period. Examples include those excited at the aesthetic or technical possibilities of the electric light, or sceptical because they did not understand what electricity was or how it worked. In particular, the film highlighted servants' perspectives, one of whom was happy that the new lights did not give off any soot or smoke to blacken the paintwork, whilst another was wary, knowing that people had died through accidents involving electricity. This short film can now be shown at Lotherton Hall.

Each of these dramatic outputs emphasizes the views of women in this narrative. As noted above this is a popular way to frame the story, as audiences tend not to be aware of the roles many women played in promoting electric light, or in deciding to adopt it in their homes.

The success of these outputs is due in part to the appeal of the stories and anecdotes which Gooday brings out in *Domesticating Electricity*. These humanizing stories of the fears and hopes of the people of the time, and the sometimes amusing, sometimes tragic, accidents or problems they ran into, bring the period to life and lend themselves well to dramatization. As we consider the ways in which we might further develop this project in the future, the success and excitement of these dramatic outputs is something which we are keeping in mind. While not without its problems, the use of storytelling to portray events and facts in both history and STEM subjects, such as the science and technology of electricity, may provide an effective way to 're-image' STEM, as noted above. Michael F. Dahlstrom has argued that storytelling is an ideal way to communicate science to non-specialist audiences (2014). Presenting content in the form of a story is a naturally engaging method to encourage learning, and may prove helpful in stimulating and maintaining greater interest in STEM content.

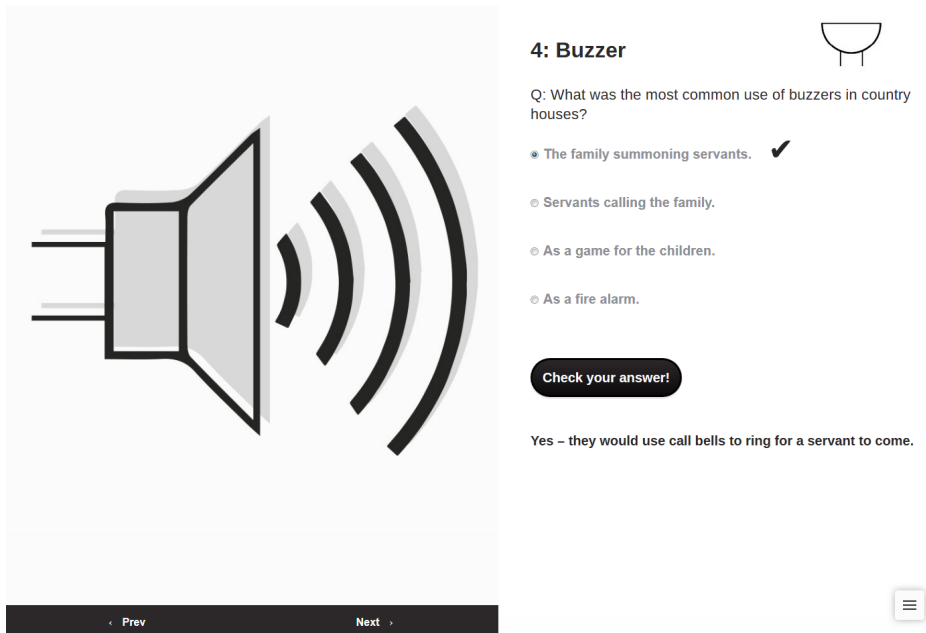
Online interactive

Our online interactive resource brings together the stories of each of the three partner houses to present a narrative of domestic electrification suitable for use in the classroom or by pupils working alone at home. It combines content from the science, history and design and technology curricula to provide a cross-curricular learning tool. As noted above, preferences for either science or arts and humanities subjects begin to develop early amongst school pupils, especially along gender lines, and by A-Level significantly larger numbers of boys than girls study physics and maths, and vice versa for the arts and the humanities (Zecharia *et al.* 2014). This online resource represents a large step taken by this project intended to counter this division, starting at the primary level, by integrating the two areas in a resource to be used by KS2 pupils, in particular those in Year 4 (age 8-9) and Year 6 (age 10-11). These are the two years in which electricity features in the science curriculum. Accompanying written resources document the ways in which the interactive links in to the National Curriculum. For example, it could be used as part of a local history topic, or as part of KS2 design and technology which encourages a focus on 'how key events and individuals in design and technology have helped shape the world' (National Curriculum 2013: 194).

