

Museums as brokers of participation: how visitors view the emerging role of European science centres and museums in policy

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Museums as brokers of participation: how visitors view the emerging role of European science centres and museums in policy

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Abstract

Science centres and museums in Europe traditionally offer opportunities for public participation, such as dialogues, debates and workshops. In recent years, starting with the support of grants from the European Commission, the purpose of these initiatives is increasingly more connected with the policy making processes where science centres play a role as brokers between the public and other stakeholders. This article begins an investigation on how these two levels of participation – the participation of museums in policy, and the participation of visitors in museums – are related in seven European science centres and museums. The results suggest that science centres and museums are regarded by their visitors as potential platforms to facilitate public participation in policy, especially in countries where the general infrastructure for public participation in science is weak.

Keywords

co-development, museum governance, public engagement, public participation, science centres, science museums, science policy

Introduction

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Science centres and museums in Europe have fully embraced the 'participatory turn' in science communication ([Jasanoff, 2003](#)), and they currently employ a variety of strategies, methods and instruments to stimulate and support public participation. Dialogue, debates and programmes relying on the active participation of adult visitors are very common in these institutions today. The traditional one-way forms of communication from the museum to the visitor have been replaced by new forms of interaction between the institution and the visitors, and among the visitors themselves. This approach represents more than just a new set of tools at the disposal of science centres and museums; it suggests a major change in how they relate to their public and, arguably, how the public relates to science museums.^[1]

Why do science centres and museums engender public participation? The three main rationales which are commonly referred to when making the case for public participation – normative, instrumental, and substantive ([Stirling, 2007](#)) – can also be used to explain the development of participatory forms of public engagement in museums. According to the normative view, participation *is a good thing to do* and it belongs to the forum function of the museum: that is, the idea of the museum as an institution that, in addition to exhibiting artefacts, generates and sustains public discussions ([Cameron, 1971](#); [Davies et al., 2008](#); [Simon, 2010](#)). Science centres worldwide have explicitly committed to being institutions that facilitate this kind of dialogue between scientists and the public ([SCWC, 2011](#)).

By contrast, according to the instrumental rationale, public participation is necessary to access unique expertise and competencies belonging to different sections of the public for the purposes of evaluation, co-curation, co-development and in general to provide multiple storylines within exhibitions and programmes ([Davies, 2010](#); [Boon, 2011](#)).

The third rationale reflects the substantive view: public participation helps to achieve better results in the context of the relationship between science and society, and in this case science centres and museums act as places that support deliberative democracy ([Cameron and Deslandes, 2011](#)) and scientific citizenship ([Paquette, 2006](#)).

These three rationales profoundly shape the relationship between museums and their visitors. While considerable research has been done in relation to the first two rationales, the third one remains at this point much more unexplored, especially in contexts when museums not only host participatory initiatives, such as consensus conferences (Durant and Joss, 1995), but when they are directly involved in the frameworks, platforms and processes related to science policy. Science museums in fact increasingly participate as fully-fledged stakeholders in the network of conversations and discussions leading to the development of science policies and science governance. The field where this is most evident is nanotechnology, where both in the USA and in Europe science centres are the main brokers between policy makers and the public (Bell, 2008; Bell, 2009; Chittenden, 2011; Laurent, 2012), and they are responsible not only for communication with the public but also for the professional development and training of scientists and policy makers. In general, science museums are increasingly expanding their role as brokers of public engagement with science across all disciplines and audiences (McCallie et al., 2009).

This article focuses on the substantive rationale for public participation in museums, and it explores how the emerging role of science centres in policy affects public participation inside seven national science centres and museums across Europe.^[2]

Science centres as stakeholders in public policy

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Until the early 1990s, science centres and museums positioned themselves as trusted providers of information and knowledge for the benefit of the public. Museums fully embraced the so-called 'deficit model' of science communication: a model where the public was considered to have a deficit of knowledge, and the organisations responsible for science communication were supposed to fill it (Wynne, 1992; Gregory and Miller, 1998). The 'deficit model' is very similar to what Zahava Doering described in 1999 as the 'baby bird' model of museums audiences, commonly found in museums of all kinds, '...which regards the visitor as a relatively undeveloped appetite needing our wise and learned feeding' (Doering, 1999).

During the 1990s, this one-way form of communication began to be criticised for being inadequate, especially with regard to contemporary, controversial and 'unfinished' science ([Wynne, 1992](#); [Miller, 2001](#); [Durant, 2004](#)). The information and knowledge about contemporary science to be transferred to the public was by definition incomplete, volatile and uncertain; it became increasingly difficult to 'exhibit' such information and present it to the public in the traditional way. Influential policy documents stated that science had to regain public trust and be accountable, as did the institutions communicating it ([House of Lords, 2000](#)). The one-way, top-down model of communication through exhibitions was replaced by the 'engagement' model: exhibitions and programmes aimed at engaging the public in a debate about the implications of science and research; the focus shifted from the content to the context of science, that is, its social implications. The change in museology was visible: exhibitions started to explore the most contemporary aspects of science and, rather than providing incontrovertible facts, they were built around questions, with the museum helping visitors find their own answers. A wide variety of programmes for all audiences became a fundamental component of each exhibition.

