

### ***Part 3. What We Have Each Learned***

The young people's accounts come first. These show they developed their knowledge of science, what it is to be a researcher, and a deeper understanding of themselves and their own learning processes. Through the project they grew in self-confidence, increased their ability and willingness to contribute to and benefit from their own learning and that of others, and took responsibility for their own research.

Then come the doctoral students' accounts. These show they refined and deepened their understanding of their own learning and of their doctoral research in the course of learning to mentor young people. They also show that the project afforded them an opportunity to make a valuable contribution to the community, improve their ability to communicate science and develop their practice as research supervisors

Finally, we, the project leaders, show you what we each have done to walk our talk and talk our walk. We researched our practice leading the project and the effectiveness of the educational techniques used and learned more about how to create collaborative educational experiences for young people and postgraduate students that contribute to their progress as scientists and life-long learners.

#### **3.1 Young People's Research and Reflections**

The young people presented their science research in the form of an academic poster at a mini conference and sent a summary of their learning journey in response to prompt questions.

Molly and Mari's Conference Poster



Figure 30 Molly and Mari's conference poster

## Molly's Reflections

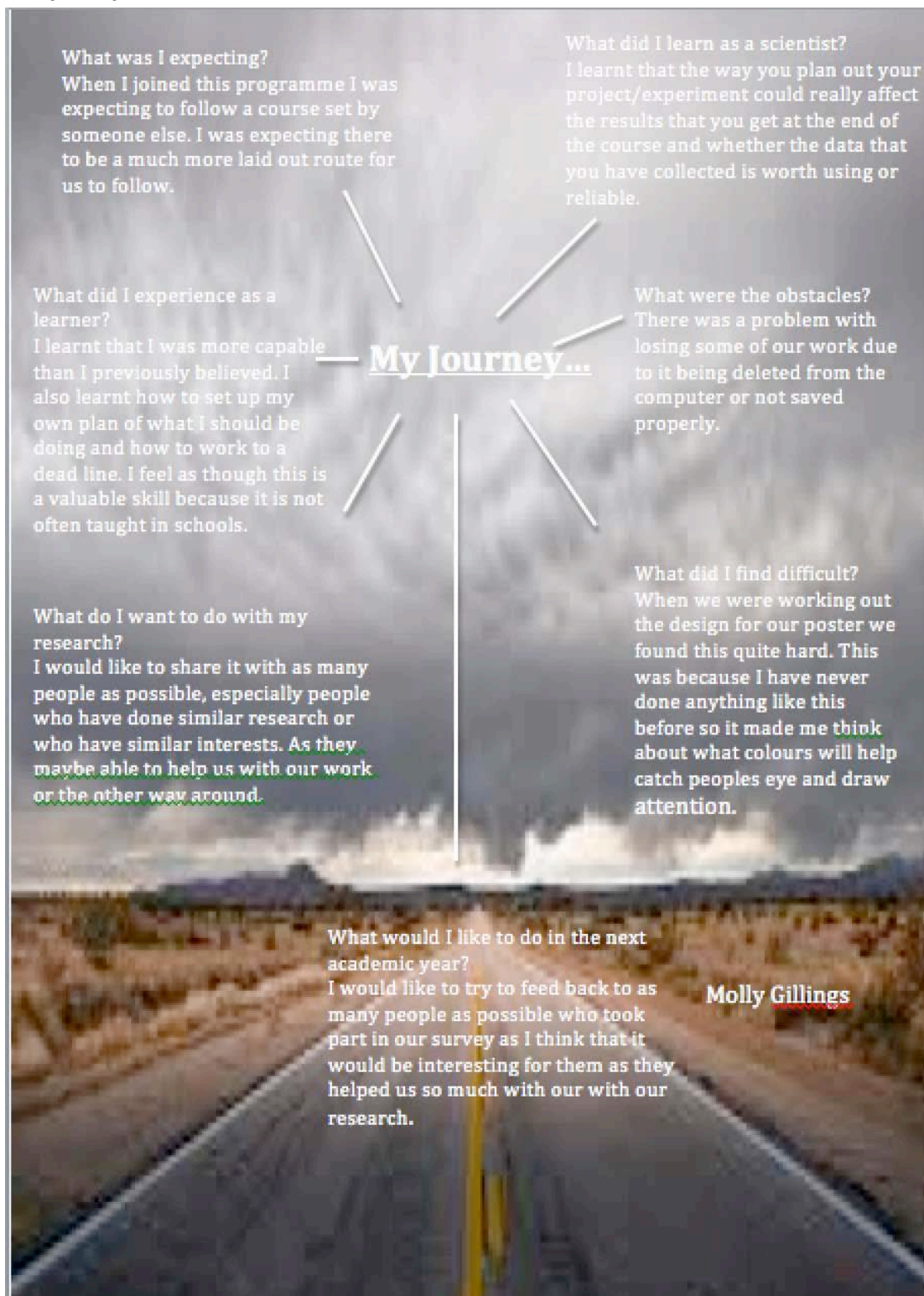


Figure 31 Molly's reflections

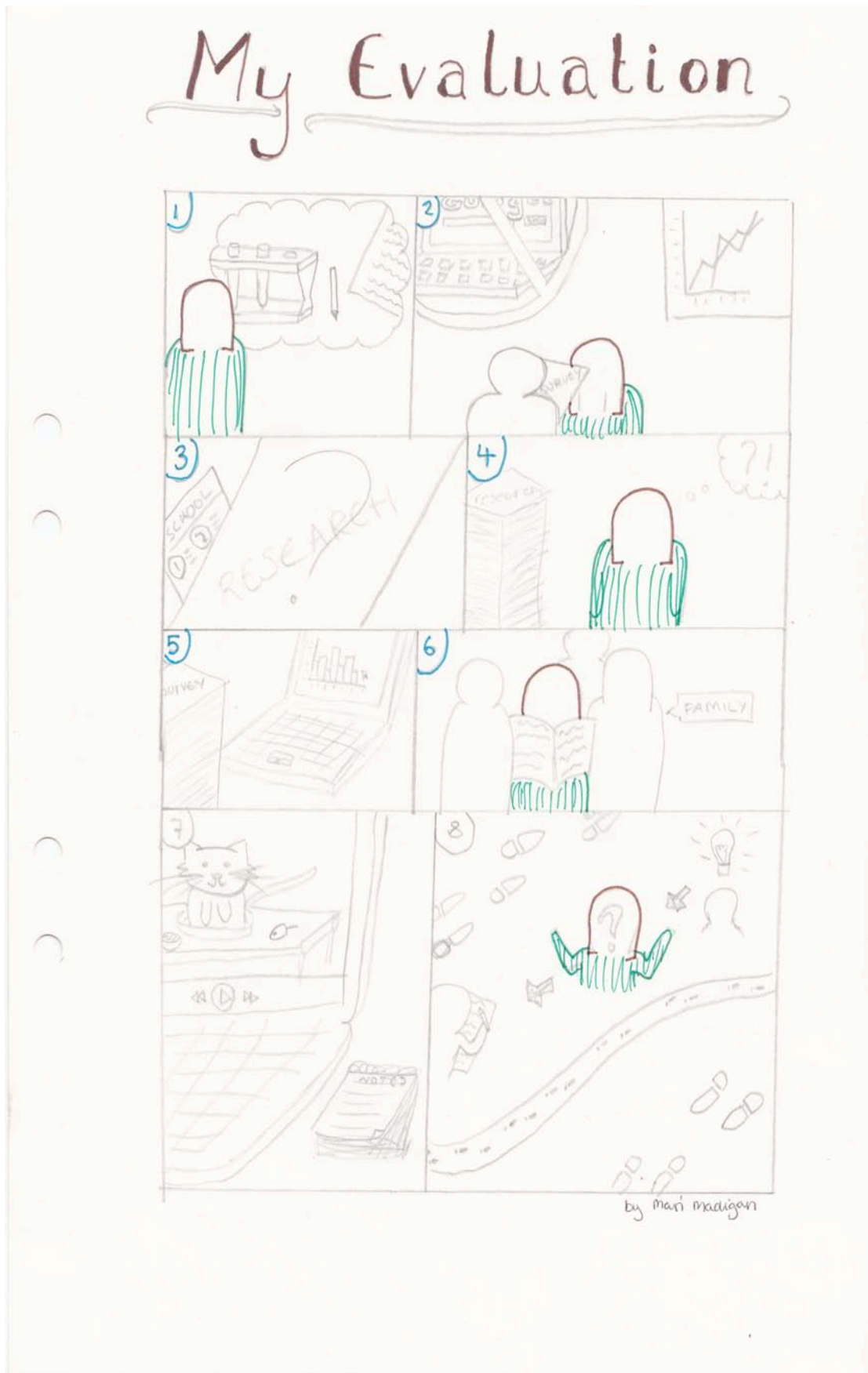


Figure 32 Mari's reflections

1. What did I expect from this programme?

I expected experiments with ready-trying and tested answers and results.

2. What did I learn as a scientist?

I discovered that there aren't always answers and that sometimes you have to find the answer yourself

3. What did I experience as a learner?

I learnt that sometimes learning is not always prepared for you, and you have to take it into your own hands.

4. What were the obstacles to my learning and research?

Analysing the surveys was hard, but in the end we finished.

5. What did you find challenging?

Creating the graphs was also difficult

6. What do I want to do with my research?

I would like to show my family and friends what I have achieved.

7. What would I like to do in the future?


I would love to research animals and their psychology because that is what I am interested in.

8. Conclusion...

I have learned that researching is a journey.





## Barnabas's Conference Poster






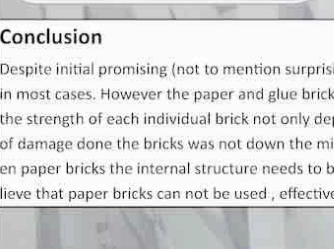
# Paper Bricks: a useful alternative to concrete?

Author: Barnabas Fletcher Supervisor: Joe Williams

Every year in America 4.5 million tonnes of paper is thrown. What if this waste paper could be used to make homes in impoverished countries? I set out to find out whether or not this would, theoretically, possible. I created 6 test samples and tested them for strength and the results were surprising.

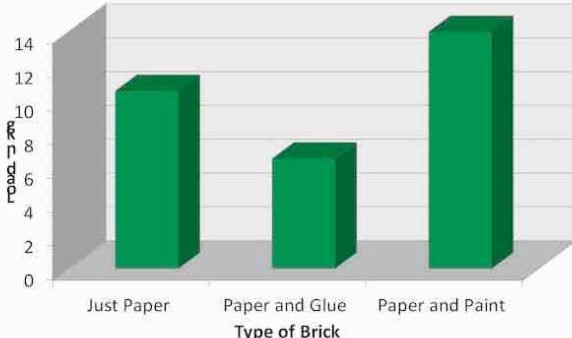



### Method

- To begin my research I filled a bucket ripped-up newspaper and water. This formed a pulp, which would be used to make my test samples.
- A week later, I put the pulp into the maker. To try and ensure the same amount of paper in each brick I marked point that the first brick had reached and worked from there.
- I produced 6 samples in the same way, these samples were approximately 23cm x 9cm x 5cm. These were left to dry for 2 months by a de-humidifier indoors.
- On the day of the test I took 4 of the bricks and painted them, 2 with white emulsion paint and 2 with PVA glue.
- For my experiments I used 2 chairs, to act as supports, a cloth bag, to hold my weights, and of course a brick. The chairs were set up 20 cm apart.
- To conduct my experiment I placed my weights into the bag at 250g intervals. When the brick broke, I recorded the total weight in the bag. I repeated this twice for each sample type, Paper, Paper and Glue and Paper and Paint

### Results

#### Average Load at Breaking Point



Type of Brick	Load at breaking point	Comments	Average Load
Just Paper	13kg	At 9kg 250g a small piece broke off At 13kg the layers of paper broke apart	
Just Paper 2	8kg	Split in half along the layers of paper	10.5
