

# Lindsay Keith

## SMASHfestUK

**A participatory action research  
programme resulting in the development  
of a novel model, 'SCENE' for inclusive  
public engagement with research**



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Keith developed an innovative science/technology/engineering/arts/maths (STEAM) festival (SMASHfestUK) based on participatory action-research (PAR) using inclusive, co-design approach methods. SMASHfestUK explored the under-representation of white working-class and Black, Asian and Minority Ethnic ('BAME') people in arts/cultural spaces and informal science learning, creating, prototyping and testing solutions. Keith developed a dynamic model, "SCENE," for inclusive public-engagement. SCENE uses narratives, community-co-design, enquiry, entertainment and hyper-local approaches to engage publics. This pioneering model was developed dynamically over annual iterations, exploring and improving the representation of underserved/under-represented audiences.

SMASHfestUK designed co-design workshops with stakeholders (school pupils, families, scientists, academics, engineers, students, teachers, researchers) prior to each festival. Workshops results informed the engagement model so each festival reflected stakeholder input. After each festival independent evaluations using front-end and summative methods

capturing quantitative comparative data and qualitative reflection took place. Findings fed into SCENE. Inputs were mapped against outcomes in a theory-of-change model revealing leverage points where the smallest inputs yielded largest results. The changes, aimed at improving and deepening engagement of audiences, were incorporated into PAR and co-design for the next festival/iteration.

The significance of SMASHfestUK and SCENE is evidenced by changing practice, changing policy and impact of outcomes. SCENE resulted in 71% Black/Black - heritage under-16s at SMASHfestUK, (compare to 11% at the British Science Festival). Changing practice: UK Science Festivals Network now actively promotes co-design methods. Keith consulted/quoted in UKRI "Museums of the Future" report. Panelist at NESTA "Everyone Makes Innovation Policy" event, and contributed to an All-Party-Parliamentary-Group on STEM Inclusion/Diversity. SMASHfestUK consulted for the Science and Technology Facilities Council's new public engagement strategy (2017) and "Wonder" initiative to reach underserved audiences. Presented at ERASMUS+ NATRISK (<http://natrisk.ni.ac.rs/>) as a method for engaging publics in disaster planning. Findings from SCENE are also incorporated into "Tomorrow's Engineers" code of practice involving 100 organisations including Engineering UK, BP, Shell, RAE and DfE.

1.A note on terminology: At the inception of this research in 2015 the term BAME as an acronym for Black, Asian and Minority Ethnic people was in common formal useage in academic research and other industries, SMASH-UK no longer uses this term preferring (in consultation with our stakeholders) to use Black, Black Heritage or Mixed heritage, Asian or Ethnic Minority, however for legacy reasons it appears in this portfolio.

## Contents

|             |   |
|-------------|---|
| Component 1 | Codesign and SMASHfestUK 2015: Asteroid   |
| Component 2 | Codesign and SMASHfestUK 2016: Sola Storm   |
| Component 3 | Codesign and SMASHfestUK 2017:<br>Supervolcano! And 'The Earth and Sky Tour'                                |
| Component 4 | Codesign and SMASHfestUK 2018: Flood  |
| Component 5 | Codesign and SMASHfestUK 2019 Space<br>Plague! (Bradford) and SMASHfestUK 2020<br>"Space Plague" (Deptford) |

## Venues

|                      |   |
|----------------------|---|
| Components 1-2-3     | The Albany Theatre, London, SE8 4AG<br>(2015-2018)                                      |
| Components 1-2-3-4-5 | The Deptford Lounge London, SE8 4RG<br>(2015-2020)                                      |
| Components 3 and 5   | Bradford City Park, BD1 1HY (2017 and 2019)<br><br>Neath Market Square, SA11 3NA (2017) |
| Component 3          | Gloucester Library 2017, Gloucester, GL2 0AJ<br>(2017)                                  |
| Component 3          | General Gordon Square, Woolwich, London<br>SE18 6FH (2017)                              |
| Component 3          | The Grahame Park Estate, Colindale, London,<br>NW9 5QY (2017)                           |

## Table of Contents

|    |   |
|----|---|
| 7  | <b>Introduction and Context (Components 1-2-3-4 and 5)</b>  |
| 6  | <b>Research Questions:</b>  |
|    | <b>Summary of findings, iterative design and conclusions:</b>   |
| 9  | Component 1: SMASHfestUK 2015: ASTEROID!  |
| 10 | Component 2: SMASHfestUK 2016 Solar Storm!  |
| 11 | Component 3: SMASHfestUK 2017 Supervolcano! And 'The Earth and Sky Tour'                              |
| 12 | Component 4: SMASHfestUK 2018 Flood!  |
| 13 | Component 5: SMASHfestUK 2019 Space Plague! (Bradford) and SMASHfestUK 2020 Space Plague! (Deptford)  |
| 14 | Conclusions:  |
|    | <b>Detailed information, data and evidence for components 1-2-3-4 and 5</b>                           |
| 16 | Component 1: SMASHfestUK 2015: ASTEROID!  |
| 33 | Component 2: SMASHfestUK 2016: Solar Storm!   |
| 49 | Component 3: SMASHfestUK 2017: Supervolcano   |
| 62 | Component 4: SMASHfestUK 2018: Flood!   |
| 74 | Component 5: SMASHfestUK 2019 Space Plague! (Bradford) and SMASHfestUK 2020 "Space Plague" (Deptford) |

## Introduction and Context (Components 1-2-3-4 and 5)

In 2013 a study was carried out into the science aspirations of 10-14 year old school pupils in England (Archer, 2013). The study showed that certain demographics did not aspire to study or choose careers in science, including some BAME groups and white working classes (WWC). The study gave rise to the concept of "science capital" which correlated with aspirations to enjoy, study and have careers in science subjects (Archer et al., 2015). Assets which raise science capital include a) recognition of the role that science plays in everyday life, b) whether families talk about science, and c) whether visits to informal science learning (ISL) events or locations (such as science museums or centres) factored in a child's upbringing (DeWitt, Archer and Mau, 2016). Visitor data showed that BAME and WWC people are under-represented in visitor demographics to ISL activities and venues (Dawson, 2015, 2017; Kennedy, Jensen and Verbeke, 2018). Historically people represented in these demographic groups were referred to as "hard to reach" audiences (Parkinson, Buttrick and Wallis, 2013). In regard to the above Keith set out to explore the following research questions:

### Research Questions:

- What are the barriers to access to informal science education for BAME and WWC people?
- Can these barriers be overcome?
- What mechanisms can be used to increase science capital?
- Do these mechanisms change attitudes to science?

Keith took a participatory action research (PAR) approach to answering these research questions, and in doing so adopted a framework of human-centred co-design to develop testable, iterative prototype experiences to investigate and test their hypotheses (Burns et al. 2011; Sanders & Stappers 2014). The design approach is similar to a reflective cycle used in teaching and described by educationalist Graham Gibbs (Gibbs 1991), but also draws on the principles of co-design as described by Sanders and Stappers (2014) which incorporate design approaches and a design-based prototyping and iteration cycle (Figure 1).

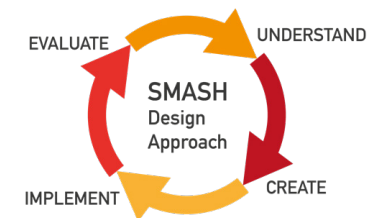


Figure 1: The SMASHfestUK design approach is similar to the Gibbs reflective cycle but takes into account the physical creation and prototyping of a tangible product or service. It also draws on the principles of co-design.

It was determined that the optimum platform to test the research framework and hypothesis would be the creation of a new STEAM festival, as this would provide a platform and locations for carrying out PAR in communities that represented those demographics (BAME and WWC) that were underserved and under-represented in STEM engagement activities. The festival, SMASHfestUK (Figure 2.1 and 2.2) was developed through a co-design approach involving iterative cycles of insight gathering, ideation, prototyping and validation working with a wide range of stakeholders in interdisciplinary creative collaborations.

The UK Science Festivals Network is run by the British Science Association and collects demographic and other evaluation data from a range of science festivals across the UK. SMASHfestUK joined this network to allow their research and evaluation data to be accessed and used more widely by the UKSFN in combination with a network of other science festivals across the UK to contribute to nationwide insights into engagement practices.

The results of this research are beginning to be published in the academic literature, though this process is not yet complete. The following three journal papers explore some (but not all) of the work represented in this multi-component output submission.

-Keith, L. & Griffiths, W. 2020. 'Space Plague': an investigation into immersive theatre and narrative transportation effects in informal pandemic science education'. *Journal of Science Communication* 19 (07) <https://gala.gre.ac.uk/id/eprint/30696/>

-Keith, L. & Griffiths, W. 2021. Communities and Narratives in Neglected Spaces: Voices from SMASHfestUK. *Journal of Science Communication* 20 (01) <https://gala.gre.ac.uk/id/eprint/30697/>

-Keith, L. & Griffiths, W. 'SCENE': a novel model for engaging underserved and under-represented audiences in informal science learning activities. *Research for All* (accepted on abstract, under review)

SMASHfestUK

Fig.2.1



Fig 2.2



Fig 3

Fig.2.1 SMASHfestUK logo designed in 2014 using feedback from co-design events by Geof Banyard (@DoctorGeof) a contemporary artist who's influences draw from British urban art and steampunk aesthetics.

Fig 2.2. This was later incorporated into the logo for SMASHfestUK research

Figure 3: The distribution of UK science festivals who are represented by the UKSFN Logo

## Summary of findings, iterative design and conclusions:

### Component 1: SMASHfestUK 2015: ASTEROID!

A literature review and co-design processes were used to derive a set of principles to guide an inclusive engagement process to target engage BAME and WWC demographics with STEM. This led on to the co-designed development of a format for a 'hyperlocal' science and arts festival which would, importantly (and uniquely for a science festival) be narrative-lead. 'SMASHfestUK '2015 Asteroid!', was devised and used to engage targeted socio demographic communities and succeeded in attracting more than 1000 visitors in Deptford, a socio-economically challenged area of South East London, over 5 days. Data showed that the visitors were largely (85%) drawn from the Deptford area and surrounding postcodes and that, demographically, the audience largely comprised BAME and WWC visitors. From this success a Theory of Change was developed as the first element of a dynamic model for inclusive engagement that would be used to underpin successive festivals. Specific findings from 2015 also showed that child visitor ages skewed younger than expected (<12) and the model was adapted to widen the reach in 2016. Unusually for a science festival, the event attracted more girls than boys. Feedback also suggested that the narrative and immersion within a story was effective at engaging visitors, and that the local/personal approach was important, so these would be developed for the following year's festival.

## Summary of findings, iterative design and conclusions:

### Component 2: SMASHfestUK 2016 Solar Storm!

The 2016 festival ("SMASHfestUK 2016 'Solar Storm!'") incorporated 35 unique events and attracted 1048 attendees for ticketed shows with a further 850 attendees to drop-in activities, increasing the audience significantly on the year before. 94 artists and creatives were directly involved in the co-produced event including 40 scientists and 64 collaborative projects.

Following a successful but limited schools outreach pilot programme in 2015, in 2016 a SMASHfestUK Community Audience Development Programme and Schools Outreach programme ran all-year long, engaging 2924 school pupils and local children. Evaluation showed that the event was reaching new audiences, with only a minority having been to another informal science learning event or venue, but also built a loyal following of 30% who had attended the year before, with the majority of visitors being local to Deptford. The model was shown to be successful in engaging visitors with low science capital, as intended, reaching BAME communities particularly which made up >70% of the child visitors. 42% of visitors reported that they might consider a STEM career and 100% reported that they would be more likely to study a STEM subject following attendance at the festival. A new "Young Explainers" programme successfully attracted older children and young adults successfully as creators and facilitators instead of audiences, with some of this

cohort going on to study STEM subjects at university level. Although the facilitating team were diverse ethnically and by gender, it was noted that extra effort to attract black, male scientists to help deliver activities in 2017 would provide more effective role models for visitors. Further, with greater resources to put towards evaluation it was determined to focus more on collecting data for proxy measures of science capital.

In 2016 SMASHfestUK was awarded 1st prize in the National Co-ordinating Centre for Public Engagement (NCCPE) 'Engage' awards for public engagement with the judging panel noting "*This is a truly innovative project. It is really effective to have a hyper local approach that is narrative-based and semi-immersive. They challenged concepts of hard to reach, and worked with young people to create a festival everyone wanted to be part of.*"

## Summary of findings, iterative design and conclusions:

### Component 3: SMASHfestUK 2017 Supervolcano! And 'The Earth and Sky Tour' Space Plague!

In 2017 the staff and volunteers delivering the festival ("SMASHfestUK 2017 'Supervolcano!'") were more diverse than ever with significantly more BAME males in attendance, and including outreach activities and programmes, more than 6000 local people experienced a SMASHfestUK event directly or through the community development and schools outreach programmes. The festival's online presence also spread with more than 60,000 people watching an online broadcast of a 5 metre tall model cryovolcano "eruption". Direct visitors to the festival numbered 2676, an increase of 800 on the previous year. The audience again comprised mostly local people with 57% BAME visitors (combined adults and children) and reached new audiences with 71% reporting to have never attended a similar informal science learning (ISL) event or venue. Evaluation data indicate that SMASHfestUK was successful at building/raising science capital in both visitors and volunteers, formally training 15 engineers and 32 apprentice engineers in public engagement methods, and increasing library visitors by 32%. In 2017 the Theory of Change model was updated to a logic model which is still in use.

In 2017, SMASHfestUK, alongside 12 partner primary schools in South East London, was awarded a prize for innovative collaboration by The Engineer, in their prestigious "Collaborate to Innovate"

Awards. SMASHfestUK also became recognized for its successful approach to inclusive engagement and was made a case study for best practice for a number of organisations including the STFC, The Royal Academy of Engineers, The Wellcome and the Million+ Society of Modern Universities.

During 2017 SMASHfestUK's "Earth and Sky Tour" moved outside of its Deptford's base for the first time. Touring a condensed version (1 or 2 day events) of 'Supervolcano' to five new areas – Colindale, Woolwich, Neath, Bradford and Gloucester, this programme of mini-festivals tested the hypothesis of taking the 'hyperlocal' approach to communities remote from the SMASHfestUK base and showed that it was possible to replicate the findings of engagement in other under-served communities.