However, the engagement model also revealed some shortcomings. This model appeared not to recognise fully the competences that the public hold, and that are fundamental for the development of science and technology in contemporary society ([Collins and Evans, 2002](#)). Having an arena of dialogue and debate is important, but it became increasingly clear that the follow up to those debates is as important as the opportunity to have them. Science communication happens not only between scientists and the public, but involves a complex network of stakeholders, all of which need to be involved in the conversation. Together these stakeholders set the direction of science and shape its agenda. The contribution of the public is therefore necessary for the development of science, and for what is today called Responsible Research and Innovation, or RRI ([Owen et al., 2012](#)). Science centres and museums could thus be conceived as active players in the development of policies regarding the relationship between science and society and this was reflected in their inclusion in the funding streams of the European Commission. Through numerous collaborative projects, European museums have demonstrated their capacity to act not only as forums for discussion, but also as brokers able to convey the public's ideas, opinions, desires and fears to a vast network of stakeholders. Museums have therefore become 'full players' in the governance of science.

During the late 1990s and early 2000s, the involvement of science museums in policy was rather episodic and it was mostly prompted by European funded projects under the Framework Programmes 5 and 6 aimed at investigating the possible roles of museums in this field. However, in very recent years there has been a discernible tendency to make such involvement structural. For instance, the PLACES project (<http://www.openplaces.eu/>), ran for four years and left a legacy consisting of a network of seventy partnerships between local administrations and science centres which continue to develop science communication policies at local and regional level. The VOICES project (<http://www.voicesforinnovation.eu/>), a collaboration between 27 science centres and museums from all European countries, represented the first formal exercise promoted by the European Commission to involve citizens structurally in setting the priorities of the Horizon 2020 research agenda of the Commission. In the European project RRI TOOLS (<http://www.rri-tools.eu/>), several science centres are the strategic hubs of this major initiative which has the ambitious goal of developing the main tools to implement RRI in the current European framework programme for research and innovation.

As a result, museums are not only a location where public participation takes place, but they can be involved as institutions in the organisation, management and decisions relating to the policies discussed by the citizens. Visitors participate in discussions at the museum, and museums participate in discussions with policy makers. The mutual influences of these roles are increasingly more complex and intertwined. They impact how museums are perceived by their visitors and in broader public opinion. The dialogue that takes place in science centres has a significant impact outside the walls of the particular institution; it ends up influencing a wide range of stakeholders on matters of science and society. Thus science centres and museums belong to the increasingly expanding and important network of places of informal engagement with science which bridge informal, policy-free settings with politically motivated activities (Stilgoe et al., 2014).

Museums often work together on policy-related projects, but implementation is affected by the context in which each museum operates. There are substantial differences across European countries in terms of science communication culture, public participation infrastructure, and presence and activity of science centres and museums. In order to compare the state of science communication culture across Europe, Mejlgaard et al. propose an analysis based on six parameters: the degree of institutionalisation (e.g. regular science sections in newspapers; dedicated TV programmes, etc.); political attention to the field; scale and diversity of actors involved; academic tradition; public interest in science and technology; training and organisation of science journalism. Countries that report intense activities on three or more of these parameters have a 'consolidated' science communication culture; these are primarily western European countries. Countries where there is a tendency towards improvement on at least one of the six parameters have a 'developing' culture: these are primarily smaller countries and some eastern European countries. The third group of countries is characterised by low performance on all the parameters, and it includes eastern European countries, mostly from the south-east part of eastern Europe (Mejlgaard et al., 2012).

Rask et al. conducted a similar analysis on the national infrastructures for public engagement in science and technology. Their study considered the degree of formalisation of the following procedures in each country: involving civil society in formal science and technology bodies; stakeholder consultations; direct democracy; public debates on techno-scientific themes; technology assessment and foresight; deliberative democracy; transnational and European projects; E-engagement. The results show that western European countries have implemented more formalised systems for public participation than eastern European countries, and to a large extent the same divide can be seen between northern European countries and southern European countries (Rask et al., 2012). Finally, membership data from Ecsite (<http://www.ecsite.eu/members/directory>) show that in eastern Europe there are far fewer science centres and museums than in western Europe.

In selecting the institutions for this study, we considered these differences and formed a balanced and diverse sample of national science centres and museums from countries belonging to all of the above groups: consolidated, developing, and fragile science communication, and high and low levels of public participation. In terms of the role of the institutions in policy, all the institutions within this study have recently participated in at least one European project related to science policy. The participation of science centres in European projects is thus one indicator of their emerging role in science policy. However, many of these projects are not sustained over longer periods and are visible only to small audiences, usually because they are designed to involve a limited public (such as the project VOICES, for example, which is based on focus groups) or because they rely substantially on programmes rather than exhibitions (specific programmes are ephemeral and normally engage fewer visitors than physical exhibitions). Moreover, regardless of the participation of the museum in policy related projects, there can be a big difference between what visitors expect and what museums perceive as their role in science policy (Cameron, 2012). Therefore the first question of this study addresses the awareness among museum visitors generally that there might be a role for science centres in policy:

RQ1: To what extent are visitors aware of the role of museums in public policy, and how do they see it evolving in the future?