Paper and Glue	17kg	It didn't break, but I ran out of weights	
Paper and Glue 2	11kg	Broken in half	6.5
Paper and Paint	8kg	***	
Paper and Paint 2	5kg	The brick was still wet inside, so its an anomalous result	14

### Conclusion

Despite initial promising (not to mention surprising results) I discovered that, without further work, paper bricks would not be a viable alternate to concrete in most cases. However the paper and glue bricks were promising, so if I were to continue I would explore that avenue of research. Conversely I believe that the strength of each individual brick not only depends on the additional substances added to it, but also the internal structure of the brick itself. The majority of damage done the bricks was not down the middle, but horizontally as the layers of the brick broke apart. My conclusion from this is that to truly strengthen paper bricks the internal structure needs to be analysed and a method of regulating the internal structure needs to be used and until this is achieved I believe that paper bricks can not be used, effectively, to construct buildings in impoverished areas.

Figure 33 Barnabas's conference poster

For my research I decided to try and find out if paper bricks would be of any use in the construction of houses and other buildings. This choice was inspired by two things: firstly it was related to what my supervisor was doing (always convenient!), and secondly I wanted to see if they would be of any use.

To find out if they would be any good I decided to make some bricks myself. To do this I asked BRLSI to buy a paper brick maker and then used that to make my bricks. To make the bricks I mixed paper and water to create a pulp, and then I put this into the brick maker. I produced 6 bricks in total. Despite the instruction sheet saying it would take 1 week to dry, it took 3 months and even then one of the bricks wasn't totally dry inside.

For my experiments I used 2 chairs (to act as supports), a cloth bag (to hold my weights), and of course a brick. The chairs were set up at 20 cm apart. To conduct my experiment I placed my weights into the bag at 250g intervals. When the brick broke, I recorded the total weight in the bag. I repeated this twice for each sample type: Paper, Paper and Glue, and Paper and Paint.

I discovered that despite the initially promising (not to mention surprising) results, paper bricks would require more work and research to be able to be used as a strong and safe building material.

### *Barnabas's Reflections*

What did I expect from the programme?

I expected to learn more about 'real' researching and to learn how to become a better scientist.

What did I learn as a scientist?

That research isn't as easy as it sounds and that sometimes you have to be very, very patient.

What did I experience as a learner?

I experienced both interest and sometimes some more boring moments. For example when I was waiting for my bricks to dry it was very boring (they took 2 months to dry) as I had nothing to do for my research.

What were the obstacles to my learning and research?

The biggest obstacle was the two month period in which my bricks were drying. As during this time I lost interest in my research to the wait.

What did I find difficult?

Again the wait for my bricks to dry was tough, but also the presentation at the end was hard too.

What excited me and 'fired me up'?

The most exciting part of my research was the experiments. Also, once I had got going with my presentation I enjoyed that as well.

What do I want to do with my research?

I might try and build on it. E.g. do the experiments I ran out of time to do: The waterproof test and the wall strength test. Both of which I devised but didn't put into action.

What would I like to do in the next academic year?

Nothing in particular really, perhaps it might be good for the current young researchers to do help next year's group or maybe do something in the first session.



 **ELECTRICITY MONITOR MODEL**  UNIVERSITY OF BATH

**NICOLA BARKER KITTY GILLINGS GEORGIA BAPTIST TERESA CHIANG**

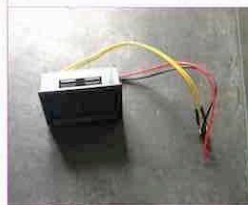
Over the past few months, our team have been looking at the electricity usage of different households. We created a survey and also an electricity monitor model. See below. The surveys were a real success and if you look at my colleagues poster, it will explain about the survey aspect of our investigations.