## Summary of findings, iterative design and conclusions:

### Component 4: SMASHfestUK 2018 Flood!

Once again the festival increased its audience, rising 32% to 3526 direct visitors, of which more than 92% were local to Deptford and south east London, and engaged more than 60 volunteers, 11 universities, 4 museums and 58 researchers in 46 activities or performances, many of which were delivered multiple times over the course of 5 days. For the 4th year running there was a positive gender skew towards girls compared to boys, and for the second year running evaluation showed that science capital was built and/or raised in visitors, both adults and children. The data also established that the increase in science capital was greatest in BAME and WWC visitors, and that the greatest increase in visitors was to the library venue. Although the venues were close together physically, it was notable that there was a difference in the demographics of attendees, with more BAME and WWC visitors going to the library venue, and therefore more effort was put into increasing the STEM content of events in this venue.

In 2018 SMASHfestUK was again awarded a 'Collaborate to Innovate' award by The Engineer for the work done with its outreach primary schools, and was additionally the winner of the prestigious Times Higher Education Award 2018 for Outstanding Contribution to the Local Community. Taking the findings of the 4 years of festival work together, Keith and Griffiths developed the SCENE Model for

Inclusive Engagement (Keith & Griffiths in press) which describes a method for engagement that uses narrative transportation in order to effect change in real life, and decided to further test the roles of embodiment and immersion in stories by creating a fully immersive experience for the next SMASHfestUK event. SCENE is an acronym of STEAM (science, technology, arts, engineering and maths), Community, Enquiry, Narrative and Entertainment.

Narrative transportation refers to the extent to which audiences, or visitors, or consumers are transported to a fictional world. The narrative refers not to the story they are told, but that which they create for themselves within the story. There is evidence to suggest that narrative transportation can change attitudes in real life. When young visitors were observed to report an increased likelihood of choosing to study STEM subjects or choose a STEM career after a SMASHfestUK experience, it was proposed that this was the effect of narrative transportation within a SCENE framework.

Taking the findings from 4 annual iterations of the SMASHfestUK codesign and research cycles together, it was proposed to further explore the roles of embodiment and immersion in stories in creating narrative transportation effects, by developing a fully immersive experience for the next SMASHfestUK events.

## Summary of findings, iterative design and conclusions:

### Component 5: SMASHfestUK 2019 Space Plague! (Bradford) and SMASHfestUK 2020 Space Plague! (Deptford)

In 2019 and 2020 Keith, working with SMASHfestUK devised, produced and delivered a fully immersive theatrical experience, 'Space Plague', which told the fictional story of a novel disease which arrives on earth following a meteor shower and threatens a global pandemic. Although the coincidental timing with COVID-19 arriving in the UK was purely serendipitous, the authors were able to pivot the production towards pandemic education, and this has been reported in a recent article in the Journal of Science Communication COVID-19 Special Edition. Initial evaluation showed that adopting the SCENE methodology for engagement resulted in again reaching audiences which were highly diverse and represented BAME communities well, making up half of the audience. The data for science capital showed even greater rises in science capital than had been observed for the earlier festivals which were narrative driven but only semi-immersive in nature. Longer term follow-up has been hampered by COVID-19, but will take place in 2021 to see if the effects on science capital of narrative transportation, embodiment and immersion are lasting. Keith and SMASHfestUK have also developed Space Plague as a digital Virtual Reality game, to explore whether digital immersion is as effective as real life immersion in creating narrative transportation.

**Conclusions:**

It is proposed that immersive and inclusive engagement processes in which audiences are embodied as actors with agency within stories could be a potent way to positively affect attitudes and behaviours towards science in real life. The experiences of Keith with SMASHfestUK has shown that the positive effects of such activities in semi-immersive story-lead festival events is accentuated and deepened in more fully immersive events and environments. These findings could have the potential to affect both informal and formal educational approaches to science education in future.



## Detailed information, data and evidence for components 1-2-3-4 and 5

Component 1:  
SMASHfestUK 2015: ASTEROID!

The Albany Theatre, London  
The Deptford Lounge, London

Evaluation: <http://gala.gre.ac.uk/id/eprint/19848/>

Codesign process: <https://www.flickr.com/photos/30542236@N04/albums/72157710825806791>

Festival: <https://www.flickr.com/photos/30542236@N04/albums/72157710821787818>

12 – 17 February 2015

Deptford Demographic:

The location chosen to host the festival was Deptford (see Figure 3), a former Metropolitan Area of London which is now largely located in the London Borough of Lewisham and comprises Evelyn and New Cross wards (see Figure 4). Historically, Deptford was a prosperous maritime town which existed as a Metropolitan Borough of London until 1965 when it was split into two, and came under the authority of The Royal Borough of Greenwich and Lewisham Borough Council respectively. The demise of the Deptford Dockyards, shipbuilding and subsequently power stations along the banks of the River Thames left Deptford as a poor London town with every ward in the lowest or second lowest quintile according to the Index of Mass Deprivation 2019 (see Figure 6)(Hill and Baliff, 2012; Department for Communities and Local Government, 2015) Deptford has a high number per

capita of social housing tenants compared to homeowners and is also highly multicultural with black and black mixed heritage being the largest ethnic group making up 44 of the local adult population (Potts, 2008).



Figure 4: Location of London Borough of Lewisham, highlighted in darker red, within the Greater London Metropolitan Area



Figure 5: Wards of the London Borough of Lewisham. Deptford takes in Evelyn and New Cross wards in the North of the borough, adjacent to the River Thames between Rotherhithe and Greenwich, and opposite the West bank of the Isle of Dogs (Canary Wharf).

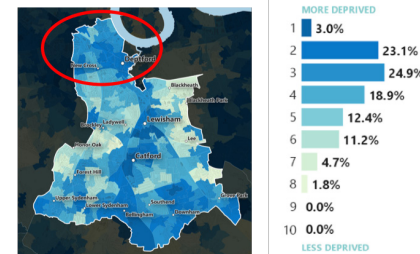


Figure 6: Data from Indices of Multiple Deprivation in England (IMD2019) mapped onto a map of the London Borough of Lewisham showing poverty in deciles, with darkest blue representing the greatest poverty. The majority of Deptford and its environs in the North of Lewisham Borough, (circled in red), can be seen to be in the lowest two deciles compared to the rest of the population of England i.e. in the 20% of the population who live with the greatest poverty (Department for Communities and Local Government, 2015). Maps created from IMD 2019 data by Alistair Rae of the University of Sheffield (Rae, 2019).

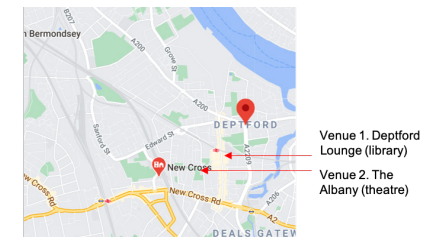


Figure 7: Markers showing the centre of Deptford and the locations of the main SMASHfestUK festival venues, "The Albany" an open plan community theatre, and the "Deptford Lounge". Illustration derived from Google Maps ('Google Maps', 2020).

### Co-design process: UNDERSTAND

A complete photographic record of co-design processes for Component 1 (SMASHfestUK 2015 Asteroid!) can be found here: <https://www.flickr.com/photos/30542236@N04/albums/72157710825806791>

The first process undertaken was a series of co-design workshops and activities with a wide range of stakeholders, in order to take a participatory co-design approach to the development of the festival. The purpose of this element of the co-design process was to discover and explore barriers that may exist to local engagement in South East London and to define these barriers ahead of the next stage of the cycle, which would be “create”, to generate ideas to overcome the barriers discovered.

The co-design process included Artists workshops, Engineers workshops, Audience workshops, Collaborative workshops, a public lecture series, an awareness raising campaign, a co-produced “zombie” film co-created with students from Deptford Green Secondary School, Haberdashers’ Askes’ Free School primary and Middlesex University Department of Design Engineering and Mathematics. The authors carried out co-design workshops with a number of stakeholders including local schools, Lewisham Council, Lewisham Homes Residents, Lewisham’s Young Mayor’s Office (Figures 8A and 8B).

Ethnographic analysis of the potential audience was undertaken in collaboration with BA/BSc Product Design and Engineering Students from Middlesex University who visited Deptford and spoke to residents to inform the festival design process (Figures 9A and 9B).



Figure 8A and 8B: Co-design workshops with schools ambassadors and representatives of the Lewisham Young Mayor’s Office, Mayor’s Office, Civic Suite, Catford, London SE6 4RU Mon 10 Nov 2014, and Monday 7th December 2014, London



Figure 9A and 9B: Middlesex University BA/BSc Product Design and Engineering students carrying out co-design site visit to Deptford, exploring the High Street, Deptford Market, The Albany Theatre and Deptford Lounge (festival venues) 13th November 2014.



Figure 9C (montage) Co-design workshoping design solutions at Middlesex University to overcome barriers to engagement learned about during ethnographic field studies to Deptford and interactions with local people.

**Defining the barriers to engagement identified during co-design process**

The outputs from the workshops were synthesized into this list of likely and potential barriers to inclusion (see Table 1)

An exploration of some of the barriers to access and engagement with informal science learning (ISL) identified during the co-design process in empathy modelling and creative conversations with likely audiences, visitors, family, community and school groups.

**Table 1**  
**Barriers to inclusion identified through co-design workshops**

| Barrier                  | Description  |
|--------------------------|--|
| Preconceptions/Attitudes | Young people and sometimes their families too, have a preconceived notion of what science is, and what scientists do and that science is “not for me”. In addition, engagement spaces such as universities or museums are not perceived as neutral but also as spaces with gatekeepers at which not all are welcome.   |
| Distance/Effort          | Some families would like to visit the science museum or natural history museum but this might take considerable effort on their part. It is easier to engage with activities locally. Sometimes (particularly in school holidays) parents need activities for children but may not be able to afford the time themselves.  |
| Interest/Motivation      | Related to science being “not for me” are notions that it is boring and therefore motivation to engage with science, particularly out of school is low. Motivation is high for activities that are perceived as exciting, such as fairground rides. Thrilling activities and exciting stories (zombies/aliens) are perceived as fun. Science is not. In relation to this, – spaces such as museums or universities are perceived as barriers |
| Cost                     | For parents and community groups time and financial resource are large considerations and may be prohibitory in attendance and engagement with informal science learning (ISL)   |

**Codesign process: CREATE**

Keith then embarked on a second phase of the co-design process, ‘create,’ to explore principles that could be used to overcome the barriers to engagement that had been identified.

The findings from the co-design process were synthesized into a set of guiding principles which, it was suggested, would help ensure that the festival would be inclusive and attract audiences that might not normally attend informal science learning events. The synthesized principles were subjected to a search of the literature to see whether precedents already existed to support the design interventions planned for the festival.

Table 2: The findings from the co-design process were synthesized into a set of guiding principles which, it was suggested, would help ensure that the festival would be inclusive and attract audiences that might not normally attend informal science learning events. The synthesized principles were subjected to a search of the literature to see whether precedents already existed to support the design interventions planned for the festival.

**Table 2**  
**Evidence-based principles that guided event design.**

| Principle and Description  | Evidence  |
|--|---|
| <p><b>Use “STEAM”</b><br/>           STEAM (Science, Technology, Engineering, Arts and Maths): an inclusive approach to engaging audiences with STEM and the Arts, with recognition that the integration of the Arts to STEM is not purely acquisitive but vital for meaningful learning, creative problem solving and social development.</p>   | <p>(Colucci-Gray et al., 2019; Henriksen, 2014; Land, 2013; Siepel et al., 2016)</p>                                    |
| <p><b>Make it “Hyperlocal”</b><br/>           An extension of the term “hyperlocal” beyond news media to mean engagement in the heart of the community. The festival and its content would be co-designed “with the community, in the community”. Venues must be local, public and accessible and must reduce barriers that arise from formal “non-community” venues such as museums or university locations.</p>  | <p>(Cable &amp; Williams, 2014; Foth et al., 2013; Harden et al., 2015; Leigh, 2017; Mytton et al., 2014)</p>           |
| <p><b>Lead by entertainment - don’t use potentially offputting names or labels</b><br/>           To overcome barriers perceived by those who think science is “not for me” it was not branded or marketed as a science festival but designed to appeal to mainstream audiences looking for entertainment/ something to do, regardless of science attitudes. This was the reasoning behind calling the festival “SMASHfestUK” and not branding it as a “science” festival.</p> | <p>(Archer &amp; Tomei, 2014; Chan, 2019; Nemeč &amp; Trna, 2007; Slater &amp; Rouner, 2002; Vorderer et al., 2004)</p> |

| Principle and Description  | Evidence   |
|--|--|
| <p><b>Use good (true) codesign practices</b><br/>           True co-design – working with stakeholders including audiences, researchers, STEM industry, artists was carried out to empower and engage end-users in and with the resulting product.</p> | <p>(Moser, 2016; E. (Make T. L. Sanders &amp; Stappers, 2014; E. B. Sanders &amp; Stappers, 2014)</p>  |
| <p><b>Impose an overarching narrative</b><br/>           Impose an overarching narrative Evidence from the use of stories to engage and affect science identity and attitudes in real life was used to underpin the narrative approach.</p>            | <p>(Bidarra &amp; Rusman, 2017; Dahlstrom, 2014; Davidson, 2017; Gallagher, 2011; Gerrig, 1993; Phillips &amp; McQuarrie, 2010; Schank &amp; Abelson, 1995; van Laer et al., 2014)</p> |
| <p><b>Make it free at the point of delivery</b><br/>           Reducing all barriers, including financial to underserved communities, particularly where the focus is on engaging people living with socio-economic challenges.</p>                    | <p>(E Dawson, n.d.; Emily Dawson, 2017, 2019; Grand et al., 2015)</p>  |

**Codesign process: IMPLEMENT**

A cycle of fundraising raised enough money to deliver SMASHfestUK as a free-at-the-point-of-access event which was funded by the Wellcome Trust, Middlesex University, The Physiological Society, L&Q Housing and an Indiegogo fundraising campaign. Free access addressed the barrier of cost. The decision was taken to use Arts as a factor in delivering STEM activities, and specifically to create a narrative within which the event would exist. Motivation was a large barrier to engagement, with young people and families who did not identify as having an interest in STEM subjects having little or no motivation to engage with a STEM festival, but they were interested in interactive experiences and science-fiction based stories with an element of danger, such as the concept of aliens or zombies.

Keith began to reflect on how to incorporate this element of immersion and danger desire by local children involved in the co-design process into a science festival whilst staying true to the scientific academic disciplines.

It was decided to impose a disaster-based storyline on the festival and all activities. In 2015 the disaster would be an asteroid threatening to impact Earth, bringing with it a novel 'alien' disease causing 'zombie-like' symptoms. The artwork for the poster nods of a futuristic society, automation and artificial intelligence (Figure 10A), while additional photorealistic artwork depicted the 'hero' of the story as a young black man, in order to resonate with the largely Black and Black - heritage youth audiences in Lewisham (Figure 10B).