The main body of the digital interactive comprises three floor plans, one for each house, and within each floor plan users are able to click on four rooms to find out more about the history of electricity in that room of the house. Clicking on a room displays a large photo of its interior, within which is a clickable hotspot, for example an electric lamp, a telephone, or an electric call signal board. Clicking on this hotspot opens a larger picture of the object, and a question about electricity which, when clicked on, will play a video answering the question and giving more information.

Each house has a guide character, played by a Theatre and Performance student. These characters introduce themselves to pupils at the beginning of the interactive, and then talk in each room about specific areas of the history of electricity - science and technology, aesthetics, and social history. Having produced these short videos for rooms in the houses, Kay also used these to structure public lectures at Standen and Lotherton, leading the audiences on virtual tours of the houses and expanding upon the themes raised in the videos. This was an innovative and engaging way of presenting the material which was well received. The Standen video clips are also on display there for visitors to watch, thus providing a simple and engaging way for visitors to learn more about the project materials alongside the house trails.

Over the course of the interactive, pupils are introduced to examples of six key electrical circuit components covered in the KS2 science curriculum: wires, bulbs, buzzers, switches, batteries and motors. The guide characters also present the circuit diagram symbols for each of these components. At the end of the interactive, pupils take a six question evaluative quiz which draws on the content from the videos. Each question corresponds to a circuit component, and at the end of the interactive the user can see an animated illustration of a circuit comprised of these components.



4: Buzzer

Q: What was the most common use of buzzers in country houses?

- The family summoning servants. ✓
- Servants calling the family.
- As a game for the children.
- As a fire alarm.

Check your answer!

Yes - they would use call bells to ring for a servant to come.

Image 4. A still from the quiz section of the interactive. The quiz comprises six questions, each of which corresponds to a circuit component and relates to the content from one of the three houses.

By using a thematic instead of subject-focused approach, our resource will be useful for primary teaching in science, history, art, and design and technology areas of the KS2 National Curriculum.

When working through the interactive, completing the content within each house unlocks the next, however it is possible for teachers to bypass this by navigating directly to the URL

for a specific house. This will enable the interactive to be used by teachers who wish to teach about one specific house, for example as part of a local history module if they are close to one of the three houses.

In building the interactive resource we employed basic principles of instructional design: 'a process for helping you to create effective training in an efficient manner' (Piskurich 2000: 1). Instructional design encourages a thought process which begins with analysis of the audience who are intended to use and learn from the output. This includes the manner in which they best process and assimilate information, and what methods or media are most effective in delivering educational content. Having ascertained this information, a teaching resource can be designed and developed accordingly, and should subsequently be tested and evaluated, with evaluation results feeding back into the final design (Gagné *et al.* 2005: 21; Reiser and Dempsey 2012).

This was particularly relevant when structuring the interactive resource: in November 2015, at the beginning of the process, Kay and Harrison Moore went to a local school, Addingham Primary School, West Yorkshire, to see how Year 6 pupils responded to content taken from the project. As part of this analysis phase, Kay developed an exercise for the pupils which comprised four 'character cards', each representing a historical figure from Cragside - some real, some fictional. On one side of the card was the character's name and a picture, as well as a question; on the other side was the answer, written from the perspective of the character and giving details about the history of electricity in the house and their opinion of it. The pupils were split into four groups, and each group was given a character. They thought about the question, read the answer and devised a short piece of drama to present the content to the rest of the class. This encouraged them to engage with the content by interpreting it as a story.

As noted above, this is an effective way for children to learn, and is particularly pertinent in the case of historical learning, which lends itself to narrative interpretation (VanSledright and Brophy 1992: 839-840). The teacher commented later that one of the things which made the session a success was the link to real historical people, and that the pupils 'really loved' the character card exercise.¹⁵

This analysis phase was important in the design of the interactive as it highlighted the importance of asking open questions: for example, who used a certain room or object, why an object was designed in a certain way, or what a certain person's attitude towards a given subject was. This encourages pupils to think about the answers before they are given any content, and acts as an effective hook. We therefore decided to structure the resource around a set of questions - one per room in each of the three houses - which addressed the themes of the project.

While developing this resource, Kay tested and evaluated it with Year 4 and 6 classes to ensure that the content and format were appropriate for this target audience. Based on these tests, the most effective form of delivery is from the front of the class with the teacher leading pupils through the rooms. In this way pupils can also be encouraged to lead their peers through parts of the interactive, for example one of the houses, thus offering an empowering learning experience. When trialling the interactive with these classes, feedback was gathered afterwards, and pupils were asked to answer three questions:

1. What was one thing you have learnt today?
2. What was one thing which you found difficult?
3. What would you like to know next?

