University of Southampton

Wonderseekers

IMPACT MEASURING TOOLKIT FOR MUSEUMS

Acknowledgments

The ideas presented in this toolkit are the result of collaboration between the University of Southampton and the Winchester Science Centre.

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We would also like to thank the anonymous visitors who participated in piloting the toolkit.

Contents

Introduction

The role of science centres and other informal learning spaces often goes unnoticed for their educational contributions because research on these settings and on their impact is rare. This participatory action research project, funded by UKRI Research England, put together the minds of University of Southampton researchers with those of practitioners from the Winchester Science Centre to create a relevant, easy to use toolkit that can improve the way impact is measured in informal science settings.

The project was led by the research expertise of Dr. Neta Shaby and Dr. Ran Peleg on informal learning environments with the support of Dr. Ian Coombs. Together with Wonderseekers staff, we diagnosed issues and situations related to practice that needed investigation. Together we developed and selected appropriate tools that can be used for the investigation and then use these tools to collect data. Finally, this data was analysed and reflected upon.

The tools used and experience gained are put together to form this Impact Measuring Toolkit. The toolkit can be used by practitioners to inform their instruction and provide much-needed evidence to stakeholders. The aim is to empower science museums to highlight the valuable role they play in shaping knowledge and to showcase their important contributions.

Our partners – Wonderseekers and the Winchester Science Centre

Wonderseekers, the Charity behind the Winchester Science Centre (WSC), has been sparking children's curiosity in science, technology, engineering, and maths since it was founded in 1986. By sparking and harnessing children's curiosity in science, and by removing barriers to engagement, Wonderseekers believe it can give children the confidence, ambition, and freedom to improve their own lives, the lives of others and ultimately life on Earth. Each year 130,000 visitors and 45,000 primary school children engage with the science centre, both through visits to the Centre and outreach in underserved communities.

The Toolkit

The Impact Measuring Toolkit consists of five easy to implement research tools. Each one is described in sufficient detail to allow for its application by practitioners. Each tool is provided with an explanation of its purpose, a description of the tool and when, where and with whom it can be used. Details are also included on the tool's affordances, challenges, how it can be adapted and examples of data analysis.

Participatory Action Research

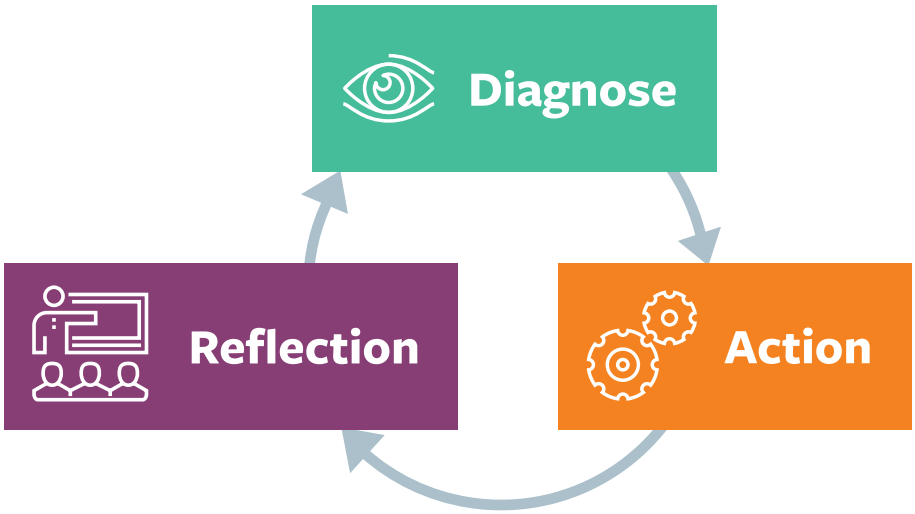
Participatory Action Research is "a research process which involves those being researched in the decision-making and conduct of the research, including project planning, research design, data collection and analysis" (Bourke, 2009). In this type of research everyone involved in the process is treated equally to co-create and execute a research plan. Some have defined Participatory Action Research as an attempt to provide participants with actionable knowledge and/or new information which they can take away and use to improve their practice (Ospina, Burns, & Howard, 2021).