The second question investigates whether the awareness of the role of museums in policy affects public participation in the museum. More specifically, it investigates the extent to which this awareness compares with visitors' existing interest and engagement with science in affecting their level of participation in the science centre. The question distinguishes two forms of participation: sharing opinions and comments with other visitors and with the museum, i.e. the 'forum' function of the museum, and visitors' interest in co-developing programmes and exhibitions within the museum.

RQ2: How are engagement with science and awareness of a policy role for science centres related to public participation in the museum?

The last question covered by this study concerns the interest of the public in a more structural form of participation in the museum, namely in its governance. While the discourse around this issue is very broad, in this study we want to focus on a democratic, normative argument in support of public participation in the governance of museums. In a democracy, citizens should be able to participate in the decisions that affect their lives. So if science centres can influence public policy (Bell, 2009; Laurent, 2012) and therefore the lives of citizens, it can be argued that citizens should also be able to participate in the decision making process leading to these policies. The third question of this study looks therefore at the interest of visitors in participating in the decision-making process of the museum:

RQ3: Do visitors think that the public should participate in the governance of the museum?

Methods

<https://dx.doi.org/10.15180/150306/003> (<https://dx.doi.org/10.15180/150306/003>)

Sample

This study is based on a survey done in 2012 and 2014 among the visitors of seven national science centres and museums in Europe (see Table 1). The sample of institutions was formed to ensure a broad and balanced geographical spread and representativeness of the different situations in regards to science communication culture and public involvement in science and technology in Europe (Mejlgaard et al., 2012). At the Science Museum in London, where the survey was first implemented and tested in 2012, the sample was recruited through the social media channels of the Science Museum and on two occasions by distributing cards in the museum with a link to the online survey. In all other institutions, a random sample of adult visitors was recruited over the course of multiple days in 2014 and asked to complete the survey using paper forms during their visit. The questions relevant for this study were the same in 2012 and 2014. An overview of the participating institutions is given in Table 1.

This study is part of a larger research project on issues of scientific citizenship and science museums; it uses a subset of the data available from the survey and it constitutes the basis for a more complex analysis, which will be presented in a later paper.

Table 1

Surveyed institutions and size of the sub-samples

Country	Code	City	Institution	<i>N</i>	Survey Date
United Kingdom	UK	London	Science Museum	114	2012
Czech Republic	CZ	Pilsen	Techmania Science Centre	123	2014
Finland	FI	Vantaa	Heureka – the Finnish science centre	114	2014
Italy	IT	Milan	Museo Leonardo da Vinci	105	2014
Netherlands	NL	Amsterdam	Science Centre NEMO	95	2014
Poland	PL	Warsaw	Copernicus Science Centre	100	2014
Portugal	PT	Lisbon	Pavilion of Knowledge	115	2014
Total				766	

Measurements

Policy role

In order to assess the visitors' awareness of a policy role of museums, the survey contained two items presented twice under different scenarios. The items were:

1. The Museum [*in all questions, 'the Museum' was replaced with the name of the institution where the survey was being conducted*] represents the public opinion in the national and local discussions about science.
2. Institutions like the National Science Academy, universities and industries give regularly advice to the government on matters of science policy. Should the Museum do the same?

In the first presentation visitors were asked to indicate how they see the situation now, and in the second, how they would like to see it in the future, using a seven point Likert-type scale ranging from 'definitely no' to 'definitely yes'. The two sets were further combined in a scale called *policy role*.

Engagement

Empirical measures of interest and engagement with science were done with six questions, which formed the scale *engagement*:

1. In addition to the Museum, I know other engaging and interesting ways to be involved with the developments of science and technology.
2. I am interested in the social and policy discussions regarding science and technology.
3. My level of knowledge about science and technology is...
4. I am socially or politically active in a domain where science and technology are relevant (for example, through my work or hobby).
5. During the last three months I encountered a topic related to science and technology (for example, in conversations, in the media, on my job).
6. I personally know people who are active (socially, professionally or politically) in science and technology.

Participation – forum

Visitor interest in two different forms of participation were measured: the interest in sharing opinions and feedback (the 'forum' function of the museum) and the interest in co-developing museum exhibitions and programmes. To measure the first form of participation, six questions were combined to form the scale *forum*:

1. There are enough opportunities to give my opinion and feedback in the Museum on matters of contemporary science and science policy.
2. The Museum has made me aware of other organisations I would like to visit or to be in contact with.
3. My point of view on matters of science, technology and society is well represented in the presentations at the Museum.
4. After the visit, I would have liked to add my point of view and/or personal experience to the programmes and/or exhibitions at the Museum.
5. I think other visitors would find it useful to know my point of view about the subjects of the programmes and/or exhibitions I visited.
6. The visit to the Museum made me realise that my point of view on science and technology is important.

Participation – co-development

To measure visitor interest in the second form of participation, three questions were combined in the scale *co-development*:

1. I think I have expertise, connections or other skills and know-how that could be useful to the Museum to develop new programmes or exhibitions.
2. I would be interested to be involved on a voluntary basis (= not paid) in the development of new programmes at the Museum.
3. And if your role and involvement was a remunerated one?