### The making of our model:

1. First i made a wooden box to hold all the electrical wiring:
2. i then made battery holders and soldered the clock wires onto the battery holders. Then i put the batteries in and the clock lit up!
3. On my empty box, i had a piece of Perspex which is a type of plastic. I then needed to cut a hole in the Perspex to fit the clock... So i did!
4.  I then fitted my clock into the hole in the Perspex and glue gunned it in to keep it secure and in place. I also glued the thermometer onto the Perspex and i glued the switch on to the outside. I still haven't finished my model. But this is how far i have got:



**Wooden box**



**clock**



Figure 34 Nicola, Kitty and Georgia's poster - a

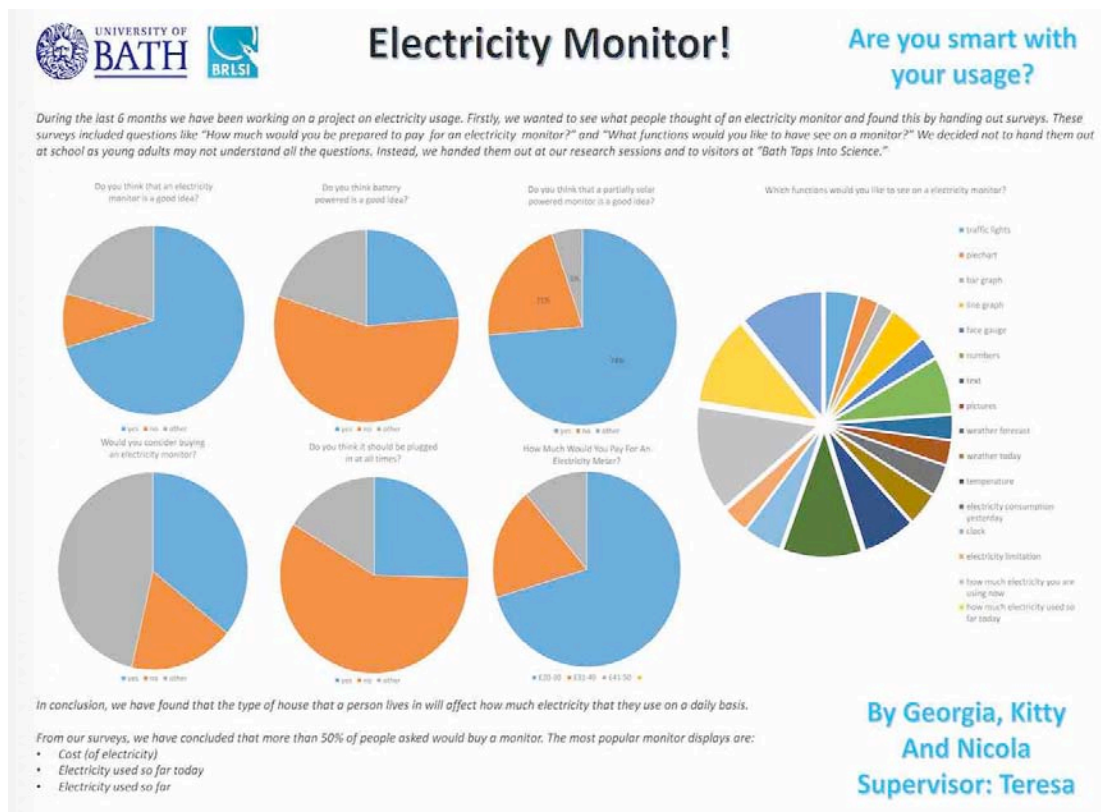


Figure 35 Nicola, Kitty and Georgia's poster - b

### Nicola's Reflections

In the beginning I was excited and rather daunted! I walked in the room and there were lots of people and I didn't know any of them. After a while I made friends with Kitty and Georgia and we decided to join a group together. We knew exactly which group we wanted and we made sure we were going to get it! And we did! Yay!

I am not sure what I expected from this but I have had great fun and learned a lot! I came in all shy and quietish... I found it hard with public speaking. But now I am loud and more confident to speak out in front of other people. Bath Taps into Science was a great experience as we talked to complete strangers as if they were our friends. They were interested in the same stuff as us so it was easy to explain everything.

I have been trying to encourage some of my friends to join our group next year but they don't seem very interested, I think this is because they don't want to be interested. I think that if they came along to a session they would be like "I want more!"

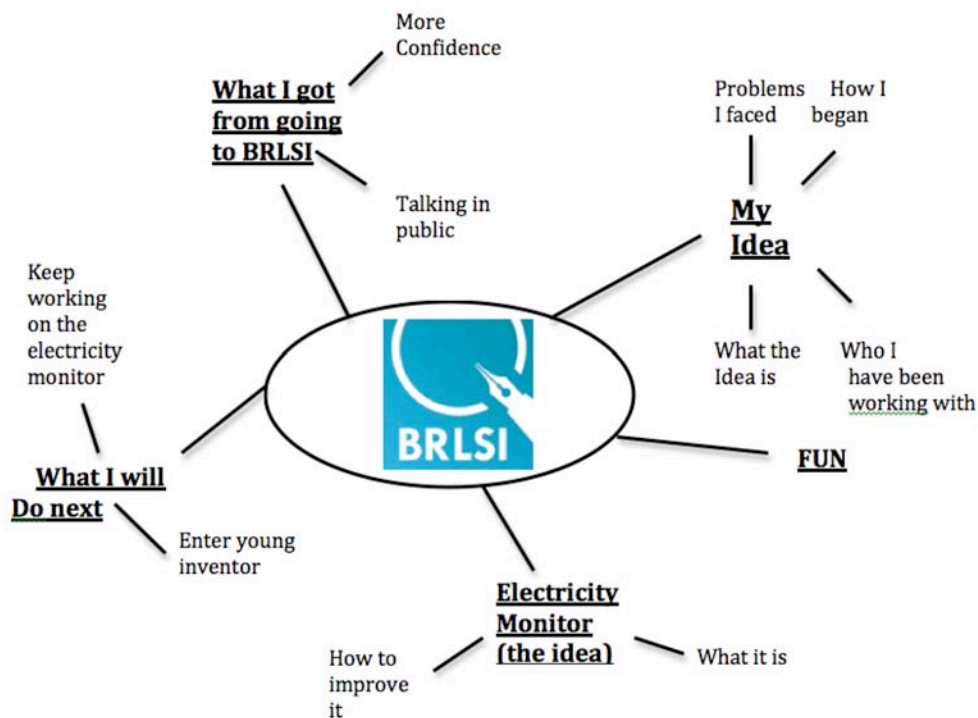
Some of my neighbours have encouraged me to become a scientist. I used to find science boring but since they told me about BRLSI I find science fun and now I think it might be my future dream career. The fact that my future is in this project it keeps motivating me to keep on with it.

I learned not to be so shy in myself and to be more confident and outward going. I think this experience will really help me interact with people in my hopeful future career as I want to be a science journalist. I would like to interview scientists on what they have discovered and write an article on it. I will need the people skills that I have learned at BRLSI to do this.

I hope that they do another session of these next year and if they do I am DEFINITELY coming to it ☺ I am now excited and not daunted! I have made friends and had fun as well as learning! Its an ideal environment to come out of your shell and find who you really are. Thank you BRLSI!

By Nicola Aged 14

*Kitty's Reflections*



**Figure 36 Kitty's reflections**

I really enjoyed going to BRLSI when I started I didn't really know what to expect from it but I loved the first session so I kept coming! There are loads of things that I have learnt through doing this. Firstly I learned that things don't always go to plan and so you have to look at what went wrong and then change it. You also have to be organized and be able to meet deadlines. At BRLSI they help challenge you and one thing that I found really hard was talking in front of all the parents at the conference. I was nervous speaking but after I was really happy! I think next year I would like to carry on with my project!