There are several models for conducting this type of research. In this project we used McNiff's (2010) cyclical model for action research. Its cyclical nature suggests that once a cycle is completed, the research can commence all over again to produce further insights.

Ospina, S., Burns, D. and Howard, J. (2021) 'Introduction to the Handbook: Navigating the Complex and Dynamic Landscape of Participatory Research and Inquiry', in The Sage handbook of participatory research and inquiry. London: SAGE.

McNiff, J. (2010). Action research for professional development: concise advise for new experienced action researchers. Poole, UK: September books.

Participatory Action Research



In the **diagnose** phase, the co-researchers develop the research question(s), according to their mission statement and their research interests.

This is followed by the **action** phase in which various tools to explore the research questions are developed. Data is collected and subsequently analysed by the co-researchers.

In the **reflection** phase, findings are presented and reflected upon. Each co-researcher also reflects on the process and the outcomes, looking ahead to the next research cycle.

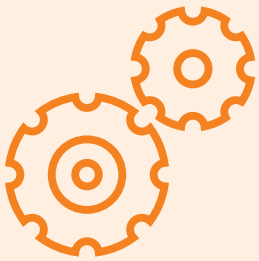
This research was a partnership between the University of Southampton and the Winchester Science Centre and took place between February-July 2023. The outline of the research project:

Diagnose – Workshop 1

This workshop centred on brainstorming and defining the research questions WSC staff wanted answered through the research. Discussion revolved around the mission statement, evaluation that is already conducted and burning questions the co-researchers wanted answered. A natural divide between research interests created two working groups, exploring different lines of research. The initial thinking was captured on a wall of 'Post-it' notes. The main ideas were then transferred to a Miro board which was used to keep track of ideas and project progress.

Action – Workshop 2 and small group meetings

Both groups refined the research question using the Miro board and documented various ideas for the research tools. In the second workshop the co-researchers finalised the data collection tools (that are outlined in this Toolkit) and agreed on a schedule for data collection. Once the data was collected, analysis meeting were held to support the WSC staff with analysing it.



Reflection – Workshop 3

The research cycle concluded in a final workshop where the two research groups presented their findings to each other. This was followed by a discussion evaluating the whole experience.

Below are some of the quotes from the final workshop that capture the experience:

> "I think that it took a while to get (going) at the very start. It's very much like we don't know what we want. And having you come in and prompt us, it allowed us, gave us the opportunity to actually act in a self-reflective manner."

> "I think for me it's the trying out the different methods [that] has really helped. Because now we know that some of these things work. We can go right, when we want to know an answer to a specific question about an event or an experience."

> "...we haven't really done anything like this before, and it's really eye opening to see what we can try out next."

Mind-Hand-Heart

When	Where	Audience
Anytime during a visit	Convenient places to write scattered throughout the space	All visitors. If possible, separate responses of different visitor groups (adult visitors, child visitors, school groups, etc.)

Purpose

Use this tool to explore visitors' cognitive, physical, and affective outcomes by finding out what they learnt, did and felt.

Description

A5 postcards left in key locations around the science centre for adults and children to fill in and a feedback post box.

Affordances:

- → Data collection is easy and does not require the presence of staff.
- → Responses are anonymous; therefore, ethical approval can be easily granted.
- → Can be completed in a group, but previous visitors' responses are not visible so do not influence other people.
- → Easily adaptable by changing the statements/questions.

Challenges:

- → The postcards elicit short statements not necessarily rich descriptions or explanations.
- → Design and printing costs should be considered.
- → Data analysis can be time-consuming and requires expertise. Seek guidance from your local university!

Adaptations

You can change the questions to anything that might be of interest.

It can be specific to an activity, an exhibit, or relating to the entire visit.

