BRINGING PRODUCT DESIGN TO A DIVERSE YOUNG PUBLIC

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ABSTRACT

This paper reports on an evaluation of an outreach provision in STEM education, specifically Product Design, run by Bournemouth University, being offered to around 18 schools in its local area, in the South of the UK. The paper cites a number of studies indicating that outreach provision is very diverse globally, as well as in the UK, often erratically funded and rarely properly evaluated. The outreach provision evaluated here has the advantage of having maintained longitudinal data over its 5 year life to date.

The paper reports on the evaluation of qualitative feedback received from school teachers and quantitative data collected on numbers of pupils who attended the workshops who chose a design related subject for their General Certificate of Secondary Education (GCSE) level study which is typically commenced in school year 9, age 12/13 years. While it is acknowledged the data is not perfect for considering impact solely on those from lower socio-economic backgrounds the provision was also aimed more generally at increasing numbers of young people taking up STEM related further and higher education.

The conclusions reached from the evaluation demonstrate the importance of outreach activities in improving education for the public, and thus, to increasing diversity in the product and design engineering professions, which in turn may provide a partial answer to the recognized skills shortages.

Keywords: Public engagement, product design, diversity, outreach

1   INTRODUCTION

This paper reports on the evaluation of the effectiveness of an outreach provision in the STEM subject of Product Design operated by Bournemouth University in the United Kingdom (UK) and should be seen in the context of the conference theme of design and engineering education for the general public. The outreach provision comprises taking practical exercises related to product design into local schools and at the same time providing careers information in an age appropriate format. The programme is run by a Co-ordinator who is a graduate of the Product Design course at Bournemouth University, as well as being a practicing product designer. They are assisted by Ambassadors. This provision is in its 5th year of operation and has been focused on around 18 local schools identified as having pupils from diverse and less affluent backgrounds. The workshops have been targeted at school years 7 and 8 pupils (age 11-14 years). To date the provision has provided 45 workshops per year reaching around 1000 pupils every year. It is considered that the practical nature of the provision is particularly important in the face of decreasing opportunities for pupils to take Design & Technology (D&T) as a subject in the UK school curriculum. The issues surrounding D&T, such as loss of workshop facilities in schools and changing emphasis in the curriculum have been heavily reported in the UK press [1][2].

It has been long recognized that people with no personal or family involvement with product design, engineering and other STEM disciplines struggle to understand the career opportunities [3][4]. Careers advice in secondary schools in England is led by the Careers & Enterprise Company which since 2015 has focused on providing industry based mentors know as Enterprise Advisors in all schools, however, secondary school is often too late. In recent years schools engaged with this outreach provision have requested not just workshops but attendance at careers events, and even a workshop for parents. This paper reports on an evaluation of this provision.

2 LITERATURE REVIEW

2.1 Definition of Outreach

What exactly the purpose of outreach provision is and how best to operate outreach provision has been a notoriously difficult thing to define as discussed by Scull & Cuthill (2010, p60) [5] among others. Scull & Cuthill note that the purpose of outreach as achieving "more equitable access to higher education for students from low socio-economic backgrounds" is common to Australia, UK and USA. Scull & Cuthill cite a number of earlier papers all reporting on the common reasons why those from low socio-economic backgrounds tend not to participate in higher education such as, limited family experience or understanding, lack of parental aspirations for education and 'simply not part of their cultural world'. Scull & Cuthill go on to report that the school-targeted outreach provision has not had significant impact. Thus, they propose the notion of 'engaged outreach' which they define utilizing a framework based on engagement with multiple stakeholders as they assume traditional outreach programmes are too narrow. Meanwhile Greany et al (2014) [9] report on School-University Partnerships, a specific initiative in the UK but sharing much in common outreach provision such as focusing on increasing under-represented groups in universities and increasing participate in STEM subjects. Greany et al [9] suggest that on a local level schools and universities work together to positive effect despite challenges particularly around funding, however, they point out the lack of evidence around impact of such partnerships as being a significant gap.

Rincon and George-Jackson (2014) [7] look specifically at STEM outreach provision in the USA and in particular the difficulties caused by insecure financial support with institutions paying 'lip-service' to diversity initiatives. It should be noted that the aims of STEM outreach provision discussed by Rincon and George-Jackson [7] and Eilam [8], along with such provision in the UK, is slightly different to general outreach provision. Essentially the purpose of STEM outreach provision is to increase the attractiveness of STEM subjects and thus, to increase numbers entering these subjects to meet the projected demand and is less focused on the backgrounds of those being targeted. Rincon and George-Jackson [7] also suggest that effective evaluation of the programmes could provide data that can help with securing funding. Eilam et al (2016) [8] discuss the high levels of diversity in the nature of STEM outreach provision in Australia, that like the UK, takes a 'bottom-up' approach to outreach. The paper contrasts this with STEM outreach provision in Israel where a 'top-down' approach is taken with apparent much higher levels of success and, critically, which generates a high level of internal legitimacy, putting outreach on a par with research and teaching in terms of legitimacy as an activity within a higher education institution.