Answers to all the above questions were given using a seven point Likert-type scale with values ranging from 'definitely no/never/very low' to 'definitely yes/very often/high', according to the question.

The reliability values of the scales for each sub-sample are reported in Table 2.

Table 2

Reliability values of the scales *policy role*, *engagement*, *forum*, and *co-development* for all sub-samples

Scale	Chronbach's alpha						
	NL	IT	FI	PL	CZ	UK	PT
Policy role	0.84	0.71	0.75	0.69	0.83	0.74	0.75
Engagement	0.80	0.75	0.87	0.81	0.85	0.81	0.70
Forum	0.79	0.80	0.72	0.71	0.80	0.72	0.73
Co-development	0.86	0.80	0.78	0.73	0.80	0.81	0.72

Note: In all sub-samples, all item-total correlations were above .30 for all scales and can thus be considered reliable. See Table 1 for the full names of the institutions in each sub-sample.

Public board

Two questions in the survey asked if the museum should have a public board in its governance, and if the advice of this board should be binding for the museum:

- 1. The Museum currently has a board of trustees and a scientific advisory board; should it have also a public board (composed of members of the public) to advise on how to represent science to the public?
- 2. If the public is to advise the Museum, its opinion should be binding for the Museum.

In this case answers were also given using a seven point Likert-type scale ranging from ‘definitely no’ to ‘definitely yes’.

Demographics

Finally, the survey contained a few questions to collect socio-demographic data (gender, age, education level). All correlations to test interrelationships between variables are calculated using Pearson product-moment correlation coefficient with a significance level of $\alpha=.05$. All regression analyses use Method Enter (Green and Salkind, 2010). Both were performed using SPSS v. 21.

Results

<https://dx.doi.org/10.15180/150306/004> (<https://dx.doi.org/10.15180/150306/004>).

The frequency distributions of the demographic factors in all sub-samples were fairly similar. Mean age varied between 31.57 (Czech Republic) and 43.08 (The Netherlands); gender distribution varied between 42.3% (Italy) and 63.2% (Czech Republic) of female visitors. More remarkable differences were found in the education level and the frequency of visit. Tertiary-level education varied between 27.9% (Portugal) and 86.7% (UK), with four institutions where more than half of the respondents had tertiary-level education (UK, Finland, The Netherlands and Poland). The percentage of respondents who visited for the first time varied between 2.7% (Finland) and 78% (Poland). All socio-demographic values are presented in Table 3.

Table 3

Socio-demographic values for all sub-samples

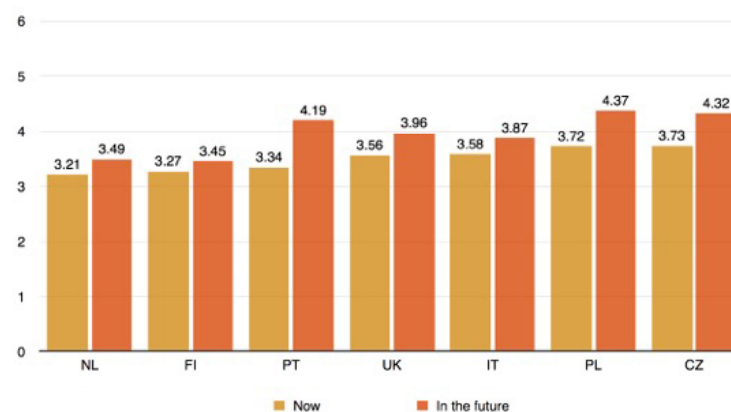
	UK	CZ	FI	IT	NL	PL	PT
<i>N</i>	114	123	114	105	95	100	115
Min age	20	18	18	18	18	19	18
Max age	62	73	66	87	71	61	62
Mean age	35.23	37.45	42.05	40.62	43.08	31.57	36.44
<i>SD</i> age	9.42	9.97	10.34	10.61	13.73	9.03	13.78
First Visit (%)	13.3	60.2	2.7	48.5	62.8	78	26.1
Male (%)	38.4	36.8	41.3	57.7	40.4	49	42.6
Female (%)	61.6	63.2	58.7	42.3	59.6	51	57.4
Elementary (%)	0	11.8	0	1	0	2	0.9
Junior school (%)	0.9	10.9	3.6	13.6	4.3	26	19.1
High school (%)	12.5	33.6	21.6	47.6	23.4	10	52.2
Tertiary education (%)	86.7	43.7	74.8	37.9	72.3	62	27.9

Note: See Table 1 for the full names of the institutions in each sub-sample.

Answering RQ1:

To what extent are visitors aware of the role of museums in public policy, and how do they see it evolving in the future?