Following the community and audience co-design workshops, additional workshops were also held which to bring in collaborating artists, engineers, scientists and facilitators to further explore for ideas for activities and events in the festival. The events had to adhere to the briefs regarding 'excitement' and 'danger' and 'apocalyptic events' that were driven by the audience codesign workshops and to the "disaster scenario" concept ('Asteroid'), and also to the principles derived from the literature search (see Figure 11 and 12).



Figure 10A and B:  
10A A poster for the first SMASHfestUK event showing the logo in situ illustrating how the influences of the artist combine to represent an anti-establishment approach with elements of danger  
10B: Additional photorealistic artwork continues the themes of danger and reflects the apocalyptic narrative



Figure 11 Flyer with details of the "mash-up" co-design day for collaborating artists, scientists, engineers, academics, facilitators, science communicators and volunteers. This took place at the Albany Theatre on December 6th 2014



Figure 12: Collaboration workshops "mash-up" day: Artists, engineers and scientists came together for co-design workshops to help synthesis the outputs from audience co-design workshops into activities, events, installations and performances that would incorporate the audience participation into the fabric of the event. This took place at the Albany Theatre on December 6th 2014



### Codesign Process: PROTOTYPE AND TEST



Figure 13: Open day co-design prototyping and testing experience, Tottenham University Technical College, Lilywhite House, 780 High Road, Tottenham, London, N17 0BX February 5th 2015 – Figure 13A: Welcome and scene-setting 13B: Female visitors to the Open Day experience testing “engagability” of creating paper maths structures with visitors, students and Middlesex University Maths Department staff. 13C: Female visitors to the co-design experience interacting with robots and learning about the science of robotics.

Co-design team and authors contributed to an open day at Tottenham University Technical College for older school children and parents testing out prototype festival activities and speaking to attendees who largely fitted the target demographic (BAME and/or WWC) to generate ideas for the festival (Figures 13A, B and C).

Feedback on the ideas, the concepts and the activities was used to further develop the final elements that would comprise the first SMASHfestUK full festival: Asteroid! 2015. The take-away from this engagement reiterated that the thrilling and adventure-filled storyline was a key driver for young people. We also discovered that the more gamified an activity was, the longer the dwell time of the visitors and the deeper the engagement with facilitators (scientists and engineers) would be.

### Co-design process: REITERATE

The festival was held over 3 days providing over 27 different events, experiences and performances that were free to attend at two venues, The Albany Arts Centre, and Deptford Lounge Community Library. The storyline underpinning the festival was that of an imminent asteroid impact with earth that would or could endanger all life on earth. Activities included ‘Patient Zero’ (Fig 14.1), an interactive game exploring inter-personal disease transmission; ‘Hairpocalypse’ (Fig 14.2), the beauty salon at the End of the World – have a makeover and discuss your apocalypse fears; ‘Godzilla in Deptford’ (Fig 14.3), an interactive engineering activity and also an artistic statement on gentrification; ‘STEM Hero selfies’ (Fig 14.4); ‘Dr Knee-bone’s Asteroid Surgery’ (Fig 14.5) – learn surgical procedures after being injured in a meteorite storm; a packed schedule (Fig 14.6) ‘Mini Micro-beasts Microscopy (Fig 14.7) – look at tiny insects under microscopes and learn why they might survive the apocalypse even if we don’t. The event attracted approximately 1207 visitors, reached an additional 1000 local school pupils through a programme of outreach events all related to the central storyline of an impending asteroid strike on Earth.

In addition to the Open Day, local students

from reception in Haberdashers Aske’s Temple Grove Free School and Deptford Green Secondary School were engaged in the co-creation and co-production of a ‘zombie movie’ which was created in the run-up to the festival and premiered at the final event, the ‘Moment of Impact Show’. The film featured the (then) Mayor of Lewisham, Steve Bullock in a cameo role, alongside students from Middlesex University, Deptford Green and Haberdashers Aske’s Schools (Figure 15). The full film can be found at <http://youtu.be/lbb-EhLgB40>

**Codesign Process: PROTOTYPE AND TEST**



Figure 14: Photographs, clockwise documenting the implementation of the first festival; SMASHfestUK 2015: ASTEROID! February 12th – 17th 2015. Pictures from top left, clockwise Figure 14.1. "Patient Zero" Figure 14.2. "Hairpocalypse" Figure 14.3. "Godzilla in Deptford" Figure 14.4 "STEM Hero selfies", Figure 14.5 "Dr Kneebone", Figure 14.6 Timetable of Activities, Figure 14.7. "Mini Micro-beasts Microscopy" Figure 14.8. Poster display



Figure 15: Co-produced 'zombie' film, 'How To Survive Armageddon' featuring the Mayor of Lewisham, students from Middlesex University, Deptford Green and Haberdashers Aske's Schools. Premiered Wednesday 18th February 2015. Whole film: <http://youtu.be/lbb-EhLGb40>

**Codesign Process: EVALUATE**

The evaluation was carried out by Flow International (Flow 2015) (Figure 16). The festival was a success, attracting more than 1000 visitors to ticketed events and further estimated 800 to drop-in activities, and the feedback about their enjoyment of the event was overwhelmingly positive.

**Success of the 'Hyperlocal' approach**

The evaluation showed that 85% of visitors came from SE London postcodes, with 60% of these visitors from Deptford itself (SE8) and the immediately adjacent postcode areas (SE14, SE10, SE4, SE13) (Figure 17 and Figure 18). Demographically, and according to census data and data from the Index of Multiple Deprivation 2019, people from the postcode areas most highly represented in the audience data are statistically more likely to have lower science capital (DCLG 2015). This suggests that people with a likely low science capital did engage with the festival and therefore that the co-design principles had been successful in lowering barriers to access to ISL events for the targeted audience demographic. The gender split of visitors under 18 was slightly skewed towards females (56% to 44%) (Figure 18). This is unusual and unexpected compared to typical science festivals, which tend to be slightly male skewed in both adults and children.



Figure 16: Evaluation Report Cover Page SMASHfestUK 2015: Asteroid! The evaluation was carried out by Flow International (McKenzie, 2015). The full audience data is contained within this report and can be accessed online. Details in bibliography.





## SMASHfestUK

## CONTACT

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## FOR IMMEDIATE RELEASE

## Meteorite science festival bound for London

Press release

Lewisham, London, 14-22 February 2015 — SMASHfestUK, a brand new science and arts festival for young people, will pilot in Deptford, south east London during the February half term holidays.

Part sci-fi, part horror and post-Apocalypse, the festival is themed around a gripping story in which an asteroid is on a collision course with Planet Earth and a zombie invasion ensues. Visitors will have the chance to plan for Armageddon, whether it's preparing for survival, singing for their lives at the End of the World Cabaret, creating a time capsule or taking a trip to the Intergalactic Travel Agency.

SMASHfestUK is the first event of its kind, designed to widen participation and build diversity in science, technology, engineering and maths (STEM) by engaging young people and hard to reach audiences.

SMASHfestUK is the creation of science TV production company The Refinery, and is partnered by the Stephen Lawrence Charitable Trust, the Wellcome Trust, Middlesex University, and the Royal Observatory Greenwich.

### Science: too white, too middle class

Over the next decade, the UK is heading for a shortfall of more than 50,000 workers for the STEM sector, but only 15% of students aspire to science careers.

In boroughs like Lewisham, the school population comprises almost 75% black and minority ethnic students. Yet black students identify even less strongly with science as a career aspiration, because of its overwhelmingly white, male, middle class image of science, and the multiple inequalities they face growing up, according to a recent study (see notes to editors).

Dr Lindsay Keith, CEO Refinery Productions Ltd, said:

SMASHfestUK • LINDSAY@REFINERY.TV • WWW.SMASHFESTUK.COM

1

Figure 22: Press release distributed to local and London-wide press prior to SMASHfestUK 2015: Asteroid!

## Component 2: SMASHfestUK 2016: Solar Storm!

The Albany Theatre, London  
(18th – 20th February 2016)  
The Deptford Lounge, London  
(15th – 20th February 2016)

<https://gala.gre.ac.uk/id/eprint/19844/>  
<https://www.flickr.com/photos/30542236@N04/albums/72157665587627752>

The 2015 evaluation and feedback cycle revealed a number of positive and negative factors:

### Positive

- The narrative/story concept worked really well to engage visitors
- Experiences which were gamified were highly attractive and engaging for audiences
- Immersion within an over-arching storyline was effective
- The co-design and methods used had been effective at attracting new audiences
- BAME and/or WWC had been well represented in audiences
- The experience increased cultural capital through increased theatre attendance
- The experience reached more girls than boys, unlike traditional science festivals

### Negative

- The audience skewed younger than anticipated, engaging mostly primary children but very few over 12s
- The communications and marketing had been limited, with no printed programme of events which made navigation of the festival more difficult.

A theory of change model was subsequently developed which shows the evolution of thought to incorporate feedback, evaluation and co-design outputs into desired outcomes for the following iteration of the festival. (Figure 23). Primary drivers of change are described near the centre of the Theory of Change cycle diagram, with specific references to existing academic literature references, co-design, experience-analysis and new methods adopted to secure favourable outcomes and described on the outside of the cycle diagram. Having shown that the festival could attract a significant number of people from the local community, and that this community represented demographic communities that are not well represented at other science festivals, the focus changed towards achieving a deeper relationship, with more visitors and clarifying the demographic make-up of the audience the following year. Co-design processes and feedback also resulted in placing a greater emphasis on story and personalization/localisation of the 2016 event.



Figure 23 Theory of change model for SMASHfestUK Primary drivers of change are described near the centre of the Theory of Change cycle diagram, with specific references to existing academic literature references, codesign, experience-analysis and new methods adopted to secure favourable outcomes and described on the outside of the cycle diagram.

**Codesign process: UNDERSTAND**

Keith with SMASHfestUK embarked on a further cycle of co-design, driven by the following principles, which revolved around deepening the personalisation and localisation so that the 'story' felt personal to every visitor. It was also decided to enhance the gamification of events wherever possible and develop more immersive, gamified activities. Since the audience had skewed towards younger visitors in 2015, a 'Young Explainers' programme was developed to be piloted for older children and young adults, the marketing and communication strategy was bolstered, and an official programme was produced. Specific changes include:

- Developing the over-arching story narrative by commissioning a play, 'Cosmic Jives', which related directly to the story
- Increased immersion and gamification by developing new immersive activities (Survival Village, I'm Wearing My Thermals, The Sun at Night, The Human Power Station).
- Introducing the 'Young Explainers' programme for older children/young adults.
- Development of a marketing and communications strategy, including a brochure and printed programme of events.

### Codesign process: CREATE

SMASHfestUK 2016 Solar Storm! (Figure 24) took place during the half term school holiday in spring 2016, running from the 18 to 20 February in the Albany Theatre, with drop-in events in the Deptford Lounge running across the whole holiday week (Figure 25). The story was:

“... a solar storm is about to hit Deptford. Electricity, electronics, communications and infrastructure will all be hit. Deptford - and the world - will plunge into darkness as hospitals crumble, water supplies dry up ... life and health are at immense risk”.

The festival unfolded this fictional narrative through three days of activity all themed around an imminent solar storm. Audiences could experience a human power station, a self-build planetarium, a new play, poets, comedians, human-sized mutant fruit flies, UV interactive activities, a variety show, electric paint, Aardman Animation and a pilot virtual reality experience at The Albany. Deptford Lounge library featured an interactive installation, a coding club, a solar exhibition, artist's residency and a film programme.

The festival provided 35 unique events (an increase from 27 in 2015), and there were 1048 attendees for ticketed shows, along with 850 attendees at drop-in activities at Deptford Lounge. Collaborations were supported and 94 artists and creatives were directly involved, including writers, artists, performers, poets, musicians, digital producers and filmmakers. Where possible the focus was on ensuring that

collaborators were diverse and gender balanced, and reflected the audience. Forty scientists were involved, including an eco-geneticist, a design engineer and a Professor of Mathematics, and 64 collaborations (including University of Greenwich Student Films) emerged as a result, as did new artworks.



Figure 24: Poster and brochure detail for Albany Theatre events 18th-20th February 2016

| SMASHfestUK 2016               |             |
|--------------------------------|-------------|
| <b>CONTENTS</b>                |             |
| BUILD A BATTERY COUNTDOWN      | 03          |
| CRACKING THE CODE              | 04          |
| CODE CLUB                      | 05          |
| COMEDY CLUB FOR KIDS           | 06          |
| COSMIC VIBES                   | 07          |
| DIY OPEN SOURCE PLANETARIUM    | 08          |
| THROWING SPANNERS AT NANOBOTS  | 09          |
| DR DEATH                       | 10          |
| ELECTRIC PAINT WORKSHOPS       | 11          |
| EMPE                           | 12          |
| SURVIVAL VILLAGE GEODESIC DOME | 13          |
| GLOWBAR                        | 14          |
| HUMAN POWER STATION            | 15          |
| I'M WEARING MY THERMALS        | 16          |
| LEVEL UP HUMAN                 | 17          |
| MUTANT CIRCUS                  | 18          |
| PHOTOVOLTAIC FRENZY            | 19          |
| SECRET FILM CLUB               | 20          |
| SMART MATHS TOWER GAME         | 21          |
| SMART MATHS STRUCTURES         | 22          |
| SOLAR CRAFTITI                 | 23          |
| SOLAR & LUNAR OBSERVING        | 24          |
| SOLAR STORM EXHIBITION         | 25          |
| SOLAR STORM ARTISTS            | 26          |
| THE SUN AT NIGHT               | 27          |
| SOLAR STORY TELLING            | 28          |
| SUNDOWN SHOW                   | 29          |
| SURVIVAL VILLAGE DEN BUILDING  | 30          |
| THE AMAZING SCENE MACHINE      | 31          |
| THE GREAT BALL OF FIRE SHOW    | 32          |
| THE MUTATION GENERATION UNIT   | 33          |
| THE UGLY ANIMAL ROADSHOW       | 34          |
| TRAVEL THROUGH A SOLAR STORM   | 35          |
| UV+ME                          | 36          |
| ADDITIONAL INFO & JOIN US      | 37, 38 & 39 |
| THANKS & COMING SOON           | 40, 41 & 42 |

Figure 25: Contents page for programme brochure for SMASHfestUK 2016: Solar Storm!