Resources

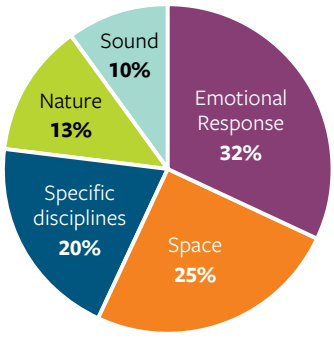
- → Printed postcards
- → Pencils, pens, markers
- → Tables or other flat surfaces for writing
- → Collection boxes

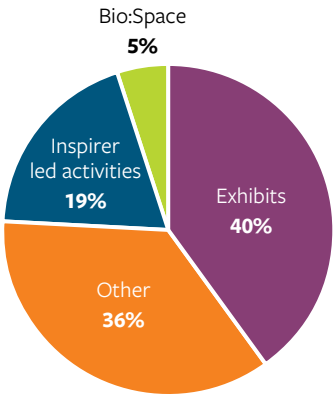
Example of data analysis

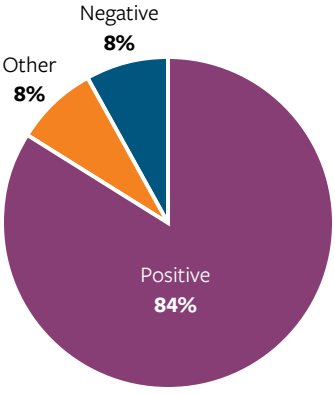
Data collected
116 responses

Audience
Family visitors to WSC on weekends and school groups on weekdays

Data analysis method
Thematic analysis of responses







Mind
What have you learnt?

Hand
What have you enjoyed doing?

Heart
How has it made you feel?

“Overjoyed and happy, happy, happy”

“Watching science live, doing the interactives, planetarium, cancer T cells”

“There is no sound in space because there is no air in space”

“Trying out the different stations and learning about them”

“Inspired to look for dormice at home”

“Meal worms eat polystyrene, dormice nest in trees, dormice leave the nut edge smooth, about sound speed”

“Going mouse and nut hunting and playing in the little big world”

“The force of the air making the tennis ball move”

“It made me feel angry because the teacher did not give us freedom”

“We can benefit if we learn from past mistakes”

“I have learnt that plastic hurts sea creatures”

Thought Bubble Wall

When	Where	Audience
Anytime during a visit	Dedicated exhibition space	All visitors. If possible, it is recommended to separate responses of different visitor groups (adult visitors, child visitors, school groups, etc.)

Purpose

Use this to discover what your visitors think regarding a specific concept/term/ idea that interests you. For example, this can be used to see how the visitors view ideas from the institutions mission statement.

Description

Dedicated exhibition space with a screen displaying a question to be addressed by visitors such as 'What does science mean to you?'. Next to the screen is paper for visitors' responses and a clip wall to hang the completed responses.

Affordances:

- → Data collection is easy and doesn't require the presence of staff.
- → Responses are anonymous; therefore, ethical approval can be easily granted.
- → Easily adaptable by changing the statements/questions.
- → Design of the exhibit space is not costly and can be used to fill-in empty spaces in the centre.

Challenges:

- → Elicits short statements and not necessarily rich descriptions and explanations.
- → Since responses are visible this could influence the responses of other visitors.
- → Data analysis can be time-consuming and require expertise. Seek guidance from your local university!

Adaptations

The question/statement can be easily changed to anything that might be of interest.

The question/statement can be specific, to a concept, activity, exhibit, or relating to the entire visit.

Resources

- → Slips of paper
- → Pencils, pens, markers
- → String and paper clips
- → A screen (lower tech solution can be used to display questions/statements)