From the answers to these questions, the Year 4 pupils tended to find the final quiz quite challenging, but picked out a variety of points to indicate what they had learnt, such as the fact that mercury is a metal, that electricity was more difficult to use and less reliable at that time, and that electricity could be powered by water, as at Cragside. The interactive aroused their curiosity, leading them to ask questions such as how people found out about electricity and how it works, what electricity might be like in the future, and how electricity was used on the Titanic. A few wanted to be able to look at more rooms in the houses, and to learn more about

the lives of the families who lived there. Thus, although some content is a little challenging for Year 4, it nevertheless encourages an enthusiastic engagement with the subject. Teachers can build on this, for example by exploring further aspects of the social history of the period, such as gender and class roles and how these have changed over time, or scientific subjects such as hydroelectricity and other renewable energy sources.

Year 6 pupils picked up on more details from the content of the videos, and were interested to learn about hydroelectricity, that electricity could be unreliable in this period, and that maids could be scared of electricity. They did not find the quiz as challenging, and many stated that they had not found anything too difficult about the exercise. The questions they raised indicated a high degree of engagement with the content of the interactive, for example: what other servants thought about electricity, when electricity became commonly used, and when switches were invented.

Conclusions

One of the key legacies from the project, in addition to the new digital and paper resources which we have produced, is the impact our activities have had on volunteers at each of the three partner houses. Dionne Matthews-Spence, Learning and Access Officer at Lotherton Hall, noted that the volunteers responsible for giving guided tours to booked groups:

...benefited the most from the input and knowledge sharing with the project officer as it has enhanced their delivery and interest in the subject. We have had comments about how useful it was to have the opportunity to be part of not only working with the university but being able to contribute to developing resources such as the adult trail. This has also encouraged further research and reading, as well as their confidence.¹⁶

In addition, Ben Dale, the House Manager at Standen, commented on the meetings which we held with volunteers at the property; these discussions served both to keep them informed regarding our work and to seek their input regarding our outputs:

...we had excellent feedback from everyone who said how useful it was to have these trails that highlighted the property's electrical heritage. It also gave many of them the confidence to talk about the electrical heritage at Standen with greater confidence to visitors.¹⁷

The animations which we produced for Cragside have been well-received by the volunteers who are using them to explain to visitors how various electrical items and systems worked; Andrew Sawyer, the curator, said that they are being introduced into new tours for the 2017 season, commenting that the animations 'will be useful to us in many ways into the future.' They have provided a good way to empower volunteers in their interactions with visitors, as Andrew Sawyer notes: '[the volunteers] are really excited to be the interpreters of the images as they play.'¹⁸

From this feedback, and also through verbal feedback from attendees at our project workshop in February 2016, we can see that there is a demand for a focus on science and technology in country house museum visitor resources. We suggest that the history of domestic electrification can also be made relevant to today's museum audiences by using our three stage model (experimental, fashionable, and normalized electrification) to discuss modern technologies which are currently moving through these stages. Another technique might involve reference to modern cutting-edge domestic technologies, for example smart homes, 3D printing, domestic robots or autonomous vehicles, all of which have the potential to change the way we live in the not-too-distant future. Examining historical electrical technologies can also provide a way to look at modern energy use, and themes of sustainability and renewable energy.

We believe that country houses comprise important venues for discussions about the history of technology because examples of historical technologies are often to be found still in situ; this gives a unique perspective on how people perceived these technologies, and how, where and by whom they were used. Nevertheless these opportunities can sometimes present their own difficulties, especially in the case of electrical technologies; such artefacts are often

small parts of larger systems which need to be interpreted but are more difficult to explain or describe. In such cases we believe the significance of, for example, a light switch, or an electrical call button, might best be explained in the ways we have demonstrated through this project - through the lens of social history or the history of aesthetics and design.

Ben Dale, the House Manager at Standen, commented: 'For too long this important aspect of the property's history had been underplayed and as a result of this project we will be able to share it with people and give it the status it deserves.'¹⁹ We anticipate that the success of this initiative - whether or not using the particular topic of electrical heritage - might result in plans to develop similar resources integrating STEM subjects with the arts and humanities to promote interdisciplinary learning opportunities within museum settings. Younger visitors to museums need never again be forced to make invidious choices about whether to engage with heritage as history, or pay attention to the sciences instead. Instead they can do both without challenging the expertise of their teachers, or the limits of the curriculum. Truly thereby can the old myth of the competing 'Two Cultures' be put to rest, with the museum (country house or otherwise) as the rightful home of a single unified culture.