## Codesign Process: IMPLEMENT

### Developing narratives

As the story-led elements of Asteroid had been the most successful activities, this was developed into commissioning a brand new play, 'Cosmic Jives', featuring Rory (Aurora), a young Black woman from Deptford, as the protagonist. In the story she loves astronomy and wants to study the stars but has to fight against structural racism and sexism to achieve her dreams. The play also explores 'The Matilda Effect' – the phenomenon of the achievements of female scientists through history having their work minimised or attributed to men. The lead role was played by Seraphina Beh, an up and coming actor from south London, and the 'Greek chorus' was played by local older children and young adults from Greenwich and Lewisham Young People's Theatre (GLYPT). The play, by playwright Rebecca Manley was performed 'in the round' and included elements in which the audience participated in exploring 'The Matilda Effect' (Figure 26.1 and 26.2).



Figure 26.1: Poster for 'Cosmic Jives' featuring recognisable street art from Deptford



Figure 26.2 The lead role was played by up and coming actor from South London, Seraphina Beh.

### Building Immersion and gamification.

An immersive 'Survival Village' was created. Visitors were warned that an impending solar storm could knock-out infrastructure leading to a return to nomadic lifestyles, and were invited to imagine that they had to build shelters from scratch after the apocalypse, using found materials and basic construction engineering techniques (Figure 27).

Another immersive experience was 'The Sun at Night' by local artist David Henckel, which was located in Our Lady of the Assumption, a Catholic church on Deptford High Street which has a largely Black community congregation. A solar projection was suspended in the church knave, with a meditational corresponding NASA soundtrack of the deep, resonance soundtrack derived from the solar surface (Figure 28).

"I'm wearing my thermals" was an immersive game of infrared hide and seek, in which children could 'hide' in a blacked out room from a seeker who had only an infrared camera in order to find them. Learning outcomes included children understanding that insulating materials prevent the transfer of heat and are good for hiding, but also learning valuable lessons about heat loss, climate change and the capacity of solar radiation as a future source of energy (Figure 29).



Figure 27 The SMASHfestUK "survival village". Albany Theatre Garden 18th February 2016



Figure 28 The Sun at Night David Henckel. Our Lady of the Assumption, Deptford High Street, 18-20 February

THE ALBANY

### I'M WEARING MY THERMALS

SMASHfestUK WITH DR NATIE, DR INDI & THE YOUNG SCIENCE EXPLAINERS  
 Thursday 2-6PM | Friday & Saturday 10AM-6PM  
 VENUE: THE ALBANY | YELLOW ROOM

This is an epic game of hide-and-seek using only the heat from your body as the signal that will give away your hiding place. Will you find a thermal hidey-hole to tuck yourself inside before the seeker comes looking with their thermal imaging camera? We will discover tricks and traps that can help you hide or give you away - all using the power of the electromagnetic spectrum. Is it a game of smoke and mirrors? Or will it blow hot or cold? You decide your strategy in this SMASHfestUK game of cat and mouse!

Age range: Suitable for ages 7+  
 Children must be supervised by parents/carers at all times

Figure 29 'I'm wearing my thermals' Albany Theatre

### Reaching older children and teenagers

In 2016 SMASHfestUK developed a 'Young Explainers' scheme in which teenagers were encouraged to help become involved in the event through creating and facilitating or performing events. The Sundown Show was a variety show in The Albany auditorium featuring a variety of cabaret artists and Young Explainers. The show told the story of a deadly solar storm, and the Young Explainers performed sets developed through training by the SMASHfestUK delivery team (Figure 30). Twenty young people joined up to volunteer their time and commitment and were trained as facilitators, creators and deliverers, rather than 'audience'.

Following a successful schools outreach pilot programme in 2015, in 2016 a SMASHfestUK Community Audience Development Programme (CADP) ran year round, developing new connections throughout the locale through schools and community groups, resulting in a launch event for practitioners and teachers throughout the borough, prior to the festival itself.

SMASHfestUK established and consolidated innovative partnerships with major cultural and scientific institutions including The Wellcome Trust, Middlesex University, Arts Council England, Royal Society of Chemistry, Science and Technology Facilities Council, The Refinery, Vound Software, University of Greenwich, Royal Observatory, Lewisham Council, Telegraph Hill Festival. It also grew successfully and deepened relationships with arts and cultural organisations including The Albany, Deptford Lounge, Fun Palaces, National Maritime Museum, Besson Street Community Garden, Mind's Eye and Greenwich and Lewisham Young People's Theatre (GLYPT) and music groups. Local partnerships were extended - including the Lewisham Education Arts Network (LEAN), The Mayor's Office, The Young Mayor's Office and the Lewisham Pupils Ambassadors Scheme.

The Schools enrichment programme (SEP) delivers 9 education events and outreach projects ahead of the festival involving 2924 schoolchildren.



Figure 30: Young Explainer Laitan Odubiyi (16) performing a set at The Sundown Show

## Codesign Process: EVALUATE

An independent evaluation was carried out by Pamela Jarvis from SAM Culture, specialists in the evaluation of cultural events (Figure 31)(Jarvis 2015). Onsite audience surveys collected 100 responses, and data was merged to produce the final audience analytics. The evaluation report was synthesised from this data plus interviews conducted with artists, scientists and cultural organisations, briefings and feedback sessions with SMASHfestUK Directors, and feedback from teachers in schools that hosted a SMASHfestUK event.

The key findings are:

- Reached new audiences – only 25% had been to similar event

- Built local following; 30% were returning visitors from 2015

- 68% of visitors from London Borough of Lewisham

- Reached underserved audiences 40% visitors said being free and local was most important to them

- Engaged people with low science capital

- As in 2015, more girls than boys visited with a more pronounced gender split

- Reached BAME audiences 70% of under 18 visitors were Black, Mixed Heritage or Asian (Figure 32)

- 42% said they might consider a science career after this experience

- 100% said they would be more likely to study a STEM subject at school after this event

### Impact

The evidence showed that while the festival had loyal visitors returning for a second year, it was also successful in attracting new audiences, which were again derived from local postcodes and black and mixed heritage people were highly represented in the audience. The evidence supported the assertion that the festival was reaching new audiences and reaching audiences who may not normally engage with informal science learning and would be considered likely to have lower science capital than average. Recruiting and training staff and volunteers who represent and reflect the diversity we see in our audiences is a critical component of engaging underserved and under-represented audiences (Figure 33). SMASHfestUK works hard to ensure that that there is both ethnic and gender diversity in their staffing, so that visitors will feel that the festival and its STEM content 'is for me'. Studies have shown that white working class children and some black and black heritage children are likely to see science as 'not for me', and this process challenges those perceptions.

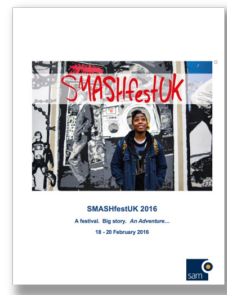


Figure 31: The 2016 independent evaluation carried out by SAM-Culture (Jarvis 2015)

### Representation

Regarding impact on under-represented groups (BAME and people living with socio-economic disadvantage), one local resident, a Black woman with older children who also runs a childcare provision called LPF Kiddies Club said:

*"SMASHfestUK is free, which is important in an area with a lot of poverty and where kids get limited exposure to opportunities. This has a knock-on effect because it means as kids progress they can't recognise opportunities or have the skills to know what to do even when opportunity is facing them – and they are unsure how to engage. They don't see past secondary school so it's good for them to meet university students and to see that 'I could do this too.' Kids could relate to SMASHfestUK events as they were right 'in their face' so they could understand the environmental issues. They had fun and could input and realise they could affect their own community when negative things happen"* (Carmel Britto, Mother, Founder of LPF Kiddies Club)

### Engaging older children and young adults

The new approach to engaging older children and young adults was also highly effective, with testimonials from two of the Young Explainers cohort saying that it had made them determined to go on to further study of STEM subjects:

*"I met science experts—like an eco-geneticist and someone from an organisation that sends satellites to the sun and tried a virtual reality headset. Seeing what other people do was mind-blowing as I'd never actually met people who work*

*in such scientific fields or pursue academic careers. It was so positive and made me think – 'if they can do it - why can't I do it too'. It's convinced me about a career in science"* (Laitan Odubiyi (16), Young Explainer)

*"It's great that there are events like this that bring a chance to people who wouldn't usually engage. Young people liked how the Festival was on the High Street, they don't see these sorts of things in the rigid environment of school and they can't explore these sorts of ideas. I enjoyed explaining ideas to children and parents and I learned a lot of new things that you don't usually put together in the conventional sense. The arts make it all more creative and putting things together in different ways reveals the overlaps. For people who don't engage with science it hooks them in and makes them want to find out more. I'd always wanted to do microbiology. By showing me different ways of doing it and career options SMASHfestUK has confirmed to me what I want to do"* (Tyreese Hines (16), Young Explainer)

Co-design events involving young adults who were included in the Young Explainer's Programme and undergraduate design students from Middlesex University were very successful (Figure 34). Several of the first Young Explainer cohort are now studying STEM at university.



Figure 32: The festival was successful in attracting a very ethnically mixed audience. More than 70% of young visitors were BAME.



Figure 33: SMASHfestUK staff and volunteers dance at an event in Woolwich General Gordon Square



Figure 34: Co-design events with Young Explainers and undergraduate design students from Middlesex University



Figure 35A Girls and women were well represented at SMASHfestUK in 2016 both in visitors and as facilitators, scientists and engineers involved in delivery.

**Impact on choices in STEM subjects:**

The new approach to engaging older children and young adults was also highly effective, with testimonials from two of the Young Explainers cohort saying that it had made them determined to go on to further study of STEM subjects:

*"I met science experts—like an eco-geneticist and someone from an organisation that sends satellites to the sun and tried a virtual reality headset. Seeing what other people do was mind-blowing as I'd never actually met people who work in such scientific*

*fields or pursue academic careers. It was so positive and made me think – 'if they can do it - why can't I do it too'. It's convinced me about a career in science"* (Laitan Odubiyi (16), Young Explainer)

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Co-design events involving young adults who were included in the Young Explainer's Programme and undergraduate design students from Middlesex University were very successful (Figure 34). Several of the first Young Explainer cohort are now studying STEM at university.

**Impact on girls and women**

Girls and women are under-represented across STEM study choices and career. Part of the action research approach taken for SMASHfestUK was to ensure that audiences would see themselves reflected and represented in staffing by gender and ethnicity. Although SMASHfestUK did not predict a positive female gender skew, we think this is encouraged because we engage using narratives and the science has story and purpose. Girls and women were well represented at SMASHfestUK in 2016 both in visitors and as facilitators, scientists and engineers involved in delivery (Figure 35A and 35B). For the second year running the split in under-18s skewed more towards females than males, which is unusual in science festival demographics.

*"It's also good to see girls taking an interest in subjects they had thought were boring and to meet scientists and university students - and to see the lightbulb go on."*

*"Socially and politically, SMASHfestUK aligns totally with the sort of work I want to make as an artist as it is free and inclusive. I believe in the message underpinning the play completely, which is to do with the empowerment of women and encouraging diversity in a field that historically has been the domain of white middle class men. I knew the quality of the work would be good as there was an established writer and experienced and talented producers on board"* (Alice Knight, Theatre Director of SMASHfestUK's Cosmic Jives)

*"Inspiring my daughter that science is fun, is artistic and is for girls. It's all about the girls and science"* (A female parent)

Gender Split Under 18s (2016)

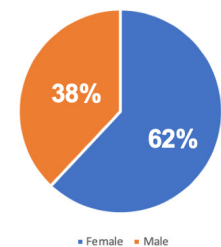


Figure 35B Gender Split under 18 SMASHfestUK 2016 visitors

**Codesign Process: EVALUATE**

**Impact through Schools Enrichment Programme**

Baring Primary School in Lewisham hosted a SMASHfestUK Assembly as part of the Schools Enrichment Programme. 75% of its pupils are Black or Mixed Heritage or Asian. 50% have English as a second language. 24% of pupils are disabled or have special educational needs, and most have free school meals.

*"Seeing the whole school aged 6-11 captivated: the behaviour was great as they were 'transfixed' by the exciting show. It is certainly not like this for all assemblies/shows (in my opinion). They were certainly inspired and curious to find out more and enthused and keen to visit the free show during the half term break"*  
(Baring's Deputy Head)

*"The festival is important as it gives local children an opportunity to get out and learn in a fun way (and for some who might otherwise be in their bedroom/ house all day staring at a screen ...) I hope for some children SMASHfestUK may have helped them in their job aspirations - I would like to do that!"*  
(Tidemill Academy Deptford Teacher)

Lucas Vale Primary School, where almost half of children qualify for free school meals, hosted an interactive whole school SMASHfestUK assembly and the pupils were encouraged to come to the festival during their holidays.

*"Thanks for the assembly and since we came back I have lots of children telling me about the festival over half term and how great it was. They really enjoyed it and I can say for most that was the only fun thing they did over the half term"*  
(STEM lead teacher).

**Awards and Recognition**

Winners of the STEM category of the National Co-ordinating Centre for Public Engagement (NCCPE) 2016 'Engage' awards for the best public engagement with STEM (Figure 36).

*"This is a truly innovative project ... The themes are strong, and the ways in which they are interpreted are really clever. It is really effective to have a hyper local approach that is narrative-based and semi-immersive. This team took a concept that lots of people talk about, and turned it on its head. They challenged concepts of hard to reach, and worked with young people to create a festival everyone wanted to be part of. Disaster led, this project was far from it. The project is just one example of a growing trend amongst the UK's researchers – to reach outside the university to really connect their work to wider society and involve the public in research in meaningful and potentially transformative ways"*  
(Testimonial from NCCPE judges).

The Royal Academy of Engineering published a case study on SMASHfestUK, based on the immersive Survival Village in 2016, as an example of best practice for engaging undeserved audiences with engineering (Figure 37), and there was widespread press coverage of SMASHfestUK 2016 in London, such as the East London News Shopper and The List (Figure 38 and Figure 39).



**SMASHfestUK**

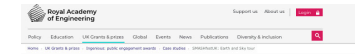
Winner at the NCCPE Engage Awards 2016 in the STEM category.



SMASHfestUK is a free festival organised in partnership between Middlesex University and the University of Greenwich and mainly taking place in Deptford, London each year in February.

The event is part of an ongoing engaged research initiative which aims to re-ignite the interest of young people aged between 7 and 17 in science and each event uses as its premise an impending natural disaster which eventually engulfs the community in which the festival is staged.

Figure 36: Winners of the National Co-ordinating Centre for Public Engagement "Engage" award for best public engagement with STEM, Wednesday November 2nd 2016.