# Black Crust



James R. Galpin - Gianluca Pesce

## What I Researched

I researched what Black Crust is, how it forms, where it forms and what causes it.

I focused my research in Bath but Black Crust forms everywhere where there is pollution and where there is the right material for it to form on (e.g. limestone).

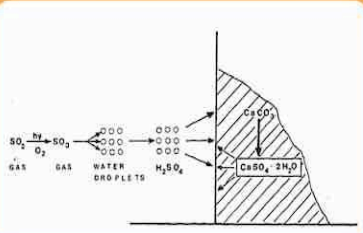


## What is it and How it forms

"Black crust is a kind of crust developing generally on areas protected against direct rainfall or water runoff in urban environment. Black Crusts usually adhere firmly to the substrate. They are composed of particles from the atmosphere, trapped in a gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) matrix." (ICOMOS-ISCS)

Illustrated glossary on stone deterioration patterns, September 2008, Page 42.

[http://www.icomos.org/publications/monuments\\_and\\_sites/15.pdf/Monuments\\_and\\_Sites\\_15\\_ISCS\\_Glossary\\_Stone.pdf](http://www.icomos.org/publications/monuments_and_sites/15.pdf/Monuments_and_Sites_15_ISCS_Glossary_Stone.pdf)



(Gazzoni) - The Determination and Conservation of Stone, Richard Poppel Editors, Page 128, <http://www.docubation.org/images/00000001/2/0415716a.pdf>

Black Crust Forms on the surface of stones containing calcium carbonate ( $\text{CaCO}_3$ ). Here the acid rain containing sulfuric acid ( $\text{H}_2\text{SO}_4$ ) that wets the surface of the stones, dissolves the  $\text{CaCO}_3$  and turns it into  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ .

Acid rain forms in pollutant environments where the exhaust of the cars or the chimneys of buildings introduces sulfuric dioxide ( $\text{SO}_2$ ) in the atmosphere. Here the  $\text{SO}_2$  chemically reacts with the water droplets (humidity) to form  $\text{H}_2\text{SO}_4$ .

## Where it Forms in Bath



I walked around Bath and took pictures of buildings that had Black Crust. Some of the buildings I took pictures of were very interesting. For example building in the picture labelled 1, on the left side it has been cleaned but on the right side it clearly not been cleaned. You can clearly see on the right side, Black Crust forming underneath the ledge. This picture was taken at The Royal Crescent. The Building in the picture labelled 2 has a lot of Black Crust. You can see where a sign has been, but the sign has been removed leaving behind a clean area of stone. The pictures labelled 3 and 4 are of the same building. The building in the picture labelled 3 is in a reasonably open place and is not near a road, where as the building labelled 4 is in an ally way and is near a road. I do however think that the building in the picture labelled 3 has been cleaned but there is no easy way to find out. Another interesting thing I found is that on the building in the picture labelled 5 the pattern on the stone has affected where water runs down and this has affected where the black crust has formed.

## Conclusion



I found out what Black Crust is, how it forms, where it forms and that cars and other motor vehicles are mostly what causes Black Crust to form. If you would like to find out more about black crust then ask a question on twitter with the hashtag #BathBlackCrust.



Figure 37 James's conference poster

### *James's Reflections*

What did I expect from the programme?

I expected to research something and learn about science things I did not know about?

What did I learn as a scientist?

I learnt about black crust and things related like limestone, the weather and pollution.

What did I experience as a learner?

As a learner I experienced meeting new people and listening to their knowledge. I also learnt lots of new science things.

What were the obstacles to my learning and research?

Some obstacles I encountered were:

- Meeting and talking to new people;
- Explaining information so that other people would understand.

What did I find difficult?

At "Bath Taps into Science" I found it difficult talking to strangers about black crust.

What excited me and 'fired me up'?

At the start it was knowing that I would meet new people with lots of good knowledge to share. Also when I finished my poster it looked really good and professional and this excited me.

What do I want to do with my research?

I want my research to be available to anybody who is doing a similar research project and who would benefit from it.

What would I like to do next?

Before I went to the BRLSI young researchers I didn't understand how people got PHDs, but now I know so that is something I would like to do when I am older.

### 3.2 Doctoral Students' Research and Reflections

including accounts of their educational influence in their own learning and the young people's

#### Ammar's Conference Poster

### Background

Public engagement is emerging increasingly in the academia where researchers share their knowledge and skills with public.

As a PhD researcher at the University of Bath, I wanted to share my experience in research with 'Young researchers' in the local community.

This led me to take part in a project created by Dr. Paul Shepherd, a lecturer at the university of Bath, where five PhD students meet once a month (for six months) to mentor local school 'young researchers' aged +13, in how to design and carry out a research based project. I was a supervisor for two young researcher as seen in the photos.



## Tomorrow's budding researchers

Reflections on my personal journey

**Ammar Azzouz**  
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PhD researcher  
University of Bath  
Department of Architecture and Civil Engineering



Image: In Bath Taps into Science Victoria Park March 21st 2015, the two young researchers I supervise, as in the picture, and myself, talked to families, kids and university students, about our project

### Drivers

There are three main drivers for engaging non-researchers in research, which build the 'Public Engagement Triangle'. These three drivers are: 1) transmit, 2) Collaborate, and 3) receive. However, there are many other reasons behind my participation in this experience, including: influencing young researchers in the local community, develop my communication skills- and also getting out of my research's bubble, as highlighted below.



Influencing



Collaborate



Transmit



Receive



Raise Awareness



Liberate myself from peer fear



See my own research differently



Open access opens doors



Share ideas



Research does not happen just at the library

### The journey

On the second Saturday of each month, we met in BRLSI for three hours and a half. Here is my journey:



**Impact of this journey:**

- Develop a dialogue with different groups from different ages
- Develop my communication skills
- Learn how to listen and how to explain my research ideas to non-researchers
- Enjoy working in a team
- Enjoy volunteering

### What did I learn?



I learnt how to change my hat, namely, at the University I am a student getting the support from my supervisors (picture above with my supervisor Dr. Paul Shepherd). In contrast, at BRLSI, I was the supervisor helping the two young researchers. This made me understand that knowledge is transferable, you take and then you give, and vice versa.

It is all about the beauty of sharing

### Conclusions

- While it is more common for researchers to engage non-researchers in activities, there is but little existence of engaging young kids in research. Therefore, this experience is one of the very few in the UK. I was very pleased to be part of it
- Therefore, this fantastic opportunity brings more attention to the need to spread a wider awareness into the importance of research in the society.
- University of Bath is providing tremendous support on public engagement mainly through the 'public engagement unit'. It is important for researchers to make the most of this support.

It is time to engage, take your research out of the university NOW



Nationally coordinated by STEMNET





Figure 38 Ammar's conference poster



## *Ammar's Reflections*

What is motivating you? What did I expect from the programme?

Steve Jobs once said: 'You can't connect the dots looking forward, you can only connect them looking backwards'.

When I participated in this extraordinary programme, I did not have any pre-concept as it was the first of its kind. I had, however, a faith in it and I thought this would be great dot to be connected in my research journey. I did not get involved only because it was a new idea to inspire tomorrow's researchers find out more about research, but also because I believed that in the future I will look backwards at this journey and say 'now I can connect the dots'. I believe that this incredible experience will take me somewhere else.

What did I learn as a scientist? What did I experience as a learner?

As a researcher I learnt that science is not only about the knowledge we conduct. But rather it is about the ability to explain and transfer complex ideas to other disciplines and to non-researchers in a simple form. All of us have creative ideas, but the most significant challenge is to take these ideas out of one's mind and share them simply with others. This is, I think, one of the key secrets of successful scientists and researchers. It is not about the science it self, it is about presence, passion, enthusiasm, human interaction, sincerity and creativity.