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Notes

- ¹ See Harrison Moore, Abigail, 'Curriculum changes contradict vision for Britain's creative future', *The Conversation*, 18 February 2016. <http://theconversation.com/curriculum-changes-contradict-vision-for-britains-creative-future-54764>, accessed 25 January 2019.
- ² These changes have even led to parents 'striking' by removing their children from school to focus on different types of learning, see for example Mortimer, Caroline, 'SATs strike: Parents to take children out of school in protest over 'stressful' Year 2 exams', *The Independent*, 2 May 2016. <http://www.independent.co.uk/news/education/parents-due-to-take-children-out-of-school-in-sats-pupils-strike-protest-a7010311.html>, accessed 25 January 2019.
- ³ AHRC Grant AH/M009157/1: 'Electrifying the country house: taking stories of innovation to new audiences'. The project's website is located at <http://www.electrifyingthecountryhouse.org/>, accessed 25 January 2019.
- ⁴ 'Its educational work is so valued that schools as far afield as Portsmouth and Redcar are prepared for pay for their visit...It is the jewel in the crown for Wakefield Council and there are few places in the country where children can learn and become part of living history', 'Wakefield's Clarke Hall "living history" museum facing closure', BBC News, 22 March 2011. <http://www.bbc.co.uk/news/uk-england-bradford-west-yorkshire-12815881>, accessed 25 January 2019. See also 'Former Wakefield museum Clarke Hall is put up for sale', BBC News, 13 April 2014. <http://www.bbc.co.uk/news/uk-england-leeds-27009623>, accessed 25 January 2019.
- ⁵ See: <http://www.thenhier.ca>, accessed 25 January 2019. These have informed research and practice developed by organisations such as The National Centre for History Education Australia and Canada's History Education Network (THEN), whose educational programmes have recently been introduced across all ten provinces. The 'Great Unsolved Mysteries in Canadian History' project provides engaging, high-quality materials to schools and universities for the teaching of historical methods and Canadian history that encourage cross-disciplinary learning. The project, based at the University of Victoria, the Université de Sherbrooke and the Ontario Institute for Studies in Education at the University of Toronto, has created a series of instructional websites based on the premise that students can be drawn into Canadian history and archival research through the enticement of solving historical cold crimes. Such web resources offer inspiration for the next generation of country house education, using questions to generate creative learning, and encouraging pupils to 'solve' challenges in a manner that embeds multiple learning styles. See: <http://canadianmysteries.ca/en/about.php>, accessed 25 January 2019.

- ⁶ 'Accenture Finds Girls' Take-up of STEM Subjects is Held Back by Stereotypes, Negative Perceptions and Poor Understanding of Career Options', 7 February 2017. <https://newsroom.accenture.com/news/accenture-finds-girls-take-up-of-stem-subjects-is-held-back-by-stereotypes-negative-perceptions-and-poor-understanding-of-career-options.htm>, accessed 25 January 2019.
- ⁷ 'STEAM Hack October 2015', 16 November 2015. <http://www.culturallearningalliance.org.uk/news/steam-hack-october-2015>, accessed 25 January 2019.
- ⁸ The online interactive resource can be viewed here: <https://www.electrifyingthecountryhouse.org/wp-content/plugins/etch-ks2-interactive/html/index.html>, accessed 25 January 2019.
- ⁹ Fieldwork Education, 'Introducing the International Primary Curriculum (IPC)'. <https://fieldworkeducation.com/curriculums/primary-years>, accessed 25 January 2019.
- ¹⁰ Mrs Gordon's *Decorative Electricity* is available online at: <https://archive.org/details/decorativeelect00fellgoog>, accessed 25 January 2019.
- ¹¹ Evaluation from Standen talk, 14 April 2016.
- ¹² This was part of an original ambition which we built into the project at the beginning to provide professional development opportunities for students at the University where possible.
- ¹³ The resources page of the project website can be found here: <https://www.electrifyingthecountryhouse.org/downloads/>, accessed 25 January 2019.
- ¹⁴ The musical was directed by George Rodosthenous and Tony Gardner of the School of Performance and Cultural Industries at the University of Leeds.
- ¹⁵ Teacher's evaluation from teaching session, 30 November 2015.
- ¹⁶ Dionne Matthews-Spence, personal communication, 11 July 2016.
- ¹⁷ Ben Dale, personal communication, 19 July 2016.
- ¹⁸ Andrew Sawyer, personal correspondence, 3 November 2016.
- ¹⁹ Ben Dale, personal correspondence, 19 July 2016.

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