**SMASHfestUK Earth and Sky tour**

**Case studies**

**Project description, objectives, audience**

**Project description**

**Objectives**

**Impact**

**Background**

**Activities**

**Results**

**Reflection**



The event was the first of its kind in the UK, and was a success in many ways. It was a free event, and was held in a community centre, making it accessible to all. The event was a success in many ways. It was a free event, and was held in a community centre, making it accessible to all. The event was a success in many ways. It was a free event, and was held in a community centre, making it accessible to all.



Figure 37: Case study about SMASHfestUK by Royal Academy of Engineering, based on the Immersive Survival Village in 2016, as an example of best practice for engaging undeserved audiences with engineering.



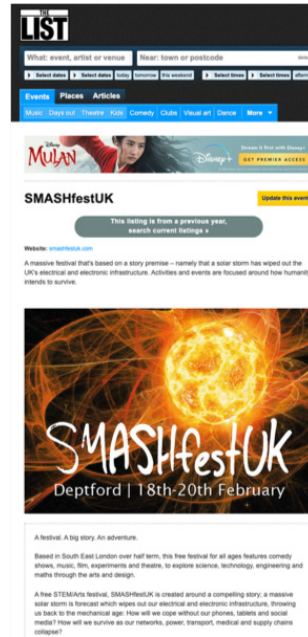


Figure 38 and 39 Typical London based press coverage for SMASHfestUK 2016 in East London News Shopper and "The List" November 2015

### Component 3: SMASHfestUK 2017: Supervolcano

The Albany Theatre, London  
The Deptford Lounge, London

13-17 February 2017

<https://gala.gre.ac.uk/id/eprint/19840/>

#### The Earth and Sky Tour

Bradford City Park  
Neath Market Square  
Gloucester Library  
General Gordon Square, Woolwich, London  
The Grahame Park Estate, Colindale, London

1 May – 15 December 2017

<https://gala.gre.ac.uk/id/eprint/19839/>

#### Positive

- Growing new audiences (25% had never been to a similar ISL event)
- Maintaining loyal visitors from previous years (30% were repeat visitors from 2015 or 2016)
- The majority of under 18's visiting the event were black, black heritage, mixed, race, Asian or other minority ethnicity.
- The gender skew amongst under 18 visitors again skewed towards females (62% to 38%).

#### Negative

- Data not robust enough to significantly assess growth of science capital in visitors
- Ethnic diversity amongst staff was good but a focus on more black adult male role models in the following years staffing and volunteering would be effective.

After the 2016 festival a logic model was produced mapping inputs and showing how desired outcomes could be achieved with regard to engaging new audiences, engaging Black and ethnic minorities and WWC visitors, and raising science capital in attendees. The long term outcomes were designed to raise science capital which ultimately, raises achievements, income and social mobility. The logic model was subsequently updated each year (Figure 40).

The 2016 evaluation and feedback cycle had revealed a number of positive and negative factors:



Figure 40. SMASHfestUK logic model (2019 version)

### Co-design: Understand

The authors embarked on a further cycle of co-design, noting that 'inclusion' and 'purpose' were key takeaways from the 2016 evaluation. It was also noted that both visitors and staff and contributors were encouraged by gender and ethnically diverse role models, and inspired by the strong messaging of the play 'Cosmic Jives'. A Black adult visitor (an education provider and parent) spoke of the empowerment he perceived of young visitors being 'actors' who had agency to affect outcomes within the story, and this exchange reinforced the decision to continue to develop the immersive elements in 2017.

The co-design in 2016/17 involved working with student from both the University of Greenwich (BA/BSc Film and TV Production) and Middlesex University (BA/BSc Product Design and Engineering students) in the ideation of supervolcano-related installations and short films. An enhanced 'Survival Village' and a supervolcano 'ziggurat' were built, prototyped and tested at The Big Draw at Middlesex University in 2016 (Figure 42). The ziggurat featured local schoolchildren voicing audio recordings from testimonies of real children who had been evacuated from the island of Monsterrat following

the eruption of Mount Soufrierre in 1989.

The co-design changes introduced in 2017 to build on the successes of 2016 were:

- Commissioning a new play, 'Rupture'
- Expanding the Young Explainers STEM Talent Show
- Deepening the focus and number of immersive activities
- Expanding the Young Explainers Programme
- Assessing science capital growth indicators
- Engaging more secondary schools, developing a Young Inventors Programme
- Doing more community and schools outreach
- Testing the efficacy of the model in remote communities with The Earth and Sky Tour



Figure 42 The creation of a new enhanced “survival village” and also a supervolcano “ziggurat” which were built, prototyped and tested at The Big Draw at Middlesex University in 2016. The ziggurat featured local schoolchildren voicing audio recordings from testimonies of real children who had been evacuated from the island of Monsterrat following the eruption of Mount Soufrierre in 1989.

Codesign process: IMPLEMENT

SMASHfestUK 2017 (Figures 43 and 44) was again in the two usual venues (theatre and library) over two days during the school half term holidays in February, with drop-in activities across the whole week. The festival engaged 20 volunteers and collaborated with 10 universities, 4 museums and 58 researchers from academia and industry, specifically training 15 of these in public engagement, as well as hosting 32 apprentice engineers from Transport for London. Forty-six activities were provided, most of which were co-designed by collaborations with stakeholders, as usual. An expansive schools enrichment programme was undertaken working with 12 local primary schools who contributed to building a 5 metre high model of a cryovolcano which ‘erupted’ as a centrepiece of the festival and was broadcast online by the Guinness Book of World Records, watched by a global audience of 60,000 people (Figure 45). Local young visitors learned how to use natural and easily found materials to filter water in the ‘Survival Village’ (Figure 46).



Figure 43: Poster and artwork for the 3rd SMASHfestUK festival, “Supervolcano” Deptford, London, 13t – 17th February 2017.



Figure 44 Brochure, artwork and programme of events for the 3rd annual SMASHfestUK festival to be held in Deptford, 13th to 17th February 2017



Figure 45 Creating a 5 metre high model of a cryovolcano in the garden at The Albany



Figure 46 Learning how to use natural and easily found materials to filter water in the Survival Village

### Deepening the local narrative – commissioning a new play, “Rupture”

Following the success of the 2016 play, another play was commissioned for the 2017 festival. Written by Rebecca Manley, ‘Rupture’ (Figures 47A and 47B) explored the devastating social and physical effects of the 1989 volcanic eruption in the Caribbean Island of Montserrat on a young Black woman resident who is evacuated and later finds herself a resident of Deptford. Work with the local young cast member from Lewisham and Greenwich Young People’s Theatre and Tramshed Theatre in Woolwich involved workshoping around the concept of volcano experiences for young people, and this fed into other elements of the festival events and delivery.



**SMASHfestUK presents**  
**RUPTURE**

A NEW PLAY BY REBECCA MANLEY  
DIRECTED BY MATT HARRISON

**CAST**  
Sara: Louise Cooper  
Loreley / Aisha / Mary Shelley: Rachel Osoffo  
John / Aisha / Tracy Shelley: Isabella Liddle  
Asha / Lindi Brown / Marlene: Ezzell, Luke Pierre  
Malcolm/Ed: Felix Ezzell, Steve Dwyer

**CHORUS**  
Monique: Ezzell  
Chanelle: Ezzell  
Camille: Dawson  
Harriet: Ezzell  
Mikaela: Ezzell

**CREATIVE TEAM**  
Writer: Rebecca Manley  
Director: Matt Harrison  
Composer: JAK O’NEILL  
Producer: Sara Stebbing  
Prop: Camille Dawson

In Partnership with Greenwich and Lewisham Young People’s Theatre, University of Greenwich and The Albany Young Creative.

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Director: Matt Harrison  
Composer: JAK O’NEILL  
Producer: Sara Stebbing  
Prop: Camille Dawson

In Partnership with Greenwich and Lewisham Young People’s Theatre, University of Greenwich and The Albany Young Creative.

Figure 47A and B ‘Rupture’ Rebecca Manley, Codesign rehearsals and workshops for “Rupture” took place between Sunday 29th January 2017 and delivery over multiple sellout performances in the main auditorium of the Albany Theatre on the 16th and 17th of February 2017.

### Expanding the Young Explainer's Programme:

Inclusive co-design continued with British Science Association funded Young Explainers STEM Talent Show (Figure 48). 2015 and 2016 had taught us that older children and young adults responded better to engagement when engaged as creators and facilitators, rather than as visitors or audiences. In 2017 we created a STEM talent show and worked with twenty Young Explainers as individuals or in groups, to create a STEM inspired performance that would contribute to a STEM talent show, with prizes for the winners who would perform their act in front of a live auditorium audience at the culmination of SMASHfestUK 2017 on the 17th February 2017.



Figure 48 SMASHfestUK worked with 20 Young Explainers to create STEM inspired performances SMASHfestUK 2017 on the 17th February 2017



#### SMASHfestUK 2017 Evaluation report

Evaluation of the Supervolcano 2017  
Free arts-science festival



Deptford February 13<sup>th</sup> - 17<sup>th</sup> 2017-03-23  
Locations: Deptford Lounge and The Albany, Deptford

Figure 49 The 2017 independent evaluation was carried out by Dr Natasha Simons, supported by SMASHfestUK volunteers (Simons, 2017).

SMASHfestUK launches...



## SCIENCE TALENT CONTEST

11-16 YEARS (YEAR 7-11)  
DEPTFORD 2017

Are you the next science superstar who can communicate big ideas?

Can you explore the theme of **FLOOD** or **WATER** in a creative way?

Whether that be survival, tsunamis, water-borne diseases or flood defences... we want **YOUR GROUP** to show **Science & Engineering** in an engaging way, in **3 minutes**.



e.g. Poetry, dance, rap, experiments, storytelling, theatre, comedy, circus... be as creative as possible.

Winning groups will receive £75 and appear in our Variety Show at the award-winning SMASHfestUK 2018!

To enter, submit your idea (max. 300 words) to [info@smashfestuk.com](mailto:info@smashfestuk.com). Closing date 15th Sept 2017.



### Codesign Process: EVALUATE

An independent evaluation was carried out by Dr Natasha Simons supported by SMASHfestUK volunteers (Simons 2017) (Figure 49). Greater resourcing was pivoted towards evaluation in 2017 to increase the reliability, depth and breadth of the audience analysis. The evaluation utilized front-end and summative methods that were able to both capture quantitative comparative data whilst allowing for qualitative reflection. The evaluation used an in-depth researcher-administered exit questionnaire (closed and open-ended questions) for adults and a shorter form for children (encompassing visuals), a post event survey for contributors, and summative evaluation forms for schools outreach. The key findings were:

-6000 local people experienced a SMASHfestUK event in 2017

-12 local primary schools contributed to building a 'cryovolcano'

-60,000 people around the world watched the Guinness Book of World Records broadcast of the cryovolcano explosion

-Focus remained on hyperlocal approach with more than 80% visitors being local

-2676 visitors (up 800 from 2017)  
-Library venue saw 32% increase in visitors

-Collaborations included 20 volunteers, 10 universities, 4 museums, 58 researchers creating 46 activities or performances

-32 apprentice engineers were trained in public engagement

-15 engineers were trained in public engagement

-Reached new audiences (71% had never attended an informal science learning event before)

-Reached Black and Minority Ethnic audiences (57% of visitors were BAME)

-Science capital was raised in visitors

One of our initial research questions had been 'Could we raise science capital in visitors who, demographically, are likely to have low science capital?' By proxy measures of science capital used, adult visitors overwhelmingly agreed that their measures had increased. They had learned new things, increased their confidence in talking about science to their children, improved their understanding of the relevance of science to everyday life, and increased their knowledge of science careers (Figure 50). Science capital was also raised in children. By proxy measures of science capital used, child visitors overwhelmingly agreed that their measures had increased (Figure 51). Of note, background data suggests that in a normal classroom cohort around 15% of children would be interested in a STEM career, but after the SMASHfestUK experience more than 50% agreed or strongly agreed that they would consider a STEM career.

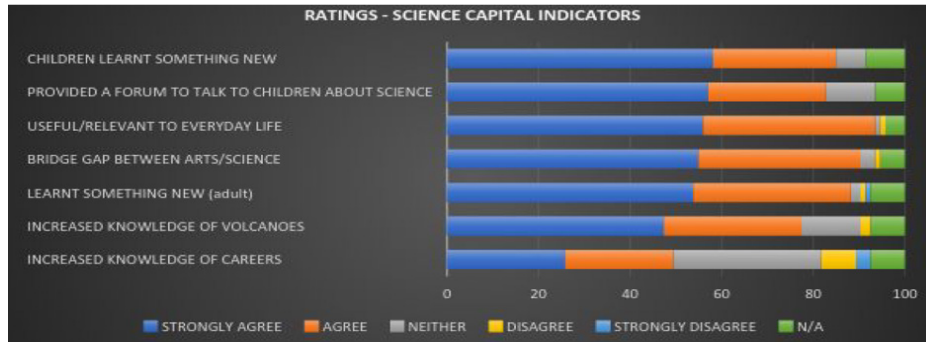


Figure 50 By proxy measures of science capital used, ADULT visitors overwhelmingly agreed that their measures had increased. They learned new things, increased their confidence in talking about science to their children, improved their understanding of the relevance of science to everyday life and increased their knowledge of science careers.

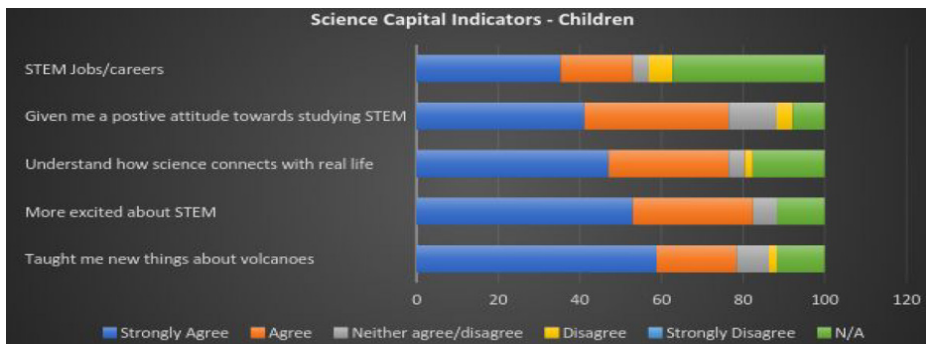


Figure 51 By proxy measures of science capital used, CHILD visitors overwhelmingly agreed that their measures had increased

**Testimonials**

Testimonials in Year 3 focussed on the importance of having events in the centre of underserved and under-represented communities.