What excited me and 'fired me up'?

I think what truly excited me the most was the internal fulfillment I gained. There is often a cliché that volunteers help others because they want to firstly help themselves as well. I believe that helping others is a moral and ethical obligation, which improves our satisfaction in life. There is a beauty about giving, and what is nicer than giving knowledge. Education and knowledge are the major forces that should direct societies. Without them societies will struggle to strive.

Young researchers changed a lot during this journey. This deeply touched me and made me feel pleasure, joy and pride to be part of influencing this change. The young researchers gained tremendous amount of confidence, energy and communication skills; and so we did. I hope we can spread this energy that gives students the freedom to express their ideas in schools. Especially in societies where youngsters are facing tragic challenges, such as bullying.

What did I find difficult?

I did not have difficulties but rather a fear. I was afraid, because it is a new project, that the young researchers will not be able to collect their data and analyse it with the proposed timeframe. Looking backwards now, I see my fears very natural. Research is a learning curve, and real researchers face unexpected challenges. But with sincere commitment and intellectual effort they can achieve their goals. This was the case in this programme, and young researchers were able to finish their research on-time.

What would I like to do next? What do I want to do next?

I am very delighted to be part in this project. Many colleagues, friends, academics and PhD candidates will ask 'why'. Why shall we bother and spend time out of our research? The answer is this not out of your research, it is just of your office and lab. It is crucial indeed to know that 'engagement, influence and impact' is one of the four core domains that construct the 'Researcher Development Framework' according to Vitae. Research is made to be shared, not to be only to be in paper or a thesis on the shelf. Therefore, I would like to be more involved to make awareness of public engagement in the academic environment.

My second aim is to break the stereotypes about research and researchers. We are often misunderstood in media and social networks with several misleading stereotypes. I have an idea in which I would like to interview PhD students to explain their research experience in one word. Then collecting these interviews in a short video. This video should be then presented in schools and the undergraduate programmes. It is hoped that this will help break some of the stereotypes to non-researchers.

I learnt a lot from this experience. I learned that ideas will always be unseen unless you communicate them. I, therefore, tried to apply this concept myself. I had an idea about curating an art exhibition in my department at the University of Bath. I sent an email to all academics, staff, students to submit their art work to me. After a couple of months, the idea is a project, the project is an exhibition titled 'The Poetry of Line', and the exhibition is open to public and staff. I connected the dots and created a line.

And I am looking forward to the next dots to be created and then connected.

Ammar Azzouz

# The Path To STEM Enlightenment

Joe Williams

Department of Architecture and Civil Engineering, University of Bath



## Introduction

Science, Technology, Engineering and Maths are some of the most important skills required in society yet it is difficult to encourage a young up-take. Outreach is a concept of growing importance in academia given the competition for finances in the modern world. The STEM outreach program with BRLSI and the University of Bath provides an opportunity for people new to the academic world to get involved with outreach, promoting these core values in a way that provides a personal benefit.



### First Session:

Meet the young researchers and "pitch" our interests and topics to them.

## My Experience

As a PhD student in this scheme, I have spent a few hours every month monitoring a group of young researchers from local schools as they complete independent research projects in the STEM fields.

### Second Session:

Develop their own idea into a question, consider how it might be answered.

Initially I did not know what to expect from the scheme in terms of benefit for me or benefit for the young students however believed it would be a positive experience either way. In addition I was eager to become involved in some community driven voluntary work and as an engineering graduate, feel strongly that STEM outreach is a great way of doing this that is both relevant to me and important to society.



### Third Session:

Develop skills that might be required, produce a method to answer the questions.

At the start of the project we were given the opportunity to "pitch" our interest and topics to the students who were then able to choose what they wanted to research and who with. This was a hugely beneficial part for me as it helped me to distill exactly what it is that I do in a professional sense and communicate it efficiently. It was also rewarding in so much that I was able to generate interest in a subject that I believe is important and interesting.

### Fourth Session:

Assess where you have got, change your aims and plans appropriately, the experiments are now underway.

Throughout the project we participated in a number of arranged activities as well as supervision sessions. I found these activities useful for my own development as well as observing the positive effect on the students. The supervisor sessions and independent study element were new concepts for the young researchers and I believe were appreciated but only once the required interest was generated. Maintaining interest and inspiration was one of the hardest parts of being a supervisor in this situation.

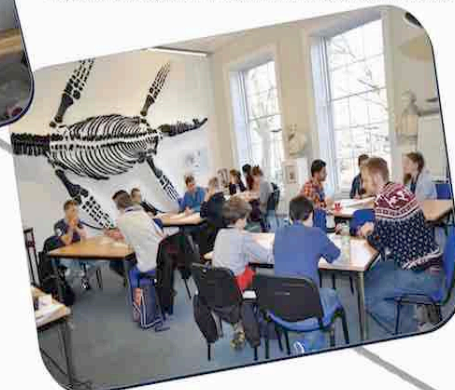
Overall the experience has certainly benefited me personally. My communication skills have been greatly enhanced by the experience and in particular it has showed me how to communicate my own work in a clear and understandable way that I'm sure will be greatly beneficial in the future. In addition it has been both beneficial and interesting to take on the role of supervisor as it has allowed me to better understand the position of those supervising me.

### Fifth Session:

How will you present your work? Start the poster design and bring together the results.

Outside of the skills development the experience has also provided an immense personal satisfaction. Seeing the development of those I am supervising and the quality of their thought and ideas has been a rewarding privilege. As engineering in my personal consideration is of such importance but is not directly covered in schools, this activity has produced a great deal of satisfaction for me.

In what I have seen I also believe that the young researchers have gained from the experience. Not only have I been impressed with the development in skills of those working with me but also the insight they have shown into scientific principles and techniques. I hope now that the experience will stay with them and maybe inspire them to pursue



## FINISH !

Present the findings to an eager and interested audience. Reflect on what can be done in a handful of weekends.

## Conclusion

I have found the BRLSI / University of Bath STEM outreach experience to be both personally beneficial and incredibly rewarding. It has been well worth the small commitment required. I would encourage any PhD student to become involved with similar projects in the future and will myself continue to pursue STEM outreach projects. The confidence and experience the project has given me has already empowered me to attend additional STEM training with the hope of starting school workshops and inspiring the next generation of engineers we need.

**Acknowledgments:** I would like to thank all the staff and volunteers associated with this project. I would especially like to thank Paul Shepard for presenting me with the opportunity to become involved in the scheme.

Figure 39 Joe's conference poster

## *Joe's Reflections*

What did I expect from the programme?

For me one of the nice things about this experience was that I literally had no idea what to expect! This was part of the appeal as I wanted to do something outside my usual norms taking the attitude that if you don't try something you will never know what you missed. The results were all the more amazing for this initial ignorance.

What did I learn as a scientist?

As a scientist I learned new things from all of the individual young researcher projects that were undertaken. I learned that paper bricks are amazingly flexible prior to breaking, how little people living somewhere tend to know about it and what black crust actually is. My eyes were also opened to the other fields that I would have had previously no experience of, the specific challenges and requirements of energy monitoring being one.

What did I experience as a learner?

As a learner I learned the true importance of an alternative perspective. In communicating ideas from the world of my research to the young researchers I was required to alter my perspective of it and distil in understandable and reasonable terms what it is I am doing and why. This sharpened my own ideas and has benefited my work. Embracing alternative perspectives was something I also found very important in the supervisor role where I found that an equal footing and mutual respect for all ideas is essential for effective supervision and the best results.

What were the obstacles to my learning and research?

I feel that one of the main obstacles was the time constraints and the lack of effective communication between the sessions. Better planning at the start by myself and my researchers may have more evenly distributed the work load and allowed for development of the ideas later on.