The answers to the question about visitor awareness of a role for science centres and museums in public policy show a moderate awareness of how these institutions fulfil such a role now; however, visitors would like to see a stronger role for science centres and museums in policy in the future. In all countries visitors are moderately positive about the science centre as a representative of public opinion; on a scale from 0 to 6, values range from 3.21 (The Netherlands) to 3.73 (Czech Republic). The differences across countries are minimal, with a slightly higher awareness about this role in Czech Republic and Poland. These are the most recent institutions in the sample, having opened to the public in 2008 and 2010 respectively. The answers to the question of whether science centres should fulfil this role in the future, however, show a marked interest in Portugal, Poland and Czech Republic; in these three countries the mean values are above 4, and these are also the countries with the largest difference between the current and future values. Finland, The Netherlands and Italy are the three countries where the mean values are lower, and these countries show the smallest difference between the current and future values. Figure 1 reports the mean values. The results sketch a visible difference between countries with a 'fragile' infrastructure for science communication and participation and countries where this infrastructure is more developed. In countries where citizens have generally fewer opportunities to participate in science and technology, there are higher expectations that science centres and museums can fulfil a role in this direction.

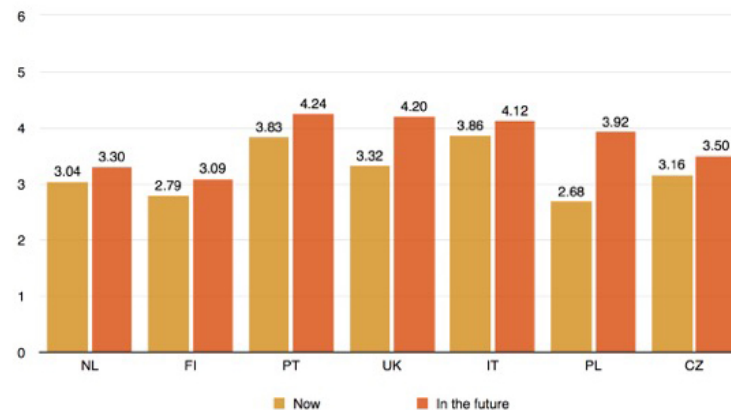


(<https://journal.sciencemuseum.ac.uk/wp-content/uploads/2020/05/graph-1-1.jpg>)

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Figure 1 : Mean values for the question 'The Museum represents the public opinion in local and national discussions about science' now and in the future. See Table 1 for the full names of the institutions in each sub-sample.

The answers to the question of whether the science centre should be an advisor to the government on matters of science communication show a similar picture. The highest values can be found in Portugal, where the science centre is actually an agency of the national government, and in Italy and the UK; the lowest values are in The Netherlands and Finland. In Poland the gap between how visitors think about this role for the science centre now (2.68) and in the future (3.92) is the largest (see Figure 2).



(<https://journal.sciencemuseum.ac.uk/wp-content/uploads/2020/05/graph-2-2.jpg>).

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Figure 2 : Mean values for the question 'Should the Museum be an advisor to the government on matters of science policy?' now and in the future. See Table 1 for the full names of the institutions in each sub-sample.

In sum, visitors are aware of the role of science centres in policy and they are in general positive about this role in the future; however, there are two notable differences across the institutions surveyed. The first one is that in countries with a high level of public participation and consolidated science communication culture, like Finland and The Netherlands, the majority of visitors are rather neutral about the idea of the science centre playing a role in policy, now and in the future. This is less evident in UK and Italy, where it holds true only for the museum as representative of public opinion. In fact, in both countries visitors are quite positive about the role of the museum as an advisor to the government on matters of science policy. This can be related, however, to the fact that the Science Museum in London and the Museo Leonardo da Vinci in Milan are long-standing large national science museums, with collections and specialist expertise on a broad range of technical and historical domains. The academic knowledge and heritage function of both museums might positively influence the expectations of the visitors in terms of the role of the museum as advisor to the government.

The second difference is that the expected role in policy of science centres and museums in the future is generally stronger in countries (Poland, Czech Republic, Portugal) where the formal possibilities to participate in science and technology are more limited. This suggests that in these countries, where there are generally very few routes for citizens to get their voices heard on matters of science and technology, visitors want a stronger involvement of museums in policy, possibly because museums are seen as accessible and innovative institutions. Instead, in the countries where there are established and visible routes for discussing science policy, the difference between the current and expected role of museums in policy is much less pronounced.

Answering RQ2:

How are engagement with science and awareness of a policy role for science centres related to public participation in the museum?

The second research question aimed to analyse whether the two forms of public participation – *forum* (i.e. the interest of the public to share feedback and opinions in the museum) and *co-development* (i.e. the visitor's interest to co-develop programmes and activities with the museum) are related to the emerging *policy role* of science centres and museums and to visitors' existing *engagement* with science.

Before conducting the analysis on the relevant variables, we wanted to examine whether socio-demographic factors (gender, age and education) are also related to the two forms of participation, *forum* and *co-development*. In the case of *forum*, there are no significant correlations in any of the sub-samples, with the only exception being the Czech one where there is a significant correlation between *forum* and age ($r(112)=.287, p=.002$). For *co-development*, the correlation with education is significant in the UK and Finland ($r_{UK}(108)=.286, p=.003$, $r_{FI}(111)=.235, p=.013$), and with age in the UK and Portugal ($r_{UK}(103)=-.336, p=.001$, $r_{PT}(115)=-.210, p=.024$). Gender was found to make a difference in three countries – Czech Republic, Italy and The Netherlands – where males have a slightly higher interest in *co-development* than females.

We then analysed the correlation values between the two forms of participation (*forum* and *co-development*) with both *engagement* (the variable measuring visitors engagement with science) and *policy role* (the variable measuring visitors' perception of the *policy role* of the museum).