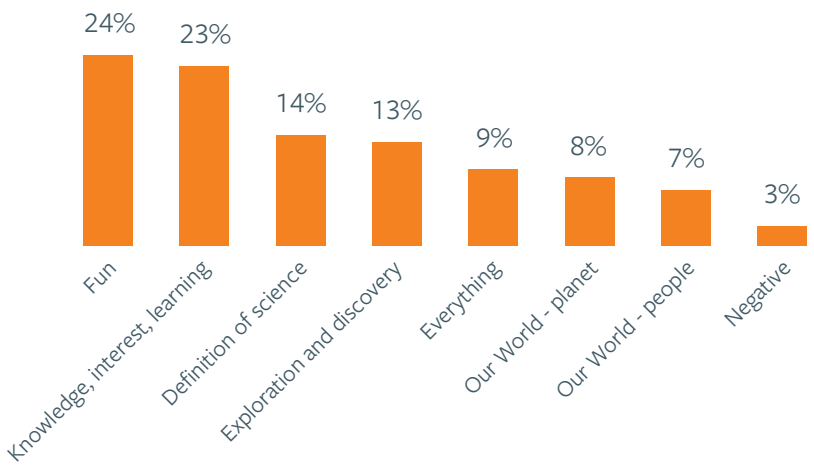
Example of data analysis

Data collected
187 responses

Audience
Family visitors to WSC on weekends and school groups on weekdays

Data analysis method
Thematic analysis of responses

What does science mean to you?



What does science mean to you?

Let us know your thoughts

"The function of the whole UNIVERSE and everything in it, and CURIOSITY"

"It means finding out new stuff"

"Science means to me that I can explore"

"EVERYTHING"

"Science is the answer to how our world works"

"It proves things can help Humanity"

"It will help the future :-)"

"Fun experiments"

Experience Meter

When	Where	Audience
At the end of the visit	Place near the exit	All visitors. If possible, it is recommended to separate responses of different visitor groups.

Purpose

Use to change your Likert-type questionnaire into a more visual, user-friendly way to collect visitors' opinions on the visit or a specific activity.

Description

The tool includes a statement or a question with five emojis to indicate the visitor's opinion by placing a small sticker.

Affordances:

- → Data collection is easy and doesn't require presence of staff.
- → Easily adaptable by changing the statements/questions.
- → Very simple data analysis.

Challenges:

- → Responses are anonymous; therefore, ethical approval can be easily granted.
- → Allows simple insights only (such as enjoyment of visit).
- → Printing costs need to be considered.
- → Responses can be influenced by previous visible stickers.

Adaptations

You can change the statement or question to anything that might be of interest.

It can be specific, to an activity or exhibit, or general relating to the entire visit.

Resources

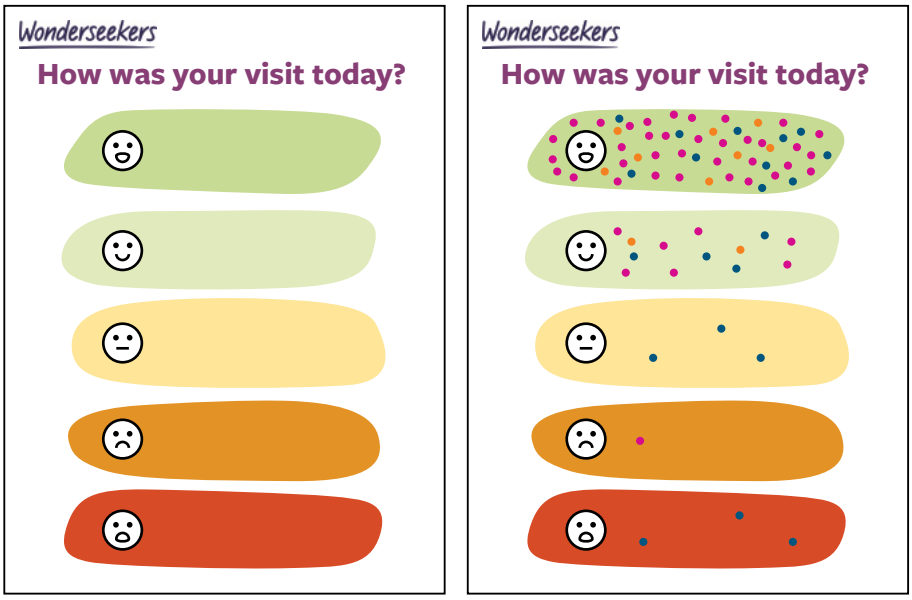
- → Printed board with statement/question
- → Stand
- → Stickers

Example of data analysis

Data collected
18 public days, 0 school days

Audience
Family visitors to WSC on public holidays

Data analysis method
Visual, or counting



How can I use those tools for on-the floor feedback?