*mean that people can drop-in(from the market, and that is really good.*  
(Female, N22, The Albany)

*Great opportunity - kids get excited about STEM and can talk to peers about it.*  
*Word of mouth learning* (Female, SE4, The Albany)

*It will attract families of all races, classes and status' to interact together.*  
*The library is a safe environment for my son.*  
(Female, SE6, Deptford Lounge)

*There are not many opportunities in Deptford for kids (that are affordable), we visit the Horniman museum a bit. The kids club struggle to find affordable things to do in the area (we have upwards of 35 kids mainly from low-income families) -* (Kids club organiser, Deptford Lounge)

*To bring local people out and together!*  
*Learning and growing in knowledge and wisdom. It's fun for families*  
(Female SE8, Deptford Lounge)

*Parents from Deptford cannot always afford it - ordinary working mums. They need things that they can do in half term - so this is great!*  
(Female, SE4, The Albany)

*Because it is right in the middle of the community - often people in deprived areas feel that arts and science is not accessible to them. Free events*

**Awards and Recognition**

SMASHfestUK, in collaboration with 10 partner primary schools in Deptford, was awarded the prestigious 'Collaborate to Innovate' award by The Engineer – the oldest engineering publication in existence (Figure 52). As a result of this SMASHfestUK was invited to create a film and make a presentation at the elite Engineer annual conference. The event was documented here <https://www.theengineer.co.uk/disaster-movie-stem/>, and the film, which documents the SMASHfestUK approach to creating inclusive public engagement can be viewed in full here: <https://vimeo.com/247768349>

SMASHfestUK featured as a case study on the MillionPlus association for modern (post-1992) universities website (MillionPlus 2017) (Figure 53), and the case study was presented to a group of educationalists and parliamentarians at the 'MillionPlus Organisation: 25 and Rising' parliamentary celebration on 25th April 2017 in the Palace of Westminster. SMASHfestUK was also chosen to be made into a case study for public engagement to be highlighted as an exemplar of best practice on the Science and Technology Facilities Council (STFC) website (Figure 54). Keith and Griffiths were also invited to advise and consult with their Public Engagement committee, with regard to a new inclusive engagement initiative, 'Wonder'.

SMASHfestUK was picked as an editor's highlight in TimeOut UK for family entertainment during the half term holidays in its January edition in 2017 (Figure 55).

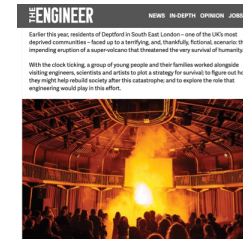


Figure 52 SMASHfestUK, were awarded the prestigious "Collaborate to Innovate" award by The Engineer



Figure 54 The STFC adopting SMASHfestUK as a case study for public engagement to be highlighted as an exemplar of best practice on their website.



Figure 53 The Million Plus case study <http://www.millionplus.ac.uk/policy/case-studies2016/delivering-expertise-in-enterprise-and-innovation-smashfestuk-delivering-science-in-diverse-commu>



Figure 55 Girls and women were well represented at SMASHfestUK in 2016 both in visitors and as facilitators, scientists and engineers involved in delivery.

## Component 4: SMASHfestUK 2018: Flood!

The Albany Theatre, London  
The Deptford Lounge, London

12-16 February 2018

<http://gala.gre.ac.uk/id/eprint/28766>

After the 2017 festival SMASHfestUK began to implement the logic model focusing on desired outcomes for audiences, now that they had established that they could build new audiences comprising majority black and black heritage or mixed -heritage people and white working classes. They had also established that they were able to build science capital successfully in audiences, and that audiences' attitudes towards STEM study and careers were positively affected by the experience. Keith and collaborator Griffiths (Middlesex University) synthesised this into a model called 'SCENE' representing the principles for inclusive design which had evolved across the iterations of the festival (Figure 56). SCENE is an acronym for STEAM, Community, Enquiry, Narrative and Entertainment.



Fig.56 The SCENE model for inclusive design for public engagement with underserved and under-represented audiences or visitors

The 2017 evaluation and feedback cycle had revealed a number of positive and negative factors:

### Co-design process: UNDERSTAND

#### Positive

- Reaching new audiences, both local and international
- Growing reach of festival to new areas
- Reaching underserved and under-represented audiences
- Building science capital in audiences
- Narrative and story and localisation remains a strong link to engagement
- Gender split in under 18 visitors again skewed more towards girls than boys

#### Negative

- Audiences still differ between the two main venues – the theatre and the library
- The library reaches more local visitors
- The library has fewer and less immersive activities

### Co-design process: CREATE (Prototyping)

The authors embarked on a further cycle of co-design. Feedback from visitors suggested a higher level of engagement with performance-based activities, in which storytelling was a key focus of the performance. These were also the events that visitors seemed to feel that led to greater understanding about science topics. One focus for the next iteration was therefore to increase the number of activities with a story-led focus, and to make the story even more localized and personal to the Deptford audience.

It was thought to be significant that girls had been over-represented compared to boys for the third year in a row, as it is known that gender identity plays a significant role in shaping children's attitudes to future study and careers, with significant numbers dismissing STEM subjects as 'not for me', resulting in an under-representation of women in STEM careers. Although the reasons were not clear, it was considered to be a positive aspect for the model and that we would continue to strongly represent female role models within SMASHfestUK storylines and staffing.

The co-design changes introduced in 2018 to build on the successes of 2017 were:

- Deeper immersion and link to stories
- Analyse differences in audiences between

- the theatre and library venues
- Bring more immersive and science activities into the library venue
- Continue to co-design
- Think about ways to tie the narrative more closely to the location and the people
- Create more immersive content

In an attempt to assess whether it was possible to replicate the findings from SMASHfestUK, attracting underserved and under-represented audiences in locations remote from the HQ in South East London, Keith with SMASHfestUK carried out a series of 'pop-up' co-design and prototyping activities during the 2017 Earth and Sky Tour (Figure 57).

The specific changes created for SMASHfestUK 2018 Flood! Were:

- A new updated production of 'Cosmic Jives'
- Production of an interactive immersive theatre show 'The Curious Case of the Flood in the Night-time'
- The flood storyline was specific to Deptford and the Thames, culminating in a variety show, 'STEM the TIDE'
- The library venue content was increased and the science content deepened
- An ID card activity was introduced, which involved creative conversations with visitors about the part they could play in saving the world and producing personalised ID cards.





Figure 57 Earth and Sky Prototyping and Codesign Tour Clockwise from top left:  
 57.1 Flyer for event in Neath Town Centre, Wales as part of the Swansea Science Festival, Saturday September 2nd 2017  
 57.2 Young visitor having visited the “what kind of scientist could I be?” activity, Gloucester Central Library. Friday 27th October 2017  
 57.3 Young visitor painted as an alien for “living in space”co-design activities, (top) SMASHfestUK staff and visitor co-designing water rockets for launching (bottom), both Neath September 2nd 2017  
 57.4 Prototyping water testing station activity for “FLOOD!”, SMASHfestUK volunteer and young visitor, Gloucester, Friday 27th October 2017  
 57.5 Co-designing “Living in Space” activity to be debuted at SMASHfestUK “Flood” in February 2018 at Neath, September 2nd 2017  
 57.6. Creative conversation with a young visitor about what science or engineering career they might be interested in to help “save the world” prior to ID card activity, Neath, September 2nd 2017  
 57.7 Prototyping and creation. Young visitors showing their ID cards and designated role in task force to save the world from imminent disaster, Gloucester Central Library. Friday 27th October 2017

**Codesign process: IMPLEMENT**

SMASHfestUK 2018 took place in The Albany theatre and Deptford Lounge, Deptford, during the school half-term holidays from 12 to 16 February 2018 (Figures 58 and Figure 59). The narrative for the 2018 festival was pivoted to further enhance the local flavor of the story and make it feel more personalized to community visitors. The theme was ‘Flood!’ but, specifically, the story was tailored to be about Deptford being threatened by a massive tidal wave or tsunami that would overwhelm the Thames Flood Barrier and river banks, turning SE8 into a floodplain.

Visitors were invited to explore the transmission of tropical diseases such as malaria as climate change warmed the UK. The interactive, immersive ‘Living in Space’ exhibit, in which visitors were ‘space cadets’ who could ‘graduate’ if they interacted with all of the activities, the visitors were introduced to ideas about the potential colonization of space as an alternatives to living on Earth. The exhibit, which was co-designed with young people from Deptford and Middlesex University students, featured gravity well tables and a VR ‘space-rollercoaster’ experience (Figure 60). The VR helmets were designed by ‘Young Explainers’ recruited from Deptford Green secondary school Design and Technology GCSE classes (Figure 61).

Two immersive and interactive plays were written and produced for the festival: ‘STEM the TIDE’, a narrative play about the Thames Flood Barrier being breached and flooding Deptford; and a new production of ‘Cosmic Jives’, the play originally commissioned for SMASHfestUK 2016 (Figure 62A). Keith co wrote and produced an interactive immersive theatrical experience, ‘The Curious Case of the Flood in the Night-time’, where the audience were jury in a murder trial (Figure 62B). SMASHfestUK increased the variety and volume of careers information available to visitors in 2018 (Figure 63).



Figure 58 Brochure and flyer artwork for SMASHfestUK 2018 “Flood!” which took place in Deptford, London during the schools half-term holidays from 12th to 16th February 2018.

Figure 59 Brochure, artwork and official programme of events for SMASHfestUK 2018 Flood, which ran in the Albany theatre and Deptford Lounge from 12th until 16th February 2018



Figure 60 Immersive "living in space" experience featuring gravity well tables, and a VR "space-rollercoaster" experience. SMASHfestUK, Deptford 12th-16th February 2016



Fig.61 Helmets designed by pupils from Deptford Green secondary school



Figure 62A. A new production of 'Cosmic Jives' was performed on 15th and 16th February 2018. The Albany, Deptford



Figure 62B "The Curious Case of the Flood in the Night-time" 15th and 16th February 2016 Albany Theatre, Deptford



Figure 63 SMASHfestUK increased the variety and volume of careers information available to visitors in 2018

**Codesign process: EVALUATE**

An independent evaluation was carried out by Dr Natasha Simons, supported by SMASHfestUK volunteers (Simons 2018) (Figure 64). The evaluation utilized front-end and summative methods that were able to both capture quantitative comparative data whilst allowing for qualitative reflection, consisting of an in-depth researcher-administered exit questionnaire (closed and open-ended questions) for adults, a shorter form questionnaire for children (encompassing visuals), and a post-event survey for contributors. The key findings of the evaluation were:

- There were 3526 visitors to SMASHfestUK in 2018 (up 32%)
- The focus remained on the hyperlocal approach, with 92% of visitors coming from postcodes neighbouring the venues
- Collaborations involved >60 volunteers, 11 universities, 4 museums and 58 researchers creating 46 activities or performances
- 29 'Young Explainers' from a local secondary school were trained in engagement
- 49% of visitors were Black, Mixed Heritage of Minority Ethnic
- Science capital was raised in visitors
- Science capital and confidence was raised more in visitors to the library than to the theatre
- Science capital increases were greatest in underserved and under-represented visitors
- The biggest percentage increase in visitors was to the library, up 623 from the previous year

Proxy measures of science capital among adults, including STEM knowledge, ability to discuss STEM with children, and linking

STEM with everyday life, were raised across the board (Figure 65). When compared to the 2017 results, most measures of science capital had improved suggesting that the deeper immersion and personalized and localised storytelling had been effective (Figure 66). The number of adults strongly agreeing that their measures of science capital had gone up was greater in visitors to Deptford Lounge (library venue) than to The Albany (theatre venue) (Table 3). This suggests that the approach of focusing more immersion and science activities in the library venue, where there were more local and first time visitors, was effective in making the greatest leaps in science capital from those likely to have low background levels of science capital before the experience.



Figure 64 The 2018 independent evaluation was carried out by Dr Natasha Simons, supported by SMASHfestUK volunteers (Simons, 2018).

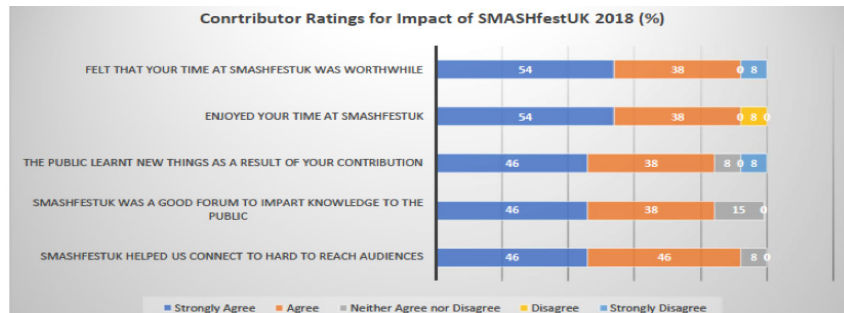


Figure 65 Most measures of science capital had improved from 2017 - 2018 suggesting that the deeper immersion and personalized and localised storytelling was effective.

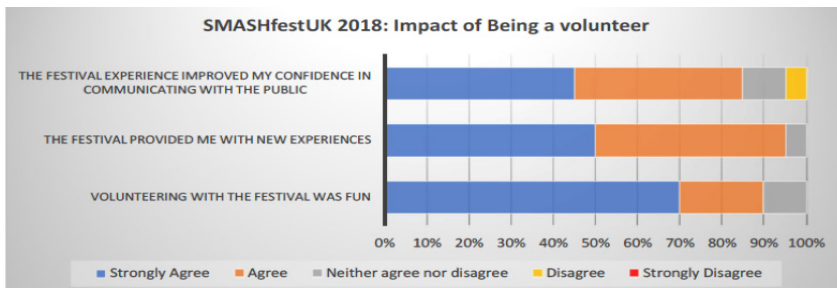


Figure 66 Proxy measures of science capital were raised in adults across the board.

|  |                 | Strongly Agree | Agree | Neither Agree or Disagree | Disagree | Strongly Disagree |
|--|-----------------|----------------|-------|---------------------------|----------|-------------------|
| Bridge the gap between the arts and the sciences | Deptford Lounge | 46.7           | 44    | 5.3                       | 2.7      | 1.3               |
|  | The Albany      | 41             | 50.8  | 3.3                       | 3.3      | 1.6               |
| Show how science can apply to everyday life      | Deptford Lounge | 50.6           | 39    | 7.8                       | 1.3      | 1.3               |
|  | The Albany      | 44.3           | 45.9  | 8.2                       | 0        | 1.6               |
| Enabled me to talk to children about science     | Deptford Lounge | 47.2           | 38.9  | 11.1                      | 1.4      | 1.4               |
|  | The Albany      | 36.7           | 50    | 10                        | 1.7      | 1.7               |
| Increased adult knowledge                        | Deptford Lounge | 43.7           | 32.4  | 16.9                      | 5.6      | 1.4               |
|  | The Albany      | 36.8           | 49.1  | 8.8                       | 3.5      | 1.8               |
| Taught children new things                       | Deptford Lounge | 53.4           | 42.5  | 0                         | 2.7      | 1.4               |
|  | The Albany      | 52.6           | 42.1  | 1.8                       | 1.8      | 1.8               |

TABLE 3 Adults “strongly agreeing” that science capital had gone up was greater in visitors to the Deptford Lounge (library venue) than to the Albany (theatre venue).