2.2 Impact of Outreach

It is also recognized that determining the impact or success of outreach provision is, at best, not well understood and at worst absent. Sadler et al (2016) [6] look specifically at STEM outreach provision in 9 Australian universities. They claim that "Research that specifically explicates the scope, nature and broad effects of outreach programmes on increasing student's post-compulsory STEM education is scarce." [6] p2 They do acknowledge a constraint as being the difficulty of collecting meaningful data within time, skills and resource limitations. Sadler et al [6] provide quantitative data regarding the different methods of data collection for evaluation, named as: pre-survey, observation during delivery, post survey, interview and longitudinal survey/enrolment data, noting that not all will be implemented in every programme or university. They note that recently most programmes had moved to tracking future enrolment patterns against outreach attendance, often due to "requests from senior management to provide increasingly detailed evidence of the value of the programmes." However, they also note that there was no institutional support provided to gain this further evidence. Sadler et al [6] also highlight the issues created by competing outreach stakeholder needs, and cite an example of a marketing driven evaluation focusing on marketing goals and not increasing student aspirations.

So this study set out to determine the impact of a traditional outreach programme i.e. one run by one University within its local area in a specific area of STEM.

3 METHODOLOGY

The programme at Bournemouth University commenced in January 2014 with the aim of delivering practical workshops in product design to local schools for pupils in years 7-9 to increase understanding of product design and increase the numbers taking the subject at GCSE an above. The

nature of the practical workshops, which are 3 hours long/ average 30 pupils, consist of an introduction asking what Product Design is, as opposed to invention, explaining the design process (inc an eg of manufacturing and testing), with an example of a product typically from, Dyson or Apple. The pupils are then given a brief (eg include marble run, sustainable chair, shelter/drinking water for developing country – see Figure 1) going on to undertake research/mind mapping, concept design and prototyping against the brief.

Figure 1. Example of pupils undertaking typical projects

It should be noted that many schools in the area this programme runs use a middle and upper school system, whereby the first year of upper (or senior) school is year 9. The list below identifies the workshops that took place and how many children were involved:

- January 2014 – July 2014 9 workshops ran in 9 different schools with approximately 300 school children involved.
- September 2014 – July 2015 workshops ran in 15 local schools, with many schools taking multiple workshops, with approximately 900 school children involved.
- October 15 – July 16 – 1075 pupils took part during 43 workshops mostly years 7 & 8
- October 16 - July 17 - 1125 pupils took part during 45 workshops mostly years 7 & 8 this included two careers evenings by invite.
- October 17 – January 2018 (on-going) – 600 pupils took part during 20 workshops in 6 different schools, mostly years 7 & 8.

The success of the programme was begun to be measured in the last two complete cycles both qualitatively and quantitatively, in a number of ways which reflect those found in Sadler et al [6]. Quantitative data collection used two methods, a questionnaire and collection of longitudinal data on choice of subject studied at GCSE. At the end of each workshop the teacher was requested to conduct a verbal questionnaire which consisted of the following questions and a count was kept by show of hands of the pupils, results are shown in Table 1.

1. Who enjoyed the workshop and would like to do another?
2. Who would now consider doing a design based GCSE and A level?
3. Who would now like to go to University?
4. Who would like to do product design or any sort of design as a career?

A representative selection of schools were chosen to track GCSE choice, these comprised 3 Middle schools one very rural (School E), one on the outskirts of a large urban conurbation (School A) and one in a market town (School B), the fourth school was a Senior school in an urban setting (School C). Numbers of students who experienced the workshops and then went onto choose a design related GCSE subject were tracked. It should be noted that due to the administrative challenge of this tracking, often across two schools, it was not possible to track all schools where pupils have undertaken workshops. It is also important to note with reference to issues suggested by Sadler et a [6] that all administration of data collection has, to date, been conducted by those operating the outreach provision.

4 FINDINGS

Quantitative data on pupil's response to the workshops over two complete cycles (i.e. two academic years) based on the verbal questionnaire taken at the end of the workshop activity by the class teacher is shown in Table 1.

Table 1. Results from questionnaires from selected schools

	School A	School B	School C	School D
2015-2016				
Percentage of Pupils that enjoyed the workshop	100%	100%	100%	95%
Percentage of Pupils that wanted to Study a Design Based subject before the workshops	57%	64%	56%	44%
Percentage of Pupils that wanted to Study a Design Based subject after the workshops	83%	89%	92%	79%
2016-2017				
Percentage of Pupils that enjoyed the workshop	100%	100%	100%	100%
Percentage of Pupils that wanted to Study a Design Based subject before the workshops	52%	68%	62%	48%
Percentage of Pupils that wanted to Study a Design Based subject after the workshops	96%	93%	100%	83%

Quantitative data on numbers of pupils who took part in workshops or subsequently went on to take design related GCSE is shown in Table 2.