Inspirer-led activities - Q&A Audio-recordings

When	Where	Audience
After a staff-led activity (for example Planetarium or Science Shows)	Close to the space dedicated to the activity	Families

Purpose

Used to obtain an in-depth view of how visitors engage with staff, for example: what further information do they seek, what topics interest them, what elements in the activity excited them?

Description

Inspirers (this is how WSC staff refer to themselves) wear an audio recording device to record interactions.

Affordances:

- → Data collection is relatively easy (just remember to turn on the audio recorder).
- → Can be used to document a variety of interactions between staff and visitors.
- → Offer deep insights regarding what interests visitors.

Challenges:

- → One time investment in purchasing audio-recorders.
- → Responses are anonymous; however, ethical approval might be complex to obtain.
- → Data analysis can be time-consuming and require expertise. Seek guidance from your local university!

Adaptations

A range of activities can be recorded.

With appropriate permissions, this method can be expanded to include exhibits and exhibitions.

Resources

- → Audio recorder(s)

Example of data analysis

Data collected
Recordings took place over three weekends in April. 3 hours of recorded data of conversations following the Planetarium and Flower Power Science Shows

Audience
Family visitors to WSC on weekends

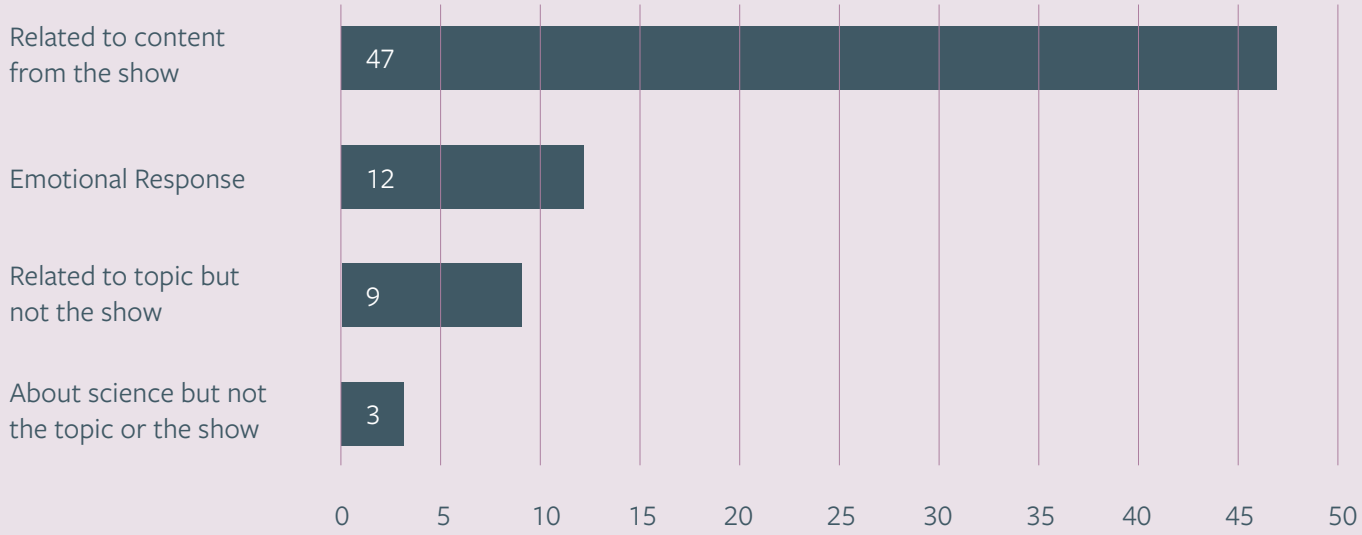
Data analysis method
Thematic analysis of Q&A