In all sub-samples there are significant correlations between *forum* and *policy role* and in most sub-samples between *forum* and *engagement*. In all cases the correlations between *forum* and *policy role* are stronger than between *forum* and *engagement*. The interest in *co-development* is instead significantly correlated with *engagement* in all sub-samples, but generally not with *policy role* (significant correlations exist only in Italy, Poland and Portugal). Table 4 shows the significant correlations values for all sub-samples.

It seems, therefore, that the two forms of participation – *forum* and *co-development* – are both related to *policy role* and *engagement*. However, while *forum* is more strongly related to *policy role*, *co-development* is more strongly related to *engagement*.

Table 4

Significant correlations between *forum*, *engagement*, *policy role* and *co-development*

	NL	IT	FI	PL	CZ	UK	PT
Forum and engagement	0.31	0.48			0.30	0.29	0.22
Forum and policy role	0.37	0.56	0.44	0.44	0.37	0.52	0.60
Co-development and engagement	0.48	0.46	0.49	0.56	0.31	0.37	0.32
Co-development and policy role		0.38		0.36			0.27

Note: Figures in bold are significant at the 0.01 level; all others are significant at the 0.05 level.

Regression analysis was used to identify the extent to which *engagement* and *policy role* affect *forum* and *co-development*. It is important to state that we cannot establish direct causality effects between variables. In fact, there are likely to be cross-effects and feedback loops between them. However, regression analysis gives a measure of how *engagement* and *policy role*, when considered together, affect the two different forms of participation in the museum.

The analysis shows two clear results. For *forum*, in all sub-samples the beta values for *policy role* are significant, and they are higher than the beta values for *engagement*. This means that, when all other factors are constant, incrementing the value of *policy role* produces a greater change in *forum* than incrementing the value of *engagement* does. For *co-development*, the reverse is true: in all sub-samples *engagement* is significant, and is higher than *policy role* (which is significant only in Poland, Portugal and Italy). In the case of *co-development*, therefore, *engagement* has a stronger effect than *policy role*. The two variables *engagement* and *policy role* explain between 18% (Czech Republic) and 39% (Italy) of the variance of *forum*, and between 9% (Czech Republic) and 42% (Poland) of *co-development*. Table 5 reports the results of the regression analysis for all sub-samples.

Table 5

Regression analysis results for *forum* and *co-development*

<i>Forum</i>	NL	CZ	FI	PL	IT	UK	PT
Adjusted R²	0.22	0.18	0.23	0.18	0.39	0.29	0.36
Engagement Beta	0.32	0.25	0.23	-	0.32	0.18	-
<i>p</i>	0.00	0.00	0.01	-	0.00	0.04	-
Policy role Beta	0.37	0.32	0.47	0.44	0.45	0.49	0.58
<i>p</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00

<i>Co-development</i>	NL	CZ	FI	PL	IT	UK	PT
Adjusted R ²	0.21	0.09	0.24	0.42	0.25	0.17	0.13
Engagement Beta	0.48	0.30	0.50	0.55	0.38	0.44	0.27
<i>p</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Policy role Beta	-	-	-	0.33	0.25	-	0.21
<i>p</i>	-	-	-	0.00	0.01	-	0.02

Note: Only significant beta values at the 0.05 level are reported.

These results go some way towards answering the second research question: 'How are engagement with science and awareness of a policy role related to public participation in the museum?' They suggest that what visitors expect in terms of the policy role of the science centre plays a stronger role in determining their interest in sharing opinions and feedback than does their existing engagement with science. In some sub-samples, namely in Poland and Portugal, the engagement with science is not even a significant factor. This can be interpreted as a sign that the perceived 'brokering' function of science centres and museums in mediating science policy is a factor in stimulating dialogue and discussion. In fact, it is even more important than the visitors' existing engagement with science.

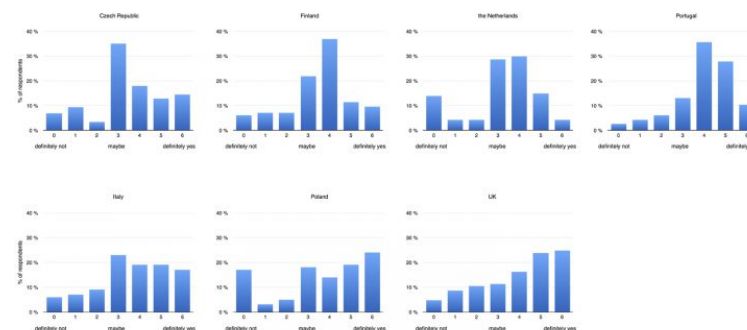
An interest in co-development instead appears to represent a wish to pursue and express a personal engagement with science, and it is not usually affected by what visitors think about the role of museums in policy. Only in three cases (Italy, Poland and Portugal) are there significant betas for *policy role*, suggesting that in these countries the co-development of exhibitions and programmes is also affected, although in a lesser way, by what visitors expect in terms of the policy impact of the science centre.

Answering RQ3:

Do visitors think that the public should participate in the governance of the museum?