What did I find difficult?

Finding time for lunch! It was also hard to encourage and motivate some of the young researchers through some of the more introspective moments. Too much time was spent in my opinion looking at the "why you are here", "what are your learning goals" etc. The workshops for younger years have a lot of hands on elements and the amount of time spent on this seemed too watered down.

What excited me and 'fired me up'?

When the young researchers made a progressive thought relating to their work that outstripped my own ideas.

What do I want to do with my research?

Not sure if this applies to the supervisors but on a similar path I would like to take what I have done this year and come back next year as a better supervisor.

What would I like to do in the next academic year?

Do this again! Start wider tutoring. I think it would also be nice next year if within the projects a can give the young researchers the chance to come to the university and carry out a simple test in a real lab environment i.e. a proper compression test. Do some of my own research.... Maybe

Joe Williams





*Giovanni's Reflections*

## Young Science Researchers Project

### From a supervising Ph.D. student's perspective

Teresa Chiang (University of Bath)

Project leaders: Paul Shepherd (University of Bath) & Marie Huxtable (BRLSI)

This was a six-month project for young people aged over 13 to learn from and work with Ph.D. students on real research projects.




### Why did I Join the Project?

1. To engage with young people and help them develop an understanding of what doing research is like.
2. To generate interest in STEM subjects.
3. To improve my communication skills by working with people who have no previous background knowledge of my research topic.
4. To try something different and have fun.

### What did I Enjoy the Most?

1. Assisting the young researchers to devise their own research projects.
2. Witnessing their developing sense of responsibility, taking initiatives for practical tasks, and how their interactions with one another and with their supervisors grew over the months.
3. Sharing their work progress and being a part of it!

Tip 1  
Be mindful of using the most appropriate language when speaking to non-technical audiences

Tip 2  
Young people are in capable of independent thinking as adults

Tip 3  
Encourage group members to speak, ask questions, and listen to others


### What were the Challenges?

1. The uncertainty of what the young researchers did and did not know about aspects of the research subject (the built environment).
2. Assigning enough time to each researcher in supervisory groups to discuss their progress.

### What did I Gain from Joining the Project?

1. Acquired supervision skills.
2. Developed an interest in promoting STEM education in informal environments.
3. Increased confidence in sharing my research and re-considered its value.

Tip 4  
Activities designed to develop research skills that are interactive and engaging are most enjoyable to run a talk



**Bath Royal Literary and Scientific Institution**  
The promotion and advancement of science, literature and art



**UNIVERSITY OF BATH**




Figure 41 Teresa's conference poster

## *Teresa's Reflections*

Thoughts about learning, teaching, public engagement experiences

Research project: how to be a supervisor, how to engage with young people

What did I expect from the Young Science Researchers programme?

- To spend Saturday afternoons on interacting with young people, working on a research project together.
- To develop my learning about a specific population, and to learn to work with young people who have little previous background knowledge of my research subject.
- To learn what it is like to supervise a research project.
- To do something different, fun and not related to my research work at the uni.
- To be given an opportunity to share my research, to reflect on it and re-assess its value to develop my expertise.

What did I learn as a scientist?

- Young people are as capable of independent thinking as adults, and they could come up with fresh and interesting ideas that I might not think of.
- Interactive activities designed to develop research skills are more memorable than a talk.

What did I experience as a learner [of being a supervisor and engaging with young people]?

I realised the delicate relationship between a supervisor and their students, like what I had with mine. While the supervisor has more knowledge of the research area than their students, they could get as excited about the project as their students. The supervisor is in a position to give support and advice to students on how to improve or progress with their projects, and let the students decide what method they want use to conduct their research, and how they will proceed with the practical tasks and the final production and presentation of the research.

What were the obstacles to my learning and research (supervising and engaging)?

- Not getting feedback on what the young researchers enjoyed doing and what difficulties they had encountered while working on the project at home.
- Not knowing what and how much the young researchers knew about aspects of the built environment.

What did I find difficult [as a supervisor and engaging with young people]?

Leadership skills: I still need to learn to run the group discussion, by allowing enough time for each young researcher in the group to talk about their progress and plans, and asking questions for the group to discuss together, and to establish research plan and expectations.

What excited me?

- Passing knowledge on to young people.
- Helping young people develop an understanding of what doing research is like.
- Convincing them what I do is useful and interesting.
- Assisting the young researchers to devise their own research projects.
- Witnessing their developing sense of responsibility and taking initiatives for practical tasks.
- Being a part of the process of personal development and transformation.
- As a result, my experience as a research student was enriched, and self-confidence increased.

What do I want to do with my research (mentoring and experience in engaging with the public)?

- Use my experience to share with people with an interest in public engagement and in working with or mentoring young people.
- Promote STEM education in informal environments.

What would I like to do next?

Take part in other similar activities engaging with young people, to interest them in the prospects of studying and choosing STEM-related careers.

Teresa Chiang

# BRSLI Young Researchers Project



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Centre for Doctoral Training in Decarbonisation of the Built Environment  
University of Bath

## Introduction

The project was launched in efforts for academics and doctoral students to undertake **public engagement** with research. Over the course of six months 13+ young students conducted their own research whilst being mentored by their relevant supervisors.

## Research Background

**Cement and concrete science:** My PhD aims to use Sol-Gel technology or in simpler terms nanotechnology to modify and enhance the hydrated cement particles at the molecular scale. The driving force behind my research is to promote a Low-carbon cementitious building material.

## Motivation

Research has become compelling and sustaining for me, an area where I have found and experienced the purest form of love. But I didn't get here on my own. My teachers and supervisors through school, college and university, did more than just inspire me. **If I could only 'give' to others what was 'given' to me** - this is by far my overriding motivating factor.

## Expectations

I had no prior involvement with a similar situation or a 'role' like this. Thus, I expected it to be challenging yet an invaluable learning experience to say the least.

## The 'Journey'



Introductory Meeting: Explaining PhD topic and general research interests



Planning and discussion sessions with the supervisors



Progress review and mock presentations

## Learning Outcome & Conclusions

Students drop out. Almost every supervisor experiences it at some point. Instead of being disheartened, reflect and improve yourself. Despite having no students of my own the sessions were beneficial. I'm one 'step' better at communicating and engaging, in particular with younger students. I feel better equipped for a similar role in the future.

Acknowledgements: Paul Shepherd, Marie Huxtable, Paul Thomas, and more importantly the entire group of Young Researchers.



Figure 42 Muzzamil's conference poster

## *Muzzami's Reflections*

As I expressed during the 'conference' it was difficult to have a predetermined notion or expectations prior to starting the BRSLI project. This was primarily due to the fact I have never been involved in STEM projects or similar settings before hand. The concept of public research as a whole was rather new to me. That said, if I had to point out what my expectations were, generally speaking, I expected the programme to be a series of dialogue between the students and mentors followed up with some form of research either experimental or otherwise. In some ways I thought it would be an ideal platform to inform as well as get the younger generation excited about the research we or (I) do at a higher level. Something along the lines of engaging them with my particular domain or research interests.

It is very easy to get caught up in the research we do at an institutional level, with all the technology, sophisticated tests and equipment, softwares etc , to even realise sometimes there are simpler ways of asking questions or the fact that there are real research questions, which may be relatively basic existing within or outside of our domain/field/interests. More so that there are even simpler methods to investigate such questions. In many ways we forget, great research, both ideas and discoveries have stemmed from the most simple of questions, the most basic of curiosities. E.g. why does the apple fall down or the discovery of penicillin by accident (messy lab condition, mistakes and curiosity). It was stimulating to see the young researchers come up with their research 'questions' - I learned that the younger generation is far more curious than I was at that age.