Type of interaction	Planetarium		Flower Power	
Question – Child	41	52	26	35
Question - Adult	11		9	
Statement – Child	7	19	8	8
Statement - Adult	12		0	
Total	**71**		**43**	
Answered	87%		83%	

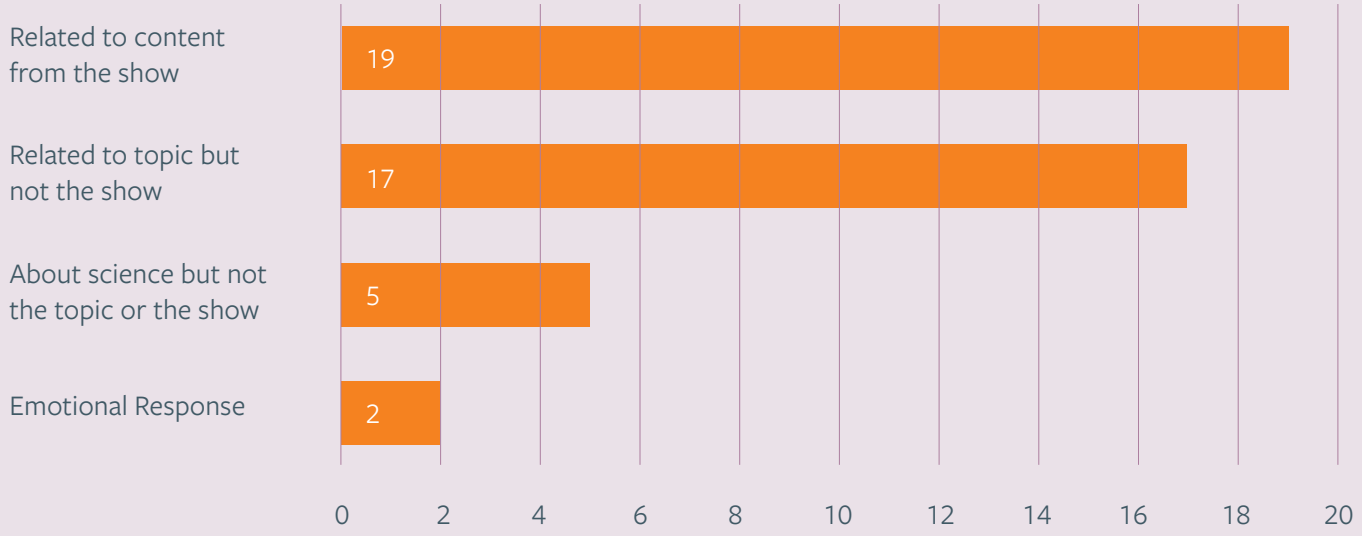
The common topics asked by visitors after a show were planets in our solar system, specifically Pluto, dwarf planets, galaxies and stars, moons and constatations.

The common topics asked by visitors after the shows were related to the science topic, ladybirds, bees and pollinators, second, were questions about the props used to demonstrate scientific concepts, such as Van de Graff Generator.

Themes of Planetarium interactions



Themes of Science Flower Power interactions



An average of **73%** of the conversations with inspirers after a planetarium show involves science communication (containing science content).

More adults interacted with inspirers (**58%**) than children (**42%**).

Where inspirers were asked questions following a show. On 30 (**67%**) occasions a single question received an answer. On 15 (**33%**) occasions a question resulted in a dialogue between the questioner and their family and the inspirer.

Video-recordings of family visits

When	Where	Audience
During the visit	All around the museum	Families

Purpose

Use to explore how children and adults engage with exhibits, staff, and each other during a visit to the museum. Offers a rich dataset from the visitors point-of-view.

Description

A member of a family (usually a child) is asked to wear a GoPro camera during the visit. All family members need to give consent (in the case of minors the parents need to give their consent and the child gives their assent). The visitor can remove the camera at any time.

Affordances:

- → Rich dataset that offers a wide spectrum of analyses and insights.
- → The families collect the data themselves. Staff are only required to hand out the equipment in the beginning and collect it at the end.
- → As close as it gets to naturalistic interactions.