Testimonials

Impact – raising science capital

The testimonials highlighted the importance of role models in raising science capital importance of role models. The work done by SMASHfestUK in ensuring staffing was diverse in ethnicity, gender and other protected characteristics that reflected the audience appeared to be paying off:

*“For people of colour, the yardstick (for science and engineering) is very much white males – so to see women and women of colour in leadership and in engineering roles here - they are being influenced by that and it is a big confidence boost. In the UK we are always seen as the minority – ‘other than’ – and I don’t want my children to feel this. So, I feel that encouraging children of colour and of the female gender is really important. I was going to do engineering at University, but when I went to the open-day there was only one other woman there and the rest were boys – to be honest, that put me off and I chose social science in the end instead. So, I know how much representation matters in making choices and seeing yourself in a role”* (Black British mother visiting with 2 daughters)

*“My son has been everyday with the kid’s club – my son has been fascinated by this! He has told me all about what he has seen with the kid’s club, so today I have brought him down. He watches science programmes, but I cannot answer his questions! But this event means that he can talk with the experts”*

*“I think that events like this are really good because they engage the children in science and engineering activities. We came*

*last year and really enjoyed it. We do quite a lot at home, but mainly arts activities and making things – so I suppose engineering – but these events are great because you get to talk to real scientists who can tell you the answers straight away, rather than googling it like we do! My son was really engaged in that and the lady was excellent at explaining it to him. These events do a lot for us, they provide an opportunity for the children to engage and because there are activities and people to facilitate – the children are really gripped!”*

*“I can’t talk to her about space and science at home – so it is important that I take her to things like this so that she can learn about it. She has enjoyed it all”* (Black-African father of 2 daughters)

Impact – promoting intergenerational learning

The testimonials also suggest that the work done by SMASHfestUK focussing on intergenerational learning and engaging parents was also paying off, and showing links between science and arts and creativity:

*“This is an excellent display that really gets kids minds working, it makes everyone realise that there is a creative side to the brain. The activities are helpful to the parents too, like growing plants without earth! In Deptford, there are some activities around the arts but not so much focusing on science – so this is great for us to get smart. The kids were tired after swimming, but they still wanted to come here to see SMASHFest! They really like the storyline to find out how they could survive if there was a flood – so it gets their minds working and feeds their imagination”*

*“I actually like doing these activities myself, I used to know how to do this – but I forgot –*

*so it is good to learn these skills again. I do actually work with children, I am a community artist, so I can share this with them too. My son actually came here last year with his mum – he enjoys doing all of these activities and learning things along the way. It is very important to be creative”*

*“He has really enjoyed doing all the things. He loved the theatre because they can go in and make noise and stuff. This really puts science in an accessible context for the children. We are quite an arty family and I’m desperate for one of my children to become a scientist – so hopefully this will help!”*

**Impact – promoting progressions in learning**

Some testimonials indicated that the impact of SMASHfestUK was not confined to the event itself, with several attendees saying that conversations continued away from the events and after they had finished. These discussions about science within families indicate rising science capital.

*“We talked about it quite a bit and remembered what we had done and which our favourite bits were. We are going to try to magic instant freezing water trick” (Female, BR1)*

*“Yes, he can’t wait to share with their peers at the school “Show & Tell” (Male, SE8)*

*“It was fantastic. We sincerely enjoyed both of the days that we attended. My girls were able to explain what they had learnt to their dad and grandmother and were so enthusiastic to share new knowledge” (Female, SE4)*

*“it sparked many conversations amongst us ... as well as looking into qualifications and career routes” (Female, SE23)*

Follow up interviews also showed a sustained effect of SMASHfestUK and progression in learning:

*“We talked about it quite a bit and remembered what we had done and which our favourite bits were. We are going to try to magic instant freezing water trick” (Female, BR1)*

*“It was fantastic. We sincerely enjoyed both of the days that we attended. My girls were able to explain what they had learnt to their dad and Grandmother and were so enthusiastic to share new knowledge” (Female, SE4)*

*“Yes, we talked about it for days and researched things further” (Female, BR1)*

*“It sparked many conversations amongst us ... as well as looking into qualifications and career routes” (Female, SE23)*

*“My son wrote about it in his journal and we bring up things we heard and learned on the day in daily activities. We will refer back to Smashfest events in future activities. He continues to show others his science experiment papers so is learning by retelling it each time” (Female, SW18)*

*“We have spent time reading through the guide to space and have used the hologram. We are watching the soil-free plants grow. Plenty to continue our learning” (Female, SE4)*

**Impact: learning is sustained over time**

Testimonials taken during follow up interviews several weeks after the event also indicated that the impact of SMASHfestUK and the learning contained within the events was sustained beyond the end of the events.

*“We talked about it quite a bit and remembered what we had done and which our favourite bits were. We are going to try to magic instant freezing water trick”(Female, BR1)*

*“It was fantastic. We sincerely enjoyed both of the days that we attended. My girls were able to explain what they had learnt to their dad and Grandmother and were so enthusiastic to share new knowledge” (Female, SE4)*

*Yes, we talked about it for days and researched things further” (Female BR1)*

*“it sparked many conversations amongst us...as well as looking into qualifications and career routes” (Female, SE23)*

*My son wrote about it in his journal and we bring up things we heard and learned on the day in daily activities. We will refer back to SMASHfest events in future activities. He continues to show others his science experiment papers so is learning by retelling it each time” (Female, SW18)*

*“Yes, he can’t wait to share with their peers at the school “Show & Tell” (Male, SE8)*

*“We have spent time reading through the guide to space and have used the hologram. We are watching the soil-free plants grow. Plenty to continue our learning” (Female, SE4)*

**Impact – effect on volunteers**

SMASHfestUK has had an impact beyond its visitors, with almost 90% of volunteers saying that it increased their confidence in communicating with the public (Figure 67).

Contributors to SMASHfestUK, who are a mixture of performers, science communicators, artists, researchers and facilitators, many of whom work across lots of science festivals agreed strongly that SMASHfestUK was worthwhile and enjoyable and supported their ability to communicate with publics. 92% said SMASHfestUK helped them to reach audiences they found it difficult to connect with (Figure 68).

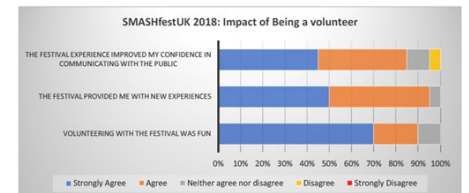


Fig.67 Impact on volunteers at SMASHfestUK 2018

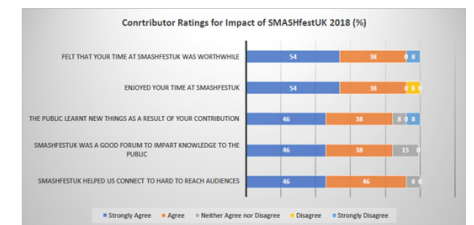


Fig.68 Impact on contributors to SMASHfestUK 2018

**Testimonials from contributors:**

“This has been the most rewarding of our public outreach because of the diversity of the local population. That is really different from our normal outreach. We have actually met people here who have had real experience of Malaria and Dengue fever and they can talk about their experience with us. We are incredibly happy to have come to SMASHfest” (Contributor, Royal Astronomical Society)

*“Parents and teachers commented on how they enjoyed the gravity mugs and thought they were a clever way to demonstrate it easily. The children were eager to try out the human factor workstations. I never got a moments rest traffic-wise or supporting the volunteers next to me. One 20-something individual was enjoying the rocket station so much that he would finish each task and then come and tell me about it. He kept hanging around me and having a chat and asking questions. Once he launched his rocket he came running back to me to let me know how amazing it was and he was all smiley and happy. He continued to walk around me and tell me how much he enjoyed that, and I responded with much praise and accolades of his accomplishment as well as a bit of a chat about rocketry. A while later he had to go and came up to me and said goodbye and gave me a hug. He reminded me why I do what I do and I left your event feeling lighter than air”* (Contributor, Earth Survival Skills and Space Camp).

**Awards and Recognition**

In 2018 SMASHfestUK was awarded a Times Higher Education Award for Outstanding Contribution to the Community (Figure 69). The judges said:

*“An inspiring example of collaboration between educational organisations and communities that began as a pilot in one deprived community but has become a national programme in just two years. Immersive experiences have been used to encourage young people to engage with practical solutions to disaster scenarios, a truly innovative way of stimulating interest in STEM and arts subjects, as well as ecological issues, while also reaching out to the wider community”.*

SMASHfestUK was also awarded The Engineer ‘Collaborate to Innovate’ award for the second year running with its primary school partners in Deptford in 2018 (Figure 70).



Fig.69 Winner of the Outstanding Contribution to Local Community Award



Fig.70 Winner of The Engineer ‘Collaborate to Innovate’ in 2018, with co-design students from Middlesex University



Media

SMASHfestUK 2018 received widespread social media interest (Figures 71 and 72). Since first attending SMASHfestUK in 2015, Carmel Britto, who runs LPF Kiddies Club, a care provision from Black and Mixed Heritage children, has returned every year and has now set up her own STEM after-school club. (Figure 73).

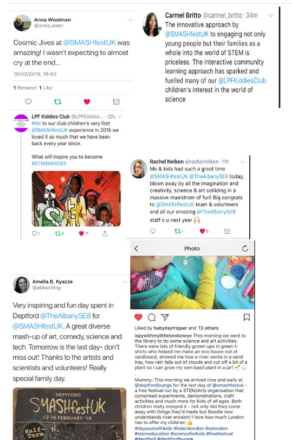
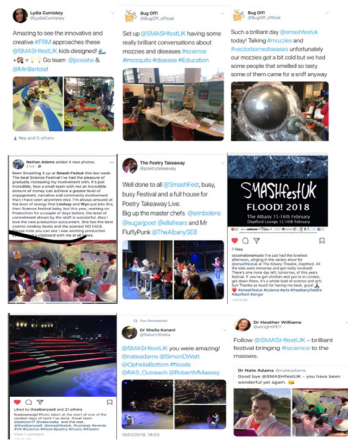


Figure 71 and 72 Sample social media for SMASHfestUK 2018 Flood!



Figure 73 Carmel Britto, has now set up her own STEM after-school club. She directly attributes the inspiration for this to her SMASHfestUK experiences.

CONCLUSIONS 2015-2018

Following a successful season of semi-immersive festival events over 4 years from 2015 – 2019 the detailed findings have been written up and accepted for publication in the peer-reviewed academic press.

The findings over 4 years supported the development of a novel model for inclusive engagement, SCENE, which represents, the use of STEAM (science, technology, arts, engineering and maths), COMMUNITY, ENQUIRY, NARRATIVE and ENTERTAINMENT as central principles for inclusive design of public engagement events. We believe that the use of SCENE principles, in partnership with co-design practices will result in more inclusive activities and events.

As per the Conclusions section in the summary of results, it is believed that the effectiveness of story-lead engagement lies in the embodiment of individuals as actors with agency within their own narratives, leading to a process of narrative transportation. Narrative transportation is how transported audiences are to the fictional world and this can affect behaviours and attitudes in real life.

Across the 4 years of SMASHfestUK live events, we have seen significant evidence of narrative transportation in visitors, and increased engagement with STEM by underserved and under-represented communities. We have also observed hard evidence of several graduates of the "Young explainers" programme go on to study STEM subjects at higher education levels. The evidence that we can see these transportative effects making changes in attitude after semi-immersive (festival) experiences suggested to us that the

effect of SCENE and narrative transportation might be even more enhanced in a fully-immersive experience, and therefore the next iteration of the festival events would be a fully immersive theatrical experience, SPACE PLAGUE, which was co-designed and created and delivered in July 2019 and February 2020.

## Component 5: SMASHfestUK 2019 Space Plague! (Bradford) and SMASHfestUK 2020 “Space Plague” (Deptford)

Bradford City Park  
20th and 21st July 2019

Deptford Lounge, London

<https://www.flickr.com/photos/30542236@N04/>  
<http://gala.gre.ac.uk/id/eprint/30696>

### Codesign process: UNDERSTAND

After the 2018 festival SMASHfestUK had established and tested the SCENE model for inclusive engagement at SMASHfestUK festival events. The 2015-2018 annual events comprised multiple consecutive and parallel events and activities which encompassed theatre, comedy, interactive installations, experiments, demonstrations and games, linked together with an over-arching disaster based storyline. It was proposed, therefore, that adapting the next SMASHfestUK event to be a fully-immersive narrative experience might result in even deeper engagement and greater narrative transportation, causing even stronger positive changes in attitudes towards science in attendees, and raising science capital further.

The reasoning behind integrating stories into the engagement model is based on the research derived from previous SMASHfestUK events and other research which suggests that storytelling is highly effective at engaging individuals and transforming their beliefs, attitudes and behaviours. Studies by Green and Brock (2000) observed that these effects are ‘strong and long-lasting’, while Philips and McQuarrie later reported that this could

fundamentally affect attitudes, confirming that ‘a story can engross the story receiver in a transformational experience’ (Phillips & McQuarrie 2010), and Green stated that ‘Narrative Transportation Theory proposes that when consumers [of a story] lose themselves in a story, their attitudes and intentions change to reflect that story’ (Green 2008). Space Plague drew on these influences to incorporate immersive narrative, contextual and collaborative problem solving, which would engage audiences emotionally and could result in some degree of narrative transportation.

Space Plague was a co-designed, fully immersive theatrical experience for young people and families about a fictional pandemic. The underpinning research question for the event was whether engagement through fully immersive theatrical narrative experience, driven by the developed SCENE model, would enhance Informal Science Learning and build greater science capital than semi-immersive events. It incorporated immersive narrative, contextual and collaborative problem solving, in order to engage audiences emotionally and to explore whether the fully-immersive theatrical experience would result in a greater degree

of narrative transportation than semi-immersive festival experience.