Perhaps for me the most difficult part was introducing ourselves in that 'ring go around' thing on the first day - believe it or not, I am shy and terrified to my bones when it comes to younger people, and the complete opposite towards elders. I also found explaining my research whilst going table to table or 'sell myself' rather demanding and an almost impossible task. Sometimes you need to get out of the technicalities and simplify things down far more basic than you are 'willing' to, that is if you want the other person to really understand and be/get excited about what you are doing/researching. In general I found communication with young ones slightly out of my comfort zone, partly my personality but could also be due to lack of prior experience.

In truth, in many ways the excitement was rather 'low' when my students stopped coming. What fired me up still and the reason I kept coming was simple. A) I had committed and the slight to near impossible chance they may show up again. But more so B) every Saturday that I spent at BRSLI I was taking a step, even if baby steps towards overcoming a barrier, and improving my communication skills with the younger ones. Even if it meant saying a simple hello. Seeing other supervisors and students interact with each other and amongst themselves is a form of learning I am not sure how to really articulate in words. Adding to that, just generally learning and observing the younger ones presenting their work, their commitment, and courage (surely it takes a lot of courage to speak in a room full of academics). What I can say is, all of it,



collectively, it was a learning experience I am very grateful for, and perhaps its true value I can only appreciate in hindsight.

Like any form of research :) -- take what I have learned so far, experiment with it and build upon it, in a manner of speaking. Ideally, if workload and commitments permit, I would want to try this out again, and/or something similar, apply what I learned and see how I get on. Wasting this experience by not getting involved again would be a shame in my opinion. Expanding and adapting along the way and adding to the experience is the only way forward I believe. Who knows it might lead to an outcome I could have not imagined; true value of hindsight.

Muzzamil Shakil

### 3.3 Project Team's Research and Reflections

In the previous section you have heard from the young researchers and their supervisors. What is also needed for you to understand what transpired are the accounts of the project team, starting with their joint poster



**'BRLSI Researchers: Supporting enthusiastic enquiries into science, learning and life'**

This project has involved developing educational practice, which puts the young person and their interests at the centre of learning.

BRLSI Youth, in collaboration with the University of Bath's Public Engagement Unit and Department of Architecture and Civil Engineering, secured a small EPSRC grant to pilot an innovative educational opportunity for young people (13yrs+) researching the Built Environment and developing their reflective research journals supported by PhD/Post-Doctoral students.

Participants met monthly for 7 months to develop their research, devise experiments to test their hypotheses, implement experiments and analyse results, as they would in a university context.

The PhD/Post-Doctoral students acted as research supervisors and the young people as researchers.

The sessions included time for reflection, 'supervision', participation in a research group, introducing skills researchers need to be effective, and opportunities to present to an audience.

**All participants in the project learned from, and with, others.**

The young researchers developed their knowledge of themselves, what it is to be a researcher, deepened their understanding of their own learning processes, and developed their confidence and ability to generate and research questions of interest to them. The PhD/Post-Doctoral students refined and deepened their educational practice and understanding of supervising knowledge creating research, communicating and sharing knowledge, and supporting learning. The project leaders researched their educational influence in learning and this innovative educational opportunity to improve it.

Figure 43 Project team's conference poster

## *Paul T's Reflections*

The BRLSI Young Researchers is something I feel I have ownership of. It is part of the overall BRLSI Youth Activities strategy I have been developing over three years and is the first of what I hope will be an ongoing programme. I had been working towards the realisation of the project for over a year when I met Paul S and 'sold' him the idea and then invited Marie to get involved. The idea of a publication was implicit in the long term plan, as publication is part of the research process and I wanted to make the whole procedure as realistic as possible and could show the educational implications of a practical expression of the Youth Activities philosophy. The BRLSI Youth Activities philosophy is one of providing 'hands on' challenging opportunities for enthusiastic learners, from which discoveries the learners can be supported to share with others. I wanted a publication that was not overly educationally academic, was down to earth, replicable and ideally something that would actively engage and encourage other community groups to copy. Clearly we should take account of the needs of the university STEM community too, but I would suggest that this should be from a scientific/layman's, not an educationalist/academic, point of view.

I have been at arms length to the project because the Young Researcher sessions take place on the same day at the BRLSI Youth Activities, which I supervise. I join the planning of the sessions and 'visit' each session to take photographs and offer a certain amount of objective observation, collate the feedback sheets and provide a link between the project and the young researchers.

What did I expect from the programme?

- For all participants to have fun and to enjoy the learning process.
- To nudge the BRLSI back to part of its founding purpose, locally generated original and innovative research.
- To establish a regular programme for 13 to 15 year olds and PhD students in a project that assumed equality, provided meaningfully learning as appropriate to each individual and an 'educationally safe' environment in which to develop skills.
- A way of producing a Geology Trail
- A way in which to produce a critical 'research paper' to evaluate the project and to disseminate the processes, procedures, research findings and learning.

What did I learn as a scientist?

Sadly because I was dropping in and out of sessions I did not attend the feedback from mentors so I did not share in their findings. I learned new things from Paul Shepherd especially the 'hands on activities' regarding observation skills. I have already been able to put one of these into use. From young researcher projects that were undertaken I was impressed with James' project on black crust, which was very relevant to the Geology Trail and has been incorporated into it. Molly and Mari's project reinforced my feeling that local people and visitors are often unaware of the built environment, its nature and its history, so the idea of BRLSI

Trails is a good one. Specifically I learned from Barnabas that it might be possible to use recycled paper to create bricks that are amazingly flexible but take a long time to dry out and how the Young Researcher's programme can impact on the whole family. From Kitty, Nicola and Georgia's project I realised that we could develop research projects in partnership with local communities, which are relevant to local people. This is something that I hope to progress over the coming academic year. My own research centred around the Geology Trail and adding a little to my knowledge of geology and the location of specimens in the centre of Bath.

What did I experience as a learner?

An obvious fact that it is not satisfactory to be an 'ad hoc' member of a learning group. I was thus able to empathise with a couple of the Young Researchers who missed sessions and then decided to drop out. It also set me thinking about school children who have irregular attendance (for whatever reason) particularly young carers. However, I also experienced the support of the group in wanting to encourage and include me in the group.

Regarding my role as a joint provider of the learning opportunities I learned from my observations and the regular evaluations that once a month sessions require very careful planning and that the learning group needs generous advance warning of the timetable, deadlines, events etc. and that forward planning for everyone is very important. The planning needs to be effectively negotiated and communicated. Also that because the time available at each session is limited, they need to have impact, be tightly focused throughout, give the mentors and young researchers time to report back, reflect and assimilate information acquired and learning achieved. In addition the acquisition of skills through 'hand on' activities can be very effective and possibly more effective than talking about them.

I also learned a great deal from the alternative perspectives provided i.e. Marie and Paul S, the mentors and the young researchers. Thus I was able to develop and improve the whole of the BRLSI Youth Activities Programmes to take more account of the learning of everyone involved, volunteers, mentors, young researchers, younger participants and families. To ensure that I do this I need to set aside more time to evaluate and reflect on the effectiveness of the provision and the learning opportunities provided. Fundamental to all developments is a need to develop mutual respect for all ideas, which lead to the effective provision and the supervision of the learning process.

What were the obstacles to my learning and research?

The time constraints and having to flit in and out of sessions, the lack of effective communication between the sessions. Better planning at the start, particular signposting the development of the programme, more accurate and detailed recording of my learning and achievement. The

need for a more accurate and detailed recording of the learning processes at all stages in the programme and the lack of a formalised system for support for participants and in the case of the Young Researchers their families during the period between the sessions.

What did I find difficult?

Ensuring that we retained all the young researchers. Communicating with all the families effectively regarding BRLSI's assumption that the Young Researchers and their families were going to be committed to the programme. Identifying accurate nomenclature for the participants. Providing a wider range of research options. Ensuring that each session had a greater proportion of the time dedicated to 'hands on' activities and appropriate equipment (e.g. lap tops). Providing the same room for all the sessions and avoiding a clash with other users (e.g. at the beginning of sessions and during the comfort break).