Challenges:

- → Purchasing the camera can be costly.
- → It can take time to recruit participants who are willing to be recorded.
- → Although not collecting personal information, obtaining ethical approval for video recording may be challenging.
- → Data analysis is highly time-consuming and requires expertise. Seek guidance from your local university!

Adaptations

With such rich dataset, adaptations are not needed.

Resources

- → Video cameras, GoPro recommended

Examples of data analysis – Evaluating exhibits

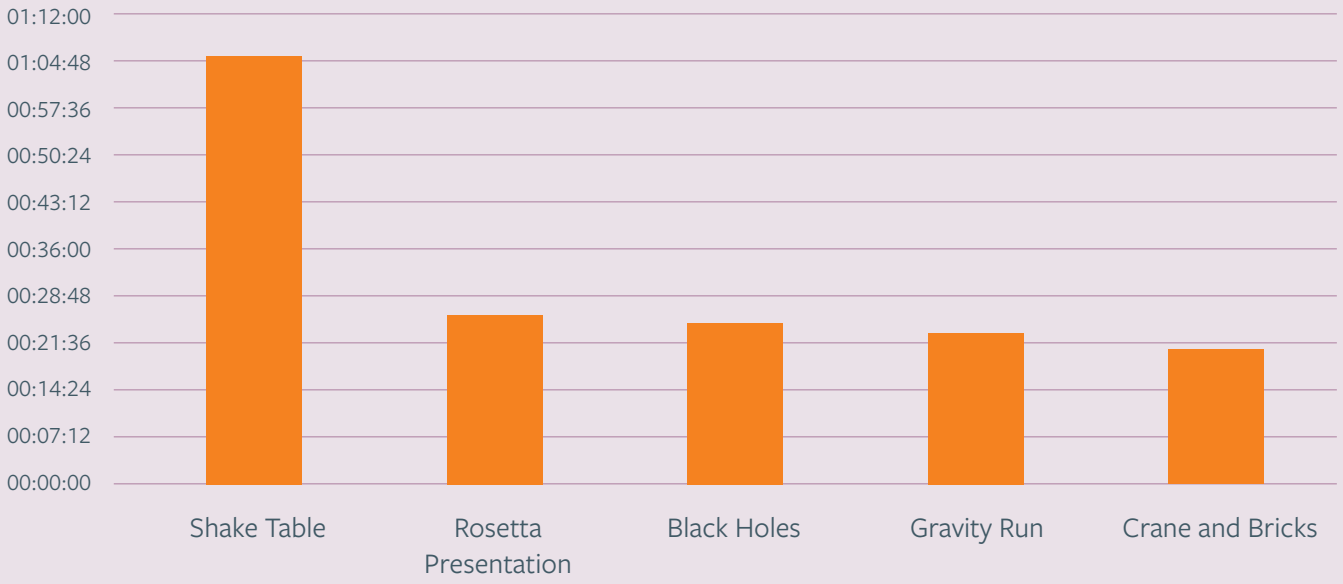
Data collected – Video recordings of 15 families, 27 children (age range 5-14) and 28 adults