Table 2. Numbers of pupils taking design related subject at GCSE

School	School A	School B	School C	School E	**Total**
Total pupils per year	600	340	256	168	**1364**
Total pupils for 3 years	1800	1020	768	504	**4092**
Total pupils picked Design GCSE	1494	928	561	430	**3413**
% of pupils that picked Design GCSE	83%	91%	73%	85%	**83%**

Additionally, in one of these schools it was also possible to track the number of pupils that took a design related GCSE as a percentage of total year cohort before and after the workshops were offered in the school. This has shown a considerable increase in numbers of pupils taking design related GCSE since workshops commenced as can be seen in Table 3.

Table 3. Pupils taking design related subject at GCSE in School A

School A	Upper	Middle	2014	2015	2016	2017
Total Pupils 2017	767	522				
Total Pupils in Year 10			153	157	149	165
Total Design GCSE Uptake Year 10			46	57	65	71
Percentage of Pupils taking Design GCSE			30%	36%	44%	43%

As can be seen in School A the number of pupils taking design GCSE has risen around 8 percentage points since cohorts who had experienced the outreach workshop activities in both years 7 and 8 reached GCSE choice.

Qualitative data from feedback from teachers includes the following quotations:

"The opportunity for the pupils to work with designers, students and experts at the cutting edge of the industry is invaluable. The pupils have been able to see and experience the real link between the subject they study at school and the outside world. It has opened their eyes to the real opportunities available to them through a subject that they enjoy. Many pupils have spoken to me after about their aspirations and ideas for the future and it has certainly opened a wider choice for them. Speaking with the head of Design and Technology at the Upper School on a number of occasions since your involvement with the school has confirmed this with a strong uptake of the subject, particularly Product Design at GCSE and beyond."

"Hello!

I just wanted to say a big THANK YOU for Friday. The children had such a brilliant day and looking through the feedback surveys they completed, they really enjoyed your session and you were definitely favourite. They liked it was hands on and they thought your presentation was really good. It was great because some of these children didn't know you could go to university and study subjects like product design. I thought you were great with the children, you were informative, friendly and interesting. I have even had parents comment on how great it was!

Thank you!!!!!"

"Thank you so much again to you for today's workshop. The pupils were inspired and really took to the challenge. They were on task for the whole two hours which at this time of year is a real achievement.

Thank you so much again, your visits have been inspiring and given the pupils a real insight and opportunity to look into the real world of design.

Have a great summer and I will be in touch again in September."

Clearly the qualitative data indicates that the outreach provision being evaluated here is having impact in the areas of aspiration and a better understanding of career opportunities in a STEM subject. It would also indicate that there is some impact on the parents which in turn may impact on their aspirations for their children.

5   CONCLUSIONS

The research set out to present a quantitative and qualitative data set that could be used to evaluate impact of the outreach provision offered by Bournemouth University in the STEM subject of Product Design. In the face of declining numbers taking D&T and Art & Design at GCSE "UK wide decrease of 9.5% from 204,788 in 2015 to 185,279 this year"; and "a decline in uptake of Art and Design at GCSE level across the UK, with a 5.9% drop from 194,637 last year to 183,085 this year." [2] the evidence presented above indicates this project may reverse this trend locally. This would suggest that should the nature of this provision be replicated by other universities and their local schools the trend may be reversed on a wider scale but this clearly needs the provision to be replicated, which given the 'bottom-up' approach in the UK is likely to be hard to achieve.

In terms of how the success of this achievement has been measured it is accepted that stronger data related to uptake of GCSEs across all schools would have been beneficial, however, there are considerable difficulties with gaining this data from schools as acknowledged in the literature Sadler et al [6]. The qualitative feedback from teachers indicates the positive response to this project by the target group. In the future it would also be beneficial if the data collected could also to be extended to identify the impact specifically on girls choosing design, as a STEM subject and to identify those from lower socio-economic groups. While the schools that were targeted were those considered to have larger numbers of pupils from lower socio-economic groups it was not possible to either influence what pupils the schools chose to put forward for this outreach provision nor to obtain data on their socio-economic backgrounds.

It is important to note that schools where the workshops were held with same group when they were in both years 7 & 8 report a higher uptake of design related subjects at GCSE suggesting that there is a need to reinforce the experience for best impact results.

In terms of the future, as part of a re-organization of central Bournemouth University Outreach provision, this outreach programme has now become part of the central provision and this will enable a much higher level of impact monitoring to be undertaken. Additionally, the Outreach provision will also now have access to a central schools database which will make tracking the pupils undertaking the programme and their future progress much easier.

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