Too much time was spent in my opinion looking at the "why you are here", "what are you learning" I need to reflect on the appropriateness and effectiveness of this approach.

What excited me and 'fired me up'?

The enthusiasm of my colleagues and the keenness of the mentors and the way in which the young researchers made very noticeable progress and gained significantly in confidence and were able to identify their achievements and explain them.

What do I want to do with my research?

My research was more in the area of participant observation and I want to use the experience to improve the programme for next year.

What would I like to do in the next academic year?

Repeat the programme but in an improved format and adapted processes and procedures. Investigate the possibility of developing a similar, but different programme for older teenagers (6th formers).

*Paul S's Reflections*

**Why did you want to get involved in the young researchers project?**

When I attended the "Sandpit" I was looking for opportunities to get me Department's postgraduate researchers (and staff) involved in what universities call Public Engagement (PE), that is, explaining what they do as researchers to a non-specialist audience. I firmly believe this is an important part of what being an academic is all about – not just carrying out leading research, but sharing that research with as wide an audience as possible – the tax-payers who fund the research as well as other academics who can benefit more directly from the findings. And whilst I had been involved in a large number of PE projects over the years, I felt that there were far more opportunities for PE presented to me than I had time available. And through the Sandpit I was therefore looking for a

way to support others in beginning to experience PE, such that they would gain the confidence and motivation to continue to engage with the public in their own right, and by doing so perhaps encourage others to follow.

The Young Researchers project was a truly symbiotic opportunity, whereby my above desires could be met, whilst at the same time helping BRLSI to deliver a much-needed programme of research for enthusiastic teenagers. I am particularly passionate about engaging with a young audience and have personally presented to over 20,000 young people over the past 10 years as part of my PE activities. Raising awareness of Engineering as an academic discipline is important to me. Since there is no “A-Level” in Engineering I myself never considered engineering as a degree subject, instead studying Mathematics in order to “keep my options open”. And whilst this provided me with a sound basis for further study, research and practice, I am mindful that perhaps if someone had come along when I was a teenager and raised my awareness of what Engineering is as a subject of study and as a profession, I might have made other choices. I am also acutely aware that I travel the country to share my experiences as an engineering researcher, but only occasionally do I collaborate with organisations locally. So working with BRLSI to develop the Young Researchers project locally appealed to me on many levels.

**What was it that excited you about working with Paul T when you first met him?**

Apart from the obvious synergies between what we were both looking for from the Sandpit, Paul T’s friendly and hugely enthusiastic approach to devising such an innovative project struck me immediately, suggesting that here was someone who would be fun to work with, even if things went pear-shaped. He seemed to have a very wide network of contacts who he was sure would be willing to help support the project in different ways. And he also seemed to know exactly what he wanted to achieve and immediately made an approach, having identified in me as someone who could deliver what he wanted. I admit that on more than one occasion I thought to myself – “hang on, what have I just let myself in for?”, wondering if I’d somehow been hoodwinked into biting off more than I could chew. But Paul T’s infectious enthusiasm and optimism meant that I always dismissed these thoughts with a “what the hell, let’s see what happens” justification.

**How would you know the project has been successful?**

Against our original aims, I’d say we have achieved two out of three objectives. We have developed a framework in which teenagers can develop independence as researchers, and an understanding of how research is conducted for real. We have also provided a platform for postgraduate researchers to learn how to communicate complex research to a lay-audience and for them to experience what it is like to supervise research, rather than simply receive supervision themselves. Our original dissemination objective, that of creating a smartphone app to map the youngsters’ research findings across the city and share their findings with a global audience, has unfortunately not been achieved, although the concept remains and it could certainly be realised in future years. The question of dissemination has instead been addressed through the organisation of an “academic style” conference and indeed this publication. Although



reaching a smaller audience, this is nevertheless a dissemination route more typical of those seen in academia, and as such, more directly addresses the first two objectives and is perhaps a more appropriate outcome.

I am also conscious that new objectives were developed along the way, which were not foreseen (at least not by me) at the beginning. Specifically our pedagogic study of how a group of youngsters can begin to direct their own learning and can gain an understanding of what “research” really is. In addition, whilst constantly grounding our approach with the mantra “what would happen in a real research group”, we have been mindful to develop a framework which is (we believe) repeatable in many other contexts by many other education / community groups. This publication is our way of sharing what we have done and what we have learned, such that others might build on our successes and allow more youngsters (and university researchers) to engage in similar projects and reap the benefits. In that respect, I would judge the project a success if others believed in it sufficiently to replicate a version of our programme elsewhere.

### *Marie's Reflections*

What did I expect from the programme?

What I expected from the programme was to learn how to give young people and doctoral students an opportunity to:

- Learn and research together as expert researchers, scientists and learners
- Develop their expertise and knowledge about the world and themselves
- Enquire into a question of personal interest them and create and offer valued knowledge that enhanced their own learning and lives and the learning and lives of others.
- Learn cooperatively, recognising, valuing and working with the knowledge, expertise and talents that each person brought to the project and created during it
- Go somewhere new cognitively, personally, emotionally, physically and intellectually

What did I learn as a scientist?

What I have learned through this project is that my learning, as a scientist, often appears serendipitous and ‘messy’ rather than predictable and formulaic. While I was involved in this project I was also working with others to bring practitioner researchers from around the world into a seminar (ARNA 2015, Townhall meeting) and develop different forms of communication. Mari’s approach to telling her story of her learning, in the form of a ‘graphic story’ has taken me to ask around the other research groups I am involved in and I now have many (new to me) work and ideas to explore. Paul S’s presentation on the academic poster and the posters young researchers and supervisors stimulated my imagination. Somewhere between these emerged the idea of living posters as an

approach for practitioner researchers to extend the educational influence of the knowledge they were creating and create and enhance educational relationships that are crucial to the generation of knowledge. (see <http://www.actionresearch.net/writings/arna/arnaposters270415.pdf>). This was at a time I was also working with Jack Whitehead to communicate and evolve Living Theory research methods (Whitehead, 1989) at a seminar and workshop (see <http://www.actionresearch.net/writings/jack/jwmhcumbria310515.pdf> for an example) which led to me recognizing that creating living posters was not only a form of communicating research but was also a research method.

What did I experience as a learner?

- The delight of learning to develop educational learning opportunities with very creative people who share my passion
- Intellectual and emotional challenge to go beyond previous practice
- The excitement of contributing to the creation of new knowledge that might make a difference that is of value

What were the obstacles to my learning and research?

The obstacles as always came from me. For instance, not keeping a research journal as I encourage others to do, not keeping up with updating the website, talking too much and listening too little.

What did I find difficult?

- Expressing myself clearly and concisely – as you might have noticed
- Recognising, appreciating and working with the knowledge that was being created by each participant

What excited me and 'fired me up'?

Seeing each person growing in confidence and learning and particularly moments when I saw someone recognize and value them self and the progress they were making.

Moments when I saw someone:

- Enjoy being part of the project,
- Taking responsibility for their own learning and contributing to the learning of others
- Growing in confidence to 'boldly go' beyond the familiar cognitively, intellectually, socially, physically, emotionally and personally.
- Learning something about themselves, the person they are and want to be making a difference that matters to them

What would I like to do in the next academic year?

- Learn to focus better on what individuals say they want to do to improve their practice and knowledge of science, research and make a helpful response to taking their enquiries forward as I research the process of enhancing my educational influence.
- Learn from what has happened to extend and develop online and community support to keep connection and momentum between meetings
- Learn how to introduce more research skills, such as how to use different forms of recording and TASC creatively, which can help researchers to improve what they are doing
- Learn how to involve more young people and students and maintain their commitment and enquiries
- And so much more!