The last question of this study concerns a form of participation which is currently only hypothetical: a 'public board', which is an instrument in the governance of the museum composed only of members of the public. Visitors were asked two questions related to this topic: whether the museum should have such a public board (in the same way as it usually has a scientific board, for instance), and if the advice of this board should be binding for the museum.

The results show that visitors are in general supportive of the idea of a public board. On a scale from 0 to 6, where 3 is the middle point, the mean values for the sub-samples range from 3.18 (The Netherlands) to 4.00 (Portugal). There are, however, two distinct distributions of frequencies. One is roughly a normal distribution, where the majority of the visitors are substantially neutral or moderately in favour of the idea of a public board (with two smaller ends representing visitors who are either quite negative or decidedly positive about a public board). This distribution can be found in Czech Republic, The Netherlands, Finland, and Portugal. The other distribution shows a more polarised situation, with a small group against the idea, and a larger group decidedly in favour. This occurs in the case of Italy, Poland, and the UK (see Figure 3 for the distributions). The difference between the two distributions suggests that in Italy, Poland and the UK visitors are more interested in some form of public participation in the governance of the museum than in the other four countries, although more research would have to be done to investigate further.



(<https://journal.sciencemuseum.ac.uk/wp-content/uploads/2020/05/figure-3-graph-3.jpg>).

Explore this image

Figure 3 : Frequency distributions of the answers to the question 'Should the museum have a public board?'

Visitors are in general decidedly less positive about the binding status of the advice of such a board. The mean values range from 2.00 (Finland) to 3.12 (Italy). In this case the distribution of frequencies is quite uniform across the seven institutions: it is a normal distribution centred on the middle value 3. However, in Portugal, Czech Republic, Italy and Poland the distribution is rather symmetrical, with an equal number of people who are in favour or against the idea, whereas in The Netherlands, Finland and the UK the number of people who are against the idea is considerably higher than those who are in favour. Mean values and standard deviations for all sub-samples are reported in Table 6.

Table 6

Mean values and standard deviations for the interest in a public board and its binding status

	NL	CZ	FI	PL	IT	UK	PT
Public Board							
Mean	3.18	3.44	3.49	3.62	3.67	3.96	4.00
Public Board SD	1.65	1.69	1.54	2.10	1.72	1.82	1.38
Binding status							
Mean	2.02	2.98	2.00	2.97	3.12	1.90	2.77
Binding status SD	1.48	1.65	1.53	1.89	1.57	1.68	1.60

It seems therefore that visitors are in general positive about a public board in science museums; in some institutions there is even a marked preference for this kind of instrument. At the same time, few visitors think that the advice of the public board should be binding for the institutions. In three institutions (The Netherlands, Finland, UK) the public is clearly against this idea; in the other four institutions the results are more differentiated, with the majority of the visitors neutral about the idea, and ‘pockets’ of visitors on both sides of the scale.

Discussion

<https://dx.doi.org/10.15180/150306/005> (<https://dx.doi.org/10.15180/150306/005>)

The purpose of this study was to examine whether public participation of visitors in seven European science centres and museums is related to the perceived emerging role that these institutions play in public policy. The analysis was conducted on three levels: measuring the visitors’ awareness about the current and potential role of science centres and museums in public policy; assessing whether this role is related to visitors’ interest in participating in the museum; and measuring visitors’ interest in a higher form of participation, namely in the governance of the institution.

Overall the results show that:

1. science centres and museums are effectively seen by their visitors as accessible brokers of public participation, especially in countries where the formal infrastructure of public participation in science is weaker
2. there is a clear relationship between certain types of visitor participation and the perceived role of science centres and museums as brokers in public policy.

That visitors are positive about the brokering role of science centres in policy is particularly evident in countries such as Czech Republic, and Poland where the science communication structure is not yet consolidated (Mejlgaard et al., 2012) or where, as in Portugal, public participation is generally low (Rask et al., 2012). One can speculate that in these countries science centres are seen as institutions that can play a role in facilitating public participation in science policy, particularly because other forms of public influence are missing. Instead, in countries where public participation is more solid and established (The Netherlands, Finland), visitors are more neutral about the idea of a formal role for science centres and museums in policy, most likely because in these countries there are already other opportunities for public participation.

The results concerning the binding role of a public board point in the same direction. In countries with a more fragile infrastructure for formal public participation (Czech Republic, Poland, Portugal and, to some extent, Italy), visitors are more positive about the idea that the advice of a public board in the museum could have a binding status. That is, in these countries visitors are more open to the idea that museums and science centres are platforms where the public can fully participate in the decision making process and where their opinion 'counts'. A possible explanation is that since in these countries there are not many formal opportunities for the public to participate in science and science policy, visitors see museums as institutions where participation is possible and accessible.

This study also suggests that across all institutions there is a discernible difference between factors affecting visitor participation in the form of sharing opinions and giving feedback (i.e. the 'forum' function of the museum) and visitor participation involving the co-development of programmes and exhibitions. The forum type of participation could therefore be described as having a 'societal' dimension: it is affected more by the idea that the museum will play a role in society, contributing to public policy, than by the visitors' personal interest and engagement in science. Symmetrically, co-development can be described as a 'personal' form of participation, affected more by the visitors' own level of engagement with science than by how they expect the museum to contribute to policy. It is important to state that we cannot interpret these results as actual 'motivations' for public participation – they only reflect how well the two variables *policy role* and *engagement* can be used to predict visitors' interest in participating in the museum.