Total time of recordings: 17 hours 43 minutes

Audience - Family visitors to WSC on two weekends

Data analysis – Time analysis

Most popular exhibits by total time



Most popular exhibits by average time per visitor

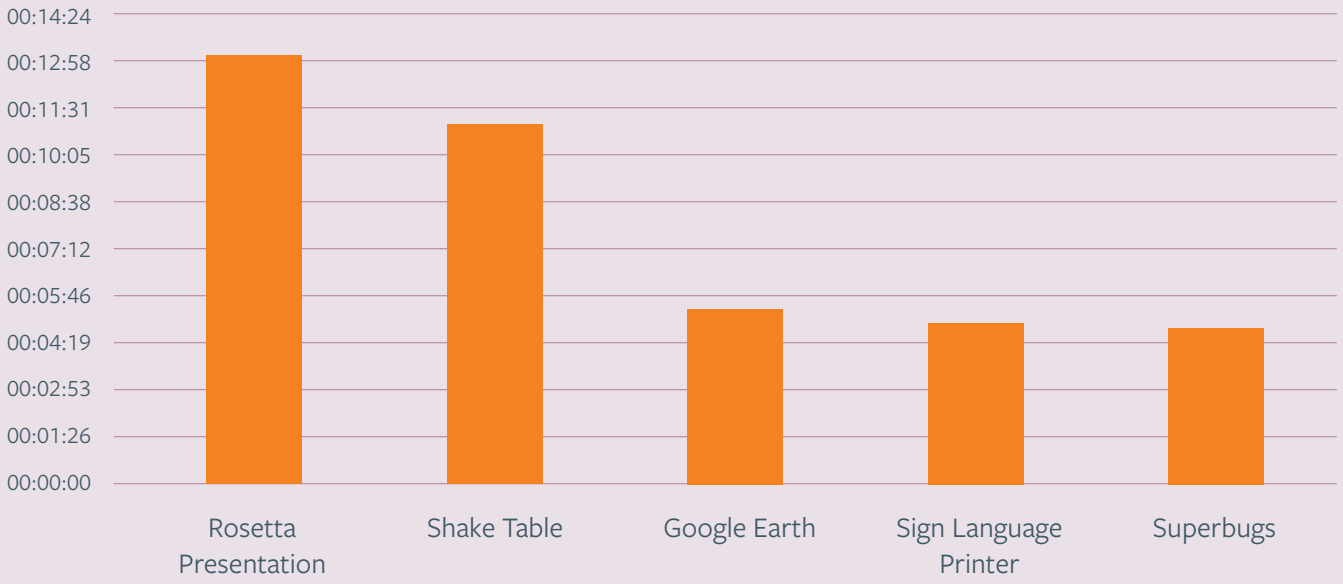


Exhibit	Out of 15 Visiting
Viscosity	11
The Giant Ear	10
Black Holes Table	9
Air Bottles	8
Ball Launcher	8
Bat Hearing	8
Echo Tubes	8
Globe	7

Exhibit	Out of 15 Visiting
Gravity Run	7
Pressurised	7
Pullies	7
Sonar	7
String Machine	7
The Little Big Room	7
Wave Machine	7

Other possibilities of data analysis

Emotional expressions

Emotions play an important role in learning, in all contexts of life. Although emotions are a powerful component of learning, they are under-theorised and under-researched in all contexts of learning. There is a growing interest amongst researchers regarding emotions and emotional engagement related to learning.

Video recordings can be used to analyse observable emotional reaction of visitors, while engaging with exhibits, each other and staff during the visit.

Explore what role emotions play in the visit

Requires expertise and time

Thematic analysis

Thematic analysis is a method for identifying, analysing and reporting patterns (themes) within data. While performing thematic analysis, the researcher organises and describes the data in rich detail, in addition to interpretations of various aspects of the research topic (Braun & Clarke, 2006).

Thematic analysis is a popular way to present data, that can be easily reported. It can be presented in graphs or other visual representations (see previous tools for examples).

Unexperienced researchers can easily be trained to perform thematic analysis!

Discourse analysis

From the richness of data, the researcher can focus on specific discursive episodes, that contains information of interest. In this case, conversations about science.

Video data can provide the full context of the interaction, including the physical side of it. When visitors talk about science, how does this relate to the exhibits, for example?

We must remember the cultural aspect of this analysis as well.

Multimodal analysis

Multimodality suggests that talk might not be the single most powerful mode of communication. In this analysis we examine an array of communicative modes such as posture, body alignment, head movement, gesture, gaze, and speech.

Although multimodal analysis requires expertise and time, it is valuable and reveals findings that couldn't be found otherwise, such as the way the body participates in the interaction and contributes to meaning making.

Can you think of more ways to analyse the data?

Find out more:
www.southampton.ac.uk/research/institutes-centres/mathematics-science-education

Scan here to visit our project page

WINCHESTER SCIENCE CENTRE AND PLANETARIUM
By Wonderseekers