### Co-design process: CREATE (Prototyping in Bradford, July 2019)

Space Plague was initially devised through co-design workshops and methods, and was prototyped and tested in a scratch performance in a marquee at Bradford Science Festival in July 2019 (fig. 74 - 75) Codesign workshops with students from the local primary school (Haberdashers Aske’s Temple Grove Free School) over two days during which groups of Year 6 students, given only the ‘Space Plague’ title as inspiration, devised, scripted, produced and directed their own short films on the theme (Figure 74). Students from University of Greenwich and from Middlesex University assisted production and the outputs from these workshops were synthesised by Keith and Griffiths into proposed storylines for the Space Plague immersive experience. These storylines were then developed further with SMASHfestUK partners (The British Ecological Society, Oxford Structural Genomics, and Diamond Light Source) into a more detailed story and activities and experiments to be performed within the immersive Space Plague experience, for a scratch performance in a specially adapted

marquee at Bradford Science Festival in July 2019. The experience explored the story of a plague which threatens a global pandemic, and included a room in which visitors had to repair a model ‘particle accelerator’ in order to create a vaccine to cure space plague. The experience was successful in engaging young people and families with science with evidence of sustained interest in the topic following the experience (Figure 75)

A full photographic record of the primary school co-design phase can be found here

<https://www.flickr.com/photos/30542236@N04/albums/72157710823047142>

The films created by the year 6 students can be found here:

<https://www.youtube.com/playlist?list=PLvsPnO89qAFWQ-dug-Jm9F3-J4k-aTtqV7>



Figure 74 (top) – a family in the ‘particle accelerator’ room, repairing it to find a vaccine  
 Figure 75(bottom) – a family using literature provided by SMASHfestUK, discussing how real particle accelerators work after the event.



Figure 76. Codesign workshop at Haberdashers Aske's Temple Grove Free School 17th and 18th June 2019

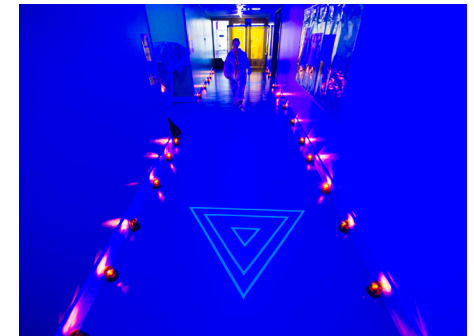
**Codesign process: IMPLEMENT  
 (Deptford, February 2020)**

The findings and evaluations from the Bradford Space Plague scratch performances were further developed using more co-design workshops to prepare for its delivery in Deptford in February 2020 (Figure 77). This would be a more expansive site-specific production creating seven sets and transitional spaces for the audience to promenade through as the story unfolded. The spaces spanned Deptford Lounge, Tidemill Primary School and a marquee in Deptford's public square. A co-design partnership with Scenography students from Central St Martin's School of Art was developed to create immersive practical sets in all 8 spaces.

The co-design also involved two series of drama workshops with Riverside Youth Drama Group in Deptford and Tramshed Drama Group in Woolwich. Young local people from both groups participated in the final delivery of Space Plague as actors and facilitators, and those from Riverside Theatre created a mock news report which became an integral part of the storyline and delivery of the final event: <https://flic.kr/p/2ixy3JJ>.



Figure 77 "Space Plague" at The Deptford Lounge, South-East London, 20th and 21st February 2020.





### The Space Plague Experience

Audiences entered in groups of 10-12 people. The event was free, but ticketed. The experience duration was around 75-90 minutes. The cast of actors, facilitators, scientists, producers and volunteers was gender balanced, diverse and reflected the local community demographics which are around 40% BAME.

### Space Plague Story

Visitors were “onboarded” by induction into the Emergency Response Team (Figure 78), who were actors and facilitators dressed in branded Hazmat suits (Figure 79), who asked each audience member to get dressed in a hazmat suit themselves and fill in a short questionnaire. The questionnaire was interwoven into the story as a way to collect evaluatory and demographic data, with permission and consent obtained.

A mock news report explained that a novel disease linked to a local meteorite shower was spreading locally, causing “zombie-like” symptoms. In the ‘Meteorite Analysis Laboratory’ the audience had to

predict meteorite impact positions from incomplete co-ordinate records using mathematical triangulation before being urged to an ‘Emergency Field Hospital’ where a ‘medic’ took the patient history of a ‘zombified’ patient (Figure 80). Using logic and inference the audience narrowed the symptoms until they were confident the cause was ‘Space Plague’. An ‘Epidemiology Laboratory’ saw the audience plotting patient addresses on a map to identify disease clusters, leading them to also plot “outlier” clusters of disease unrelated to meteor impact sites but close to water, leaving them to deduce that a water-borne insect vector may be spreading the disease further. Real larval microscopy, followed by DNA barcoding puzzles, and protein transcription from DNA sequences lead the audience to deduce a peptide sequence which was to be subjected to (mock) x-ray crystallography in a (model) ‘particle accelerator’ to determine its 3-dimensional shape. The successful solving of the protein provided a false climax, as the result indicated a vaccine candidate but that it would take 10 years to manufacture. The audience were then taken to a ‘Crisis Room’ to make public health decisions.

This took the form of a live action role playing game (LARP) with two actors trained in public health facilitation, and involved making decisions regarding what drugs therapy could be made available, or developed, the relative costs and also decisions around social and resource control measures – such as whether to impose quarantine “lockdown” procedures. The experience climaxed with the guided decision-making allowing the audience to ‘save the world’ and a film communication, the ‘Heroes Return’, from ‘central government’ celebrating the role the audience played in saving of the world (Figure 81). The film used virtual immersive film-making techniques to incorporate the audience as ‘hero’ characters in the film, in order to underpin their embodiment and immersion in the storyline.

The “Heroes return” film can be viewed at <https://www.youtube.com/watch?v=yTa67OE-GTA&feature=youtu.be>



Figure 78 - Space Plague 'Emergency Response Team' participant badge

Figure 79 – The audience as the 'Emergency Response Team' head to the 'briefing room'



Figure 80 – 'Emergency Field hospital' where audiences carried out differential diagnosis of a patient.

Figure 81- Public Health 'Crisis Room', with participants watching themselves revealed in the 'Hero's Return' film upon completion of the experience.

**Initial Evaluation Results**

Audience evaluations took place and attendees were asked whether they had learned new things about science and most overwhelmingly agreed that they had. The results show that an overwhelming majority agreed or really agreed that they had learned new things about science, or that their children had, where respondents were adults (Figure 82). Visitors were also asked to think about their feelings of embodiment and immersion before and after the experience and this showed a change in attitudes. 117 individual audience members were subjected to the same question both before and after the experience and the difference in the results was striking. This audience was asked to rate how strongly they disagreed or agreed with the statement 'I feel like a real scientist' before the event and then again after the experience. Before the event only 51.3% of people answered that they agreed or really agreed with the statement, whereas after the event the percentage who agreed 'I feel like a real scientist' rose to 81.7% (Figure 83).

The results strongly suggest that immersion and embodiment has a positive effect on the audience with regard to whether they feel like 'a real scientist'. According to the hypothesis on the role of Science Capital by Archer et al. (2013), one of the main differences in those who choose to study STEM subjects at school and beyond and those who do not is a feeling that science is, or is not, 'for people like me'; however, this research suggests that the transformative experience of immersive theatre using the SCENE model may have the power to change these attitudes.

These striking changes in attitudes suggest that the immersive experience and

embodiment as scientists within a narrative has changed how the respondents felt about themselves with regard to being or feeling like a scientist. The number of respondents who "really agreed" that they felt like scientists rose by 238%, whereas the percentage of those who did not feel like scientists reduced significantly.

Overall these results suggest that the SCENE methodology is a good way to engage marginalized audiences who are underserved and under-represented in informal science learning engagement demographics, and are unlikely to attend science festivals, centres or museums. In addition, the use of narratives and immersion promotes and builds science capital in visitors. This effect is enhanced when the visitors are fully immersed in the story and we suggest that the narrative transportation achieved by these experiences positively affects attitudes towards STEM subjects and that this may result in future positive choices in STEM study and careers.

A peer reviewed article derived from this research has been published in the Journal of Science Communication in a COVID-19 special edition (Keith 2020) for which the editors received far higher than average the number of submissions.

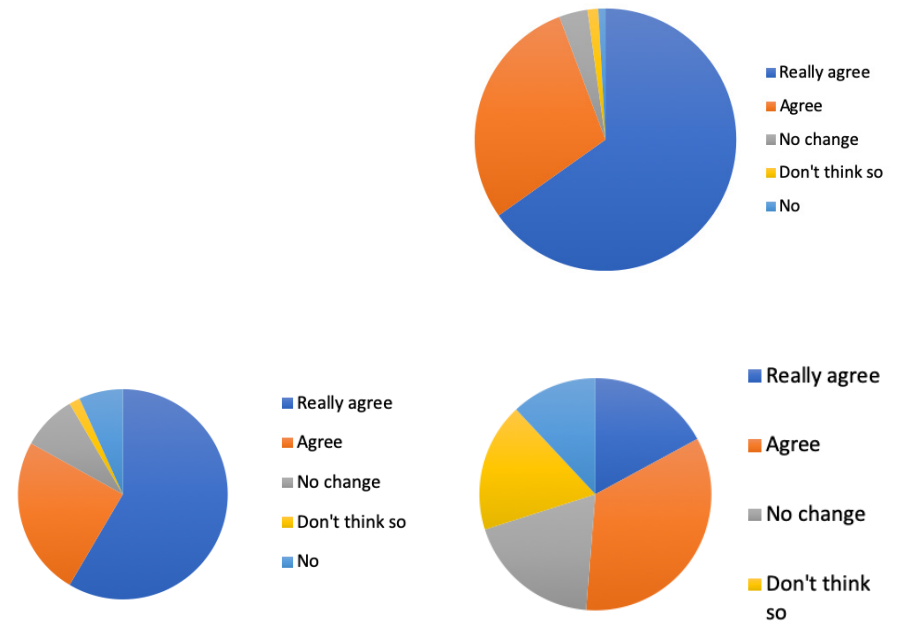


Fig.82 and 83 Responses to the statement 'I feel like a real scientist' before (L) and after (R) the event

Media



Figure 84 A review of Space Plague has been published in “The Niche”, the magazine for the British Ecological Society

**PUBLIC ENGAGEMENT**

Little did we know back in May 2019, that by the same time the following year we would be working from home with the UK in lockdown, protecting ourselves and our loved ones from the scourge of a novel virus sweeping the world and delivering devastation and destruction to communities and economies, the likes of which had not been seen since the great influenza pandemic of 1918.

**Ben Griffiths and Louise Rath**  
SMASH\_UK, www.smash-uk.org.uk

And yet, in the office of SMASH\_UK, an organisation working to equality diversity and inclusion in STEM and Arts education and careers, you might have been laughing for things we had done kind of dubious laugh. For May 2019 was when we discovered that SMASH\_UK had been awarded a large grant from the Science and Technology Facilities Council (the UK research council that funds particle physics and astronomical research) and the Royal Academy of Engineering through our brilliant lead partner at Middlesex University to deliver a co-design programme and theatrical performance of a fully immersive experience called ‘Space Plague’.

To put this in context, SMASH\_UK designs, develops and delivers engaging immersive Arts-driven STEM events, programmes and activities with the specific intention of engaging BAME audiences and young people living with poverty.

Our work is design-based and progresses through cycles of co-design and participatory action research as the norm in both a production in itself and a method for the next evolution of engaged practice innovation. We are constantly trying to learn from what we do to deliver better community programmes and events the next time around. We were founded specifically to engage audiences, such as Black and minority ethnic communities, or communities living with poverty who are both underserved by existing informal advice education opportunities, such as museums, and/or under-represented in STEM careers.

Space Plague was the fifth event in a series of festivals with SMASH\_UK delivered in Deptford a centre of south east London which was once a thriving district, and later known as the Light of London due to four massive power stations on the banks of the River Thames. But, by the late 20<sup>th</sup> century Deptford was beset by poverty, crumbling infrastructure and unemployment. This also meant it was hard to reach the communities who are so often under-represented in art and science events, and therefore it was Deptford in which SMASH\_UK chose to have their first Space Plague being the most recent, and most intensive of our adventures yet.

Since SMASH\_UK was formed we have always believed that science is the route to learning and engaging with STEM, and although we have always used narratives in our events (usually of impending natural disasters such as asteroids and super volcanoes), Space Plague was the first time we would attempt anything as ambitious as a fully-immersive theatrical performance. We knew we couldn't take on anything



this ambitious alone and were delighted when the BBC through their Public Engagement Manager, Chris Jeffs, said they would like to work in partnership with us to help deliver the event.

When we first started working with the BBC and our other partners – the Structural Geometric Consortium, the Diamond Light Source and the ISIS Neutrons and Muon Source – Space Plague was an outlier of an idea on a grand scale. Ironically, by the time it came to February 2020, it was an enormous and ambitious experience with scripts, actors, an incredible set and audience co-designed with students from UAL, Central St Martin's and Middlesex University, a cast and crew of around 40 people, including the BBC volunteers, that comprised of 11 interactive zones, appeared the most squares on Deptford High Street, the library and a local primary school. Luckily we'd had the opportunity to run what theatre practitioners call a ‘test-run’ performance in Deptford Square in 2018. It had been in a single margin and a small cast had had to make do with our co-design methods to test out the ideas and concepts we wanted to use before the big event in Deptford.

In December 2019, we were lucky enough to be invited at BBC HD in London to work with BBC volunteers to share our methods and work together to create new elements of the Space Plague story, in particular the ecology aspect. We ended up with a wonderful interactive scene, which for many audiences was the highlight of their immersive experience.

**Conclusions from SMASHfestUK Space Plague! 2019 and 2020**

To expand, events must be situated either physically or figuratively at the heart of the communities they wish to serve, and to include partners who might not normally engage with informal science learning, they should be entertainment lead. The use of enquiry as a fundamental purpose of the events encourages learning and desires learning outcomes should be established during the design phase, but finally, the use of narratives as mechanisms for deep engagement that can affect behavior in real life should not be underestimated.

**Further Research:**

Further evaluation of the longer term follow-up to Component 5 has been hampered by the COVID pandemic, but will not be carried out in 2021. Since the delivery of the live Space Plague event in February 2020, Keith with Griffiths (Middlesex University) and SMASHfestUK have been engaged in the creation of a prototype educational Virtual Reality game based on the same storyline to explore the effectiveness of the SCENE inclusive engagement model in the digital realm.

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