Visitors, thus, are not only aware of the societal role of science museums (i.e. their potential to affect wider policy), but this role of museums is a stronger predictor for an interest in discussing and debating in the museum than visitors' own existing engagement with science. The implication for museums is that public participation in science centres and museums effectively responds to the 'substantive' rationale, meaning that it can be implemented for the purpose of discussing matters of contemporary science with the goal of informing policy. In all institutions visitors were positive about this role for museums, especially in countries where other possibilities for public participation are limited. This represents on the one hand an opportunity for museums, but on the other hand it also requires the development of professional skills and knowledge to manage this form of participation.

It is important to note that this study has a number of limitations. The first is that the data used for this analysis necessarily simplified the complex issues relating to participation, policy and science museums. There were no open questions, for instance (in order to ensure the best comparability of results across countries), and the overall number of items was kept to a minimum. When interpreting the results, one should always keep in mind that there are several other factors influencing the variables of this study which are not present in this study, including, for example, differences in the institutional culture across the organisations, and national attitudes toward cultural and heritage institutions. A more complex research project and analysis, and possibly the use of qualitative methods, would determine in more detail the variety of factors affecting public participation in science museums.

The second limitation concerns the difference between the sample in the Science Museum and the other institutions. In the UK, the respondents filled in the questionnaire online, after being recruited through the social media of the Museum. In all other locations visitors compiled the questionnaire during their visit. The difference in administering the survey was due to the fact that the original idea of using social media as a channel to recruit respondents had to be abandoned since few science centres had the same reach on social media as the Science Museum, and therefore it would have been impossible to recruit respondents online in the same way as in the UK. Despite this difference, the socio-demographic indicators of the UK sample were not substantially different from the other sub-samples. It can be safely assumed that the visitors in the UK sub-sample are committed and 'connected' with the Museum – these are visitors who like to keep informed and updated about the activities of the Science Museum. Furthermore, this sub-sample has a relatively high number of repeat visitors (86.4%).

Despite the limitations, this study supports a finding that is significant for museum activity, one that could find application in the design of exhibitions and programmes. It seems that giving more visibility to the role of the museum in influencing science policy may encourage visitors to discuss and debate science issues within the museum. Further research designed around the specific situation of each institution is of course required to fully support this proposition. But the evidence so far shows that when it comes to visitors' interest in discussion and debates, how visitors think the museum can influence public policy might play a more important role than the visitors' own engagement with science. Further investigation of substantive forms of participation – those which are concerned with achieving improvement in the relationship between science and society – seem warranted, and it seems that transparency and emphasis on the role of the museum in influencing policy may also positively impact on visitors' experience and attitudes to discussion within the museum.

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Appendix

<https://dx.doi.org/10.15180/150306/006> (<https://dx.doi.org/10.15180/150306/006>).

Selection of science centres and museums in the sample

We defined the following criteria in order to identify a comparable group of institutions for analysis. The science centre or museum to be selected:

- is established in a country of the European Union;
- has a national relevance, either by statute (i.e. being defined as 'the national centre/museum') or by visitation (attracting a substantial number of visitors from outside the city/region);
- has a significant number of exhibitions and ongoing programmes on issues of contemporary science and technology;
- has taken part in at least two European collaborative projects in the past five years.

From the resulting list of 15 institutions we formed a sample with seven institutions, ensuring a broad and balanced geographical spread and representativeness of the different situations in regards to science communication culture and public involvement in science and technology (Mejlgaard and Stares, 2012; Rask et al., 2012).

The full list of institutions and the selection matrix is reported in Table 7; highlighted in yellow are the selected institutions.

Table 7

Selection criteria for the sample of institutions

Country	Museum	West/East		North, Centre, South			Science Communication culture			Public involvement in S/T	
		W	E	N	C	S	Consolidated	Developing	Fragile	High	Low
Belgium	RBINS	x		x			x			x	
Czech Republic	Techmania		x		x				x		x
Denmark	Experimentarium	x		x			x			x	
Estonia	Ahaaa		x	x				x			x
Finland	Heureka	x		x			x			x	
France	Universcience	x				x	x			x	
Ireland	Science Gallery	x		x				x			x
Italy	Museo da Vinci	x				x	x			x	
Netherlands	Nemo	x		x			x			x	
Poland	Kopernik		x		x			x			x
Portugal	Pavillion of Knowledge	x				x	x				x
Slovenia	Hiša eksperimentov		x		x			x			x
Sweden	Technical museum	x		x			x			x	
Germany	Deutsches Museum	x			x		x				x
UK	Science Museum	x		x			x			x	

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Footnotes

- In the rest of this article the terms 'science centre' and 'science museum' will be used interchangeably, since we focus on the public participation of visitors in institutions that display, discuss and engage with contemporary science through exhibitions and programmes.

- We use the term 'emerging role' to emphasise that there are still profound differences across science centres and museums in how they interpret this role, and that also within each institution it is a quickly evolving and developing